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Supplement to the ENGLISH MECHANIC, March 19, 1886.]

ENGLISH MECHANIC

AND

WORLD OF SCIENCE.

WITH WHICH ARE INCORPORATED

THE MECHANIC," "SCIENTIFIC OPINION," AND "THE BRITISH & FOREIGN MECHANIC."

ILLUSTRATED WITH NUMEROUS PRACTICAL ENGRAVINGS.

VOLUME XLII.

PUBLISHED (FOR THE PROPRIETOR) BY E. J. KIBBLEWHITE,
AT THE
Office: 332, STRAND, LONDON, W.C.
SOLD BY ALL BOOKSELLERS AND NEWSAGENTS IN THE KINGDOM.

1886.

Printed by BRADLEY and COMPANY,
12, 13, and 14, Fetter Lane, London, E.C.

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THE ENGLISH MECHANIC

AND WORLD OF SCIENCE.

SNARES AND PITFALLS OF AMATEUR CARPENTRY.

By O. J. L.

WHAT can be easier than to make a box, a set of shelves, or a kitchen table ?" asks the aspiring workman to whom has appertained a set of tools, and, may be, one of those capital benches of Syer's, with vice and planing-stop and other necessary appliances. All depends upon whether the grammar of the art of carpentry has been fully and practically learnt ; and nine times out of ten it has not, and it is curious to note how this defect prevails in other branches of handicraft. How many aspiring artists, battling with the intricacies of colour, produce pictures faulty in drawing ! How many flute - tootlers and catgut - scrapers unwittingly confess that the grammar of music is to them a sealed book ! Moreover, I can answer for the fact of many a country plumber being in blissful ignorance of the principles by which a pump raises water, although he may have learnt practically that the machine in question will not draw from a depth exceeding a certain number of feet, and that it will wholly fail if there is a pinhole in the pipe. Then, again, how often we find a mechanic—even a foreman or his "boss"—planning and wasting time and money over some machine which is to give out more power than is put into it—merely because he has not mastered the most elementary facts of mechanical science. He wants, and perhaps we should all prefer, to mount to the top of the ladder without having to begin at the bottom. But it is no use to try in this generation a feat which previous generations have failed to accomplish. Now, there is a grammar of handicraft in all manual trades which certainly does not come by nature, but which needs a good deal of downright hard work. And even in works of minor importance—hedge-carpentry and ordinary repairs—it should never be neglected or slurred over ; rather should every opportunity be taken to learn the lesson thoroughly. No one will ever become a workman who attempts to shirk it, or who gets a habit of doing work carelessly, because it is of no special interest, or because no eye but his own is likely to see it. Many an amateur needs the courage of the great artist Turner, who, finding that his coloured work was unsatisfactory, went back to monochrome, and toiled and laboured at simple drawing until he gradually crept up again to the point at which he failed, but only to find it no longer a stumblingblock but a step in the ladder of success. I dare say a good many of our readers have attempted such a thing as a table—a very useful article, and one which gives capital practice in "all-round" work—and the result may not have been of that satisfactory character which his sanguine hopes had expected. Somehow, it got a cant or twist. This leg was not quite upright, or it preferred to stand on three legs instead of four ; and it had a suspicion of rickets or unstability about the joints, which paint and putty might conceal, but of which the maker remained ever after very painfully conscious ; and painful consciousness of having made a mess of a job is terribly destructive of an amateur's peace of mind, and not the less so when good-natured or less-discerning friends admire the specimen of handiwork, whose defects are well known, in all their naked truth, to the unhappy maker. But what a lot of work is done in this world that the doer only knows will not bear close examination ! If we analyse ordinary carpenters' work, we shall find that an immense proportion of it is of an elementary character, consisting of squared pieces fitted together by mortised and tenoned joints. A table is wholly so constructed unless it has a drawer, in which case there will be dovetails at the angles, and the bottom will be fitted in a groove. Apart from the drawer, therefore, there is, at first sight, nothing like a pitfall in this case to entrap the unwary amateur. Then, why does he not succeed ? Because there is a pitfall, into which, if not upon his guard, he rushes headlong. It is concealed in the squaring up of the four pieces intended to form the legs—which legs, by the bye, amateurs are wont to make too long in proportion to their size ; 2ft. 4in. is a very general and convenient height, and need not be exceeded, except, perhaps, in the case of a dining table, where the chairs are sometimes high enough to bring the knees into uncomfortable contact with the framework. This contact is not conducive to that good temper which helps digestion, and may possibly be productive of unparliamentary language. But the amateur is more likely to practise his craft on occasional tables, or dressing table, or kitchen table, than on one fit for the dining-room, which last is usually so framed as to allow of extension lengthwise, and is hardly within the province of an amateur, unless he be unusually skilful in the manipulation of tools.

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To square up a bit of wood about 2in. each way and 2ft. 4in. in length, is not apparently a very difficult job ; but, at the same time, it needs care, and also a plane in really efficient working order. There are also needed a straightedge, a square, and a pair of accurate winding strips—the latter very commonly ignored altogether by amateurs, who think they can work quite as well without them.

First, as to planes. It is a pity to use one plane for roughing and smoothing ; nor is it, on the whole, economical. A jack-plane should be kept for taking off the outside, and reducing the wood to an approximate level ; and this should be succeeded by a trying plane to finish the surface. The former should have its iron ground to a slight curvature, as it will be easier to work if it projects a shade more in the middle. But the trying plane for final correction of the surface must have its edge a right line ; and in setting it, only the extreme corners must be rounded off, just to prevent them from marking the work. It is also of the utmost importance to see that the iron projects beyond the sole equally. It should appear, when looking along the under surface of the plane, like a fine bright line. No accurate work can be done if one angle projects more than the other, as it will give the wood an inclined surface. I believe this is a special pitfall into which a vast number of amateurs fall. A keenly-sharpened plane, nicely set, is a marvellously efficient tool, leaving a polished surface, which said polish is not always nor generally seen in amateur productions ; and no paint or varnish will conceal bad planing, however thickly it may be coated, because the surface consists of planes reflecting the light at all sorts of angles, giving the whole a very unfinished appearance. Presupposing the planes in perfect order, we may make a straightedge and a pair of winding strips of any straight-grained dry wood from half an inch to an inch thick, according to the length required. The strips should be thick enough to stand on edge, and may be a foot in length. The straightedge should be not less than 3ft. long and 3in. wide, and one edge (or both) must be as accurately true as it can be made to serve as a reliable guide. The winding strips must have their edges parallel to each other and true. They need not be of precisely equal width, but look better if so made, and they may be any width, from an inch to two or three. Two planes laid on their sides are often used for the purpose ; but it is better to keep proper strips, as they are so often wanted. Without these I may say that the square is useless, as the piece may appear to answer to this test when applied at various points, and yet it may be all on the twist, with results to be noted presently. The way to proceed is as follows:—One face of the strip, say 2¼ square, and 2ft. 4in. long for a table leg, is to be planed by jack and trying plane until apparently true and level. The winding strips are then to be laid upon it, one near each end, and the eye is to be so placed as to catch simultaneously the line of their upper edges. If these coincide, the piece is so far out of twist, and by shifting the further strip to different positions on the piece to be tested, and proving it in the same way, all the surface may be examined crossways, and the straightedge will test the same longitudinally, to ascertain whether it is hollow or rounded, or accurately level. The second side—that adjacent to the first—is next to be worked in the same way; and now the square has also to be used frequently as well as the winding strips, so as to insure the second surface being exactly at right angles to the first. The third and fourth are to be similarly treated, each being tested by the square from the one previously finished. There is another way of squaring up comparatively short pieces, which is also used largely—viz., the shooting board, which does away with the necessity of the square. It will save time to use this appliance, although it is more frequently brought into requisition to plane the edge of a board square to its face, and is made wide in the rebate for this purpose. But if the amateur has to plane up many square strips of about equal width, it will pay to make a special board for the purpose, of such length and width as may be most suitable for the stuff to be operated upon. Constant practice renders a carpenter independent of many appliances which an amateur need not be ashamed to adopt, as by these alone he has a chance of placing himself on more equal terms with his professional brother. The mortises should be next marked in what is to be the upper part of the legs, and a line ruled by the square all round the piece an inch below these, to show from what point the legs are to be bevelled downwards, as they are generally planed down towards the feet, so as to reduce them, or turned in the lathe. This bevelling, or reducing by the plane, is generally done only on the inner sides of the legs, as the table looks firmer and better with the outer edge of the legs left perpendicular. Two tenons, or a "double" tenon, as it is called, is better than a single one for uniting the four rails to the legs, and should always be used if the rail is over 2in. in width. The double tenon affords additional shoulders, and much adds to the stability of the work.

Another pitfall is to be guarded against in cutting the mortises. When these can be made to penetrate entirely through the legs, they can be half cut from each face, and will then be truly perpendicular if the squaring up of the pieces was correctly done. But such not being the case with a table, there is always danger of so using the mallet and chisel as not to cut the holes perpendicular to the face, and then, when the entire frame is put together, it will be out of square, and cannot be rectified. Ah, this terrible "out of square!" how frequently, in every sense of the expressive phrase, we meet with it. Be it morally, physically, or mechanically, it is equally a pitfall, and every precaution should be taken to avoid it. Moreover, if by [illegible] you make a frame thus out of [illegible] attempting to strain it [illegible]. Probably some of the mortises [illegible] the attempt, and if not, [illegible] will [illegible] loosened, and all the strength will be taken away from the work. Better break it up at once and begin again.

Very good practice in mortising is to be had as follows: Plane up a bit of deal, about 2in. square and 2ft. long, mark three or four mortises, cut two right through, working from each side; then cut the others from one side only half through, and into each fit a rail 1ft. long. These ought to stand perfectly upright and true to each other without any pulling and straining to make them so. Although I have spoken specially of tables as affording certain pitfalls, I certainly do not advise any young aspirant to attempt to make one until he has tried and succeeded in work of a still easier kind, such, for instance, as a plain towel-horse, which is useful and fairly simple. Here, too, each mortice can be cut quite through, which is always the surest plan, and the joint can be wedged up and glued. In this case, again, if the A B C of squaring up the work is carelessly done, the whole affair will be twisted and will not stand steadily; but if the pieces are truly square, and mortises marked and cut from each side, it is hardly possible to fail. A tenon should just fit, so that it can be pushed or tapped into place without fear of splitting the mortise, but must never be a loose fit. It may, indeed, be tight in the other directions, at the narrow ends, but not in the broad sides. Thin glue will then secure it perfectly, but if slack, it will be useless to daub it thickly. The only possible remedy, bad at the best, is to glue on each side a bit of brown paper, and when dry glue it again and drive it home. It may save a special bit of work, but it is a botch.

Another pitfall to be guarded against is the use of wood of insufficient substance for the legs or stand of an article that will, when framed and finished, be at all heavy. One of the nicest-looking hall tables in my possession of home manufacture is made of oak, and stands about 2ft. 4in. high, and it has exactly this fault of instability or top-heaviness, owing to the uprights being too thin. It was made of some stave oak, barely 1in. thick by about 2¾in. The supports are mortised into cross pieces, above and below, of the same scantling to form feet, and into the supporting rails of the top which are of ¾in. wainscot. There is a rail uniting the uprights half way down and one at top affording a central support just where the two boards of the top meet. Two brackets are added just above the centre rail as stiffeners and ornaments, and a turned central ornament completes the whole. The table looks well varnished; but it is not as stiff as I like to have such an article of furniture, although it has to bear nothing, perhaps, but a card tray and an odd tennis racket or two. If the legs and framework had been of 1½in. stuff it would have been perfectly satisfactory, and if I make another it will be of that scantling. So much for making use of stock which I felt sure would have exactly this defect of instability, instead of proper material, which I could have purchased at a low rate, and which I should have found pleasure in working.

Another snare into which most novices fall is cutting out the marked lines with saw or chisel. Always leave the pencil mark or scribed line upon the material you intend to use, and let the cut be in the waste pieces. Unless this is done tenons will be cut too small, and it will be the same with still more fatal results in the case of pins and dovetails. In cutting either of these, cut just well within the lines, and then with a last shave with a very keen chisel pare the stuff exactly, but barely, to the pencilled line. I speak chiefly of a mortise, as a tenon should be sawn true to line and need no paring; but a mortise will be bruised at first in levering out the chips with a chisel, and, therefore, a little should be left at each end to be ultimately cut clean up to the pencil mark. For the same reason a mortise should be begun the middle of its length by cutting out triangular notch, and worked gradually ba towards each end.

I have casually mentioned Syer's wor benches, not because they are, so far as know, superior to those of Melhuish, Buc or other makers, but because they are made sizes to suit the amateur, and are fitted with instantaneous grip-vice, patent planin stop, and other convenient fittings, and a also cheap. But I may as well remark th a bad bench is fatal to good work. The t *must* be level, made of good, sound, dry wo of sufficient thickness not to warp, otherw it is a hopeless task to attempt to plane up board upon it. It may do for rough out-door jobs, but for joinery—which is technical name for indoor work, such tables, cupboards, shelves, &c.—it is not o useless, but will tend to make a bad wor man of one who would otherwise prove skilful hand.

Yet another snare. Never attempt to p together by means of screws such work a set of shelves, in which the screws m enter in the direction of the grain. Th have no hold when so placed, as the fib can be drawn out lengthwise, especially such soft wood as deal. Let such shelves tenoned and glued in, or—especially in oak let the tenons come through the sides, a project far enough to have mortises cut o side to receive wooden wedges. This mak good work, and the whole can at any time taken apart for removal, and packed as a of flat boards. Where this cannot be don it is easy to let the intermediate shelves sli in grooves or rest upon ledges, while the t and bottom are put on the two sides inste of being inserted between them, thus securing the whole. It frequently happens that is necessary to plane up the two ends of board across the grain. If this is done fro one of the angles, the opposite one is sure split up. Plane, therefore, from each ang towards the middle, and also to some exte from the side edges towards the middle, as you intended to bevel the end, and th gradually reduce the central part to the lev of the outside. The plane, too, should held at an angle, so as to *slice* the wood rath than to cut it directly across the fibres. Th plane must be very keen, and the iron mu only project very slightly. Knotty stuff, wood with a curled grain, must likewise humoured, so to speak, by using the pla with circular sweeping strokes, so as to follo as far as possible, the winding of the fibre Knotty stuff is difficult to work, and if hard wood a toothing plane and scraper m be needed; but it is so handsome whe polished as to pay for the extra trouble.

PATENT LAW AMENDMENT.

A SHORT Act, amending the Patent Designs, and Trade Marks Act of 18 received the Royal Assent, and came into for on August 14 last. Section 1 provides that t Amending Act shall be construed as one wit the Act of 1883. Section 2 deals with th "declaration" in the application, and refe particularly to Sub-Section 2 of Section 5 the principal Act, which someone at the Pate Office interpreted to mean a declaration und the Statutory Declarations Act of 1835, and th office insisted for a time on the half-crow stamp. We believe, however, that some of the excess payments were afterwards returne The Amending Act settles the matter by enacting that the declaration may be made und the Statutory Declarations Act, 1835, or not, may be from time to time prescribed." It rumoured that it is intended to altogethe abolish the formal declaration, which ca scarcely be said to have prevented anyo stealing an invention from fear of being prosecuted for perjury. Section 3 extends th time for depositing the complete specificatio to ten months. By Section 5 of the Act of 188 the time within which a complete specificatio be left is nine months from the date of :ation. The specification must further be ted within twelve months, and the patent ıled within fifteen months. By the Amend- Act a complete specification may be left ccepted within such extended times, not ding one month and three months respect- , as the Comptroller may, on payment of prescribed fee, allow; and where such sion of time has been allowed, four hs' extension may be added to the fifteen hs already allowed for the sealing of the .t. So far as the would-be patentee is con- d, the boon granted is very small indeed, and uld have been wiser to have extended the for depositing a complete specification to a twelvemonth. Section 4 of the amending leals with a matter which has often been d to be a real grievance. It provides that e an application has been abandoned or ne void, the specification and drawings not at any time be open to public inspec- or be published by the comptroller. Some ago inventions which had only reached tage of provisional protection, and stopped because the applicant for some reason ot "proceed," were made public after the nted time had elapsed, and not unfre- tly inventors of some really useful and cted devices were hampered by the know- gained by opponents through the speci- ons of inventions which received pro- ıal protection only. On the other hand, provisional specifications have often led the crude idea to a successful patentee, so far as the public are concerned, they beneficial by helping to promote inven- All things considered, however, it is r to allow a dropped application to remain olivion. Section 5 of the amending Act at rest some "doubts" which had been l whether a patent could be lawfully ed to several persons jointly, when only r two can honestly make the declaration t "true and first inventor." It is now ed and declared that it has been and is l under the principal Act to grant such a it. This point is of special importance or inventors, who can thus at once give alists the security they require by making joint patentees. We do not know where doubts" mentioned in the amending sec- are, for, as will be seen on p. 25, Vol. VIII., we specially pointed out that the meaning of the sub-section in Section 5 ıe principal Act was that a joint patentee not necessarily be a joint inventor.

NTERNATIONAL INVENTIONS EXHIBITION.—XVIII.

Organs.

IE improvements that have been made in pipe organs during the past quarter of a ıry consist mainly in methods of lighten- he touch, by the employment of pneumatic electric actions, the introduction of the matic tubular transmission (which may be y described as a metal pipe with a valve e end through which compressed air is tted, and passing through the pipe actuates ible membrane or a little bellows at the end); improvements in the blowing gements, chiefly consisting in the adaptation s and hydraulic engines; a few new devices nnection with the harmonic stops; and more or less important improvements in ection with the soundboard arrangements. of these have been given in detail in our ıns, and all would require illustrations to in the differences in the methods adopted e various makers. As we mentioned in the ng article of this series, there are enough organs in the exhibition to occupy for a e day the attention of a visitor desirous of ciating their points; but unless the dants are at hand, with one or two excep- , there is not much of the interior to be

At the west end of the central gallery is church organ by J. W. Walker and Co., ancis-street, W.C., having four manuals pedals, 51 stops, 2,488 pipes, and a compass notes. The solo organ is acted upon at a nce by a new electro-pneumatic movement ıted by Mr. W. F. Schmoele, of Freiburg. nanual, drawstop, and swell shutter action of this solo organ are worked by a train of "pneumatics," the organist at the main instrument governing the whole by electric action through a ⅜in. coil, 100ft. long. The two systems of blowing are shown at this instrument, the hydraulic engine being a Bamford 8in., and the gas-engine a four-man Bisschop, the former working two large double-action square feeders, which give a slow and silent stroke with large supply of wind, and economy in consumption of water. Close to this instrument in one of the corners, Mr. H. Wedlake, of Berkley-road, N.W., exhibits a nice instrument of three manuals and pedals, 32 stops, 1,344 pipes, compass 56 notes (CC to G). In the swell organ of this instrument the nine stops have 68 pipes, an additional octave being added to the chest to complete the octave coupling. The pedal organ is fitted with Mr. Wedlake's new patent douple supply valves and tubular pneumatics, which give a lighter touch with 80 per cent. more wind than is the case with the ordinary single valve. The swell manual and couplers are fitted with "Eclipse" pneumatic levers, which are simple in construction, perfectly silent, and occupy only 16in. in height, while they leave, in the opinion of some experts, very little to be desired in the way of "touch." At the opposite corner is a partially-completed organ by Messrs. Brindley and Foster, of Sheffield, which is exhibited to illustrate their tubular-pneumatic system, which allows of the console being at some distance from the instrument. The organ contains a great of 10 stops, and a pedal of two; but the arrangements are such that the latter can be increased, while a suitable swell and a choir can be added. A wind pressure of 3¼in. only is used, and that is supplied by a Blennerhasset hydraulic engine. At the other end of the gallery is a fine instrument by H. Willis and Sons, of Camden-town, N.W., having three manuals and pedals, which is shown without a case, so that those interested can see the internal arrangements of the electric and pneumatic devices, and the various mechanical movements effected by means of compressed air. Near to this instrument is a fine church organ, by Messrs. Bishop and Son, of Marylebone-road, N.W., with separate console, placed some distance away. The case is of selected pitch pine, and the wood pipes are of Canadian pine varnished, instead of being coated with "size colour." The action is varnished or polished throughout the instrument, a practice which is to be commended, as, to a great extent, it undoubtedly prevents injury from damp. The instrument contains great, swell, and pedal organs, with 31 stops, compass 56 notes (CC to G), and has Messrs. Bishop's patent tubular-pneumatic action, which gives a touch as light and elastic as that of a pianoforte. One special feature in this organ is an arrangement by which the performer can, by turning a small wheel on the draw-stop jamb, alter the pitch instantly from normal to philharmonic, or vice versâ. The blowing is done by one of Messrs. Bailey's (Salford) powerful hydraulic engines. At the opposite corner in this part of the gallery is the organ "specially constructed" by Messrs. Henry Jones and Sons, of Fulham-road, for the Royal College of Music. As this instrument must be taken to represent what a three-manual organ should contain, we give the specification as promised. It has a "remarkably light touch without pneumatic action," and has, as will be seen, a compass of five octaves on the manual.

GREAT ORGAN CC TO C, 61 NOTES.

1.	Double Diapason,	metal and wood	CC	16ft.	61	notes
2.	Open Diapason	metal	CC	8ft.	61	„
3.	Gamba	metal	CC	8ft.	61	„
4.	Hohl Flote	wood	CC	8ft.	61	„
5.	Harmonic Flute	metal	CC	4ft.	61	„
6.	Principal	metal	CC	4ft.	61	„
7.	Fifteenth	metal	CC	4ft.	61	„
8.	Mixture (3 Ranks)	metal	CC	various	183	„
9.	Trumpet	metal	CC	8ft.	61	„
10.	Clarion	metal	CC	4ft.	61	„

SWELL ORGAN, CC TO C, 61 NOTES.

11.	Open Diapason	metal	CC	8ft.	61	„
12.	Salicional	metal	C	8ft.	54	„
13.	Voix Celestes	metal	C	8ft.	49	„
14.	Stopped Diapason	wood	CC	8ft.	61	„
15.	Gemshorne	metal	CC	4ft.	61	„
16.	Harmonic Piccolo	metal	CC	2ft.	61	„
17.	Cornopean	metal	CC	8ft.	61	„
18.	Hautboy	metal	CC	8ft.	61	„
19.	Clarion	metal	CC	4ft.	61	„

CHOIR ORGAN, CC to C, 61 NOTES.

20.	Double Diapason	metal	C	16ft.	[illegible]	notes
21.	Open Diapason	metal	CC	8ft.	61	„
22.	Dulciano	metal	CC	8ft.	61	„
23.	Lieblich Gedact	wood	CC	8ft.	61	„
24.	Flute	wood and metal	CC	4ft.	61	„
25.	Flageolet	wood and metal	CC	2ft.	61	„
26.	Corno-di-Bassetto	metal	CC	8ft.	61	„

PEDAL ORGAN CCC to F, 30 NOTES.

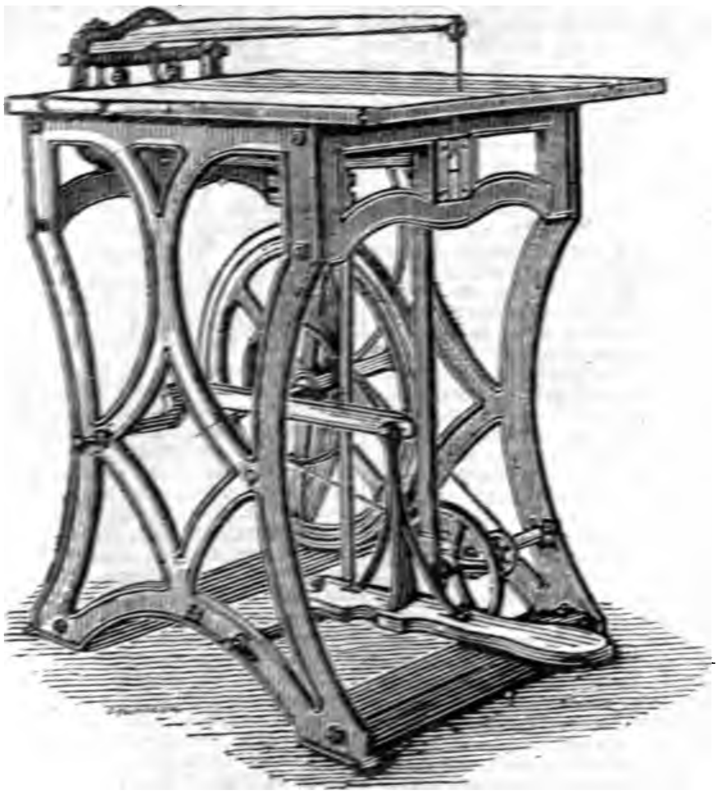
27.	Open Diapason	wood	CCC	16ft.	30	notes
28.	Bourdon	wood	CCC	16ft.	30	„
29.	Violoncello	wood	CCC	8ft.	30	„
30.	Bass Flute	wood	CCC	8ft.	30	„

COUPLERS.

31. Swell to Great.
32. Swell Sub-octave.
33. Swell to Choir.
34. Choir to Great.
35. Swell to Pedals.
36. Great to Pedals.
37. Choir to Pedals.

Tremulant to Swell Organ.

Those who wish to see all the large organs must not omit that sent by Messrs. Bryceson, of Islington, N., which is put in the South Court with the agricultural machinery. It is a concert chamber organ, with pneumatic, tubular pneumatic, and electric key and pedal action, with 24 sounding stops, and a detached console 40ft. distant. An organ by Mr. Wadsworth, of Oxford-street, Manchester, is in the North Court, and has some entirely novel devices, every pipe having a separate pallet, and the whole worked by tubular exhaust. In the music room, too, there are two organs, one by Mitchell and Thynne, of Great Titchfield-street, a large four manual instrument, and the other by T. Casson, of Denbigh, which contains five divisions, great, choir, solo, swell, and echo: 27 stops, 12 couplers, 1,146 pipes. The instrument which, perhaps attracts most attention from those interested in the construction of organs, is that of Mr. A. Gern, of Boundary-road, Notting-hill, which is located in the East Central galleries, near the music room. We illustrated the principal improvement adopted in this instrument in No. 988; but it may be interesting to mention that the soundboard is constructed entirely without slides, and that each pipe of every stop receives its wind direct from the body of compressed air in the soundboard, without the intervention of grooves. Each pipe, and consequently any stop, can be made, by a little additional mechanism, to speak on one, two, or more manuals, as well as on the pedals. Further, the stop so speaking on any given manual may be made to speak on any other, which is accomplished by simply multiplying the outlets through which the air in the chamber beneath each pipe is exhausted when a key is pressed. These outlets are governed by self-adjusting valves corresponding to each manual, and the speaking of the pipes on any particular manual is dependent on the drawing of a stop, exactly as if a separate rank of pipes were provided. The advantage of an additional manual can thus be obtained at little more than the cost of the extra keyboard and connections, so that, for instance, a choir organ may be derived from the soft stops of the great, or a clarionet may be placed in the swell, and made to speak on the choir-manual. The "model" exhibited contains four stops placed on one soundboard—lieblich bourdon (16), open diapason (8), dulciana (8), principal (4), 58 pipes to each, the compass being from CC to A. The pedal-organ is obtained by 30 pipes from the lieblich bourdon. Each of these four stops speaks on the great and swell manuals, and the bourdon on the pedals. The console is about as large as a full-sized harmonium, and may be placed at any convenient distance, while the patent soundboard can be used with the old tracker-action as well as with the tubular pneumatic. It will be understood that the instrument exhibited is merely to show the success of the system, though in itself it is an organ that many persons would like to possess. Returning to the annexe of the Central Gallery, we find amongst the American organs and harmoniums a nice little five-stop organ, by Messrs. Gildersleeve, of Torbay-street, N.W., who, we believe, are makers of pipes, and accordingly tacitly invite visitors to try those they have placed in this instrument. Close by, Mr. T. S. Jones, of Pentonville-road, N., exhibits a model village church organ, with two manuals, having two stops in swell, and three in great, with a manual coupler, and a combination coupler on the great, which depresses the octave above and below—an ingenious device, which will be found useful in



small instruments from which large volume is required. Mr. R. Brown, of Kensington-road, S.E., sends a number of student's organ, with two manuals and pedals, which attracts attention from its comparatively small size, considering the contents. There are a few other exhibits connected in the way or another with pipe organs, including a pyrophone, the invention of F. Kastner, [illegible] Baden-Baden, in which the sounds are produced by "singing flames" of gas in glass tubes. We explained the principle of this invention at considerable length in No. [illegible]; but it is rather as a curiosity than as a musical instrument that it is exhibited.

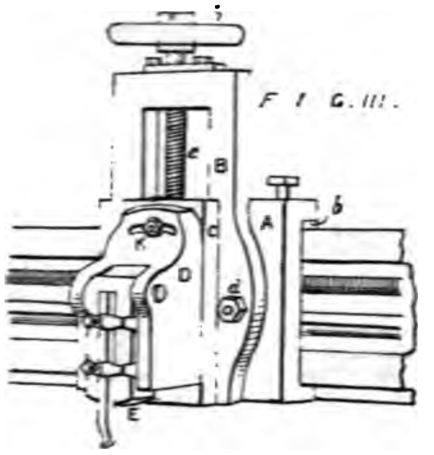
THE "CABINETMAKER" FRET OR SCROLL SAW.

IN the annexed engraving we illustrate a scroll or fret saw which is about to be introduced by the Britannia Company, of Colchester. It is called the "Cabinetmaker" because it is a real factory tool, and is, we should think, the best tool of the kind in the market. It has been severely tested for some time in the manufacture of fretwork window blinds, specimens of which, together with the machine, can be seen in the Inventions Exhibition, Stand No. 335, North Court, South Gallery, while particulars and other information can be obtained at the stand of the Britannia Company, No. 437, at the west end of the Middle Court, near the Queen's-gate annexe. The arms are of lancewood, 2ft. 6in. long, connected at the rear end by a rod and regulating nut, and attached to a peculiarly-jointed "parallel motion" frame, which allows of any amount of desired "lead" being given to the saw. As will be seen from the illustration, that there is a large flywheel, and the band runs from a grooved wheel on its shaft to a smaller shaft shown near the treadle, by which means the speed can be varied, and several cuts of the saw be obtained for one motion of the treadle. The saw is held by a pin passing through a hole, and it can be unfixed in a second and passed through perforations in the work. A self-acting blower, actuated by a rod, which can be seen in the illustration, supplies wind, which is carried by a pipe under the upper arm to the face of the work. Frets can be cut in layers up to 2in. or 3in. thickness—the finest work can be done, as can also the sawing of vulcanite, ivory, brass, &c. While, apart from its special purpose, the machine can be used with advantage in pattern-makers' and joiners' workshops—e.g., for cutting mortises. The machine is, we understand, to be made with both foot and power gear, together or separately, and it can also be fitted with a circular saw, and thus become a workshop tool of great utility in many factories.

THE AMATEUR WORKSHOP.—XI.

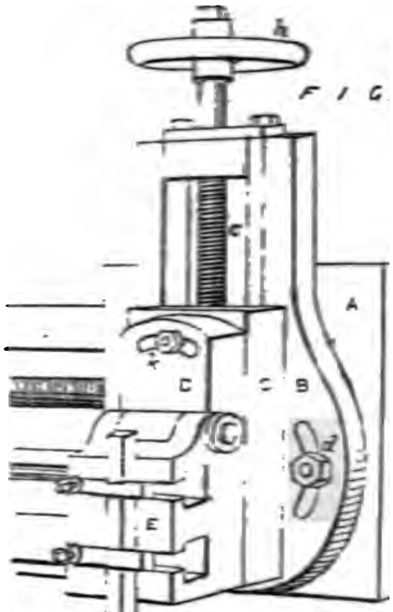
Planing Machines—Tool Boxes.

WE take now a portion of the machine, the construction of which involves a good deal of careful work, and on the accuracy of whose movements not only the truth of the planed surfaces but the very possibility of steady cutting largely depends. Our ideas will be assisted if a brief description of the structure of tool-boxes in general precedes the detailed illustrations of that one of our own particular selection.

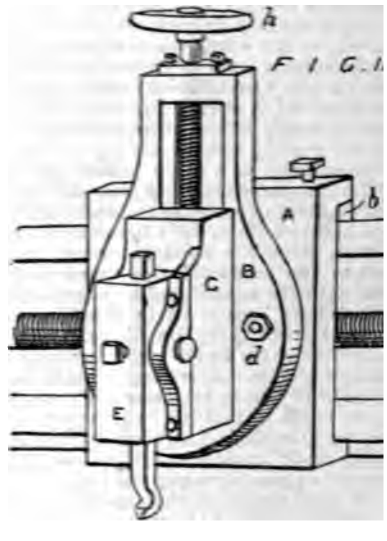


The general construction of a tool-box, therefore, is as follows:—First there is a saddle-plate marked A in all the figures, which fits directly on the cross slide, and travels along it, the accuracy of its fit being guaranteed, and the amount of the wear of the surfaces in contact being taken up by the adjustable strip *b b*, with set screws at the top. To the front of this saddle the plate B, which takes the elevating screw *c*, is attached by the bolts *d*, which bolts are either furnished with dovetail-shaped heads moving in a dovetailed groove in the face of plate A (Fig. 115), and thus permitting of the slewing of the plate B to any angle wh
or they are screwed fast into the plate
the ends which project outwards to u
nuts are embraced by circular slots in
(Fig. 112), which slots permit of a
amount of spherical movement suffici
all ordinary purposes.

The plate B carries a third plate C,



guided by vee'd edges, internal (Figs. 11
or external (Figs. 112, 114), slides upon it
a vertical direction, movement being i
to it by the hand-wheel *h*, and screw *c*,
into the nut *i*, or by mitre gearing at th
or by either at pleasure. This p
receives the plate D, which is rendered
of a slight amount of circular movemen
cient to throw the cutting tool so much
side of the box as will allow of the latt
ing the work in deep vertical cuts,
which contrivance the tool-box woul
into collision with any edges, whose de
greater than the length of the projecti
of the tool. To permit of this movem
plate is hinged on a pin near its lo
(Fig. 115) *j*, and the curved slot (Fi
112) *k*, is cast concentrically with this
that the upper part of the plate can be
over as far as the range of the slot will

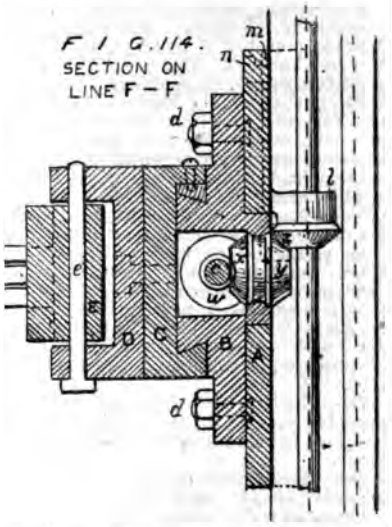


in order to place the tool at an an
cutting.

Lastly, upon this plate D is hinged the tool holder E, to which the cutter is i
ately secured. This plate is allowed t
freely outwards upon a hinge pin *e*; but

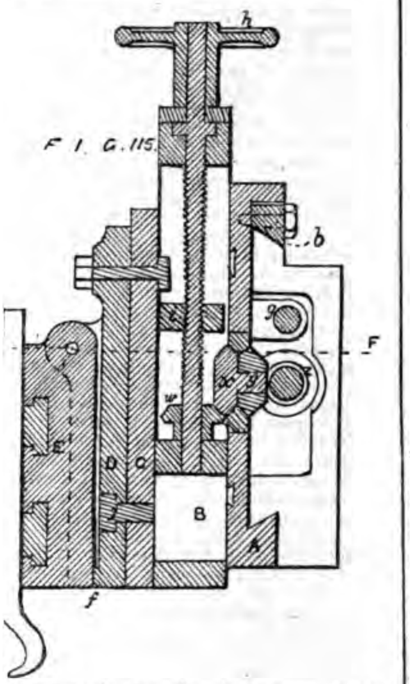
115) cast upon its back, or else upon the f D, prevents it from moving more than istance in that direction. The purpose hinging of the tool holder is to prevent inding of the tool edge on the work

FIG. 114.
SECTION ON LINE F—F



the return travel of the table. The weight of the tool-holder alone is thus d to press down on the cutting edge the backward stroke; but during its

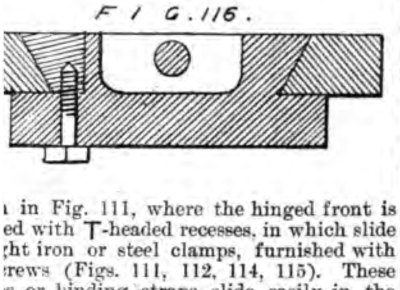
FIG. 115.



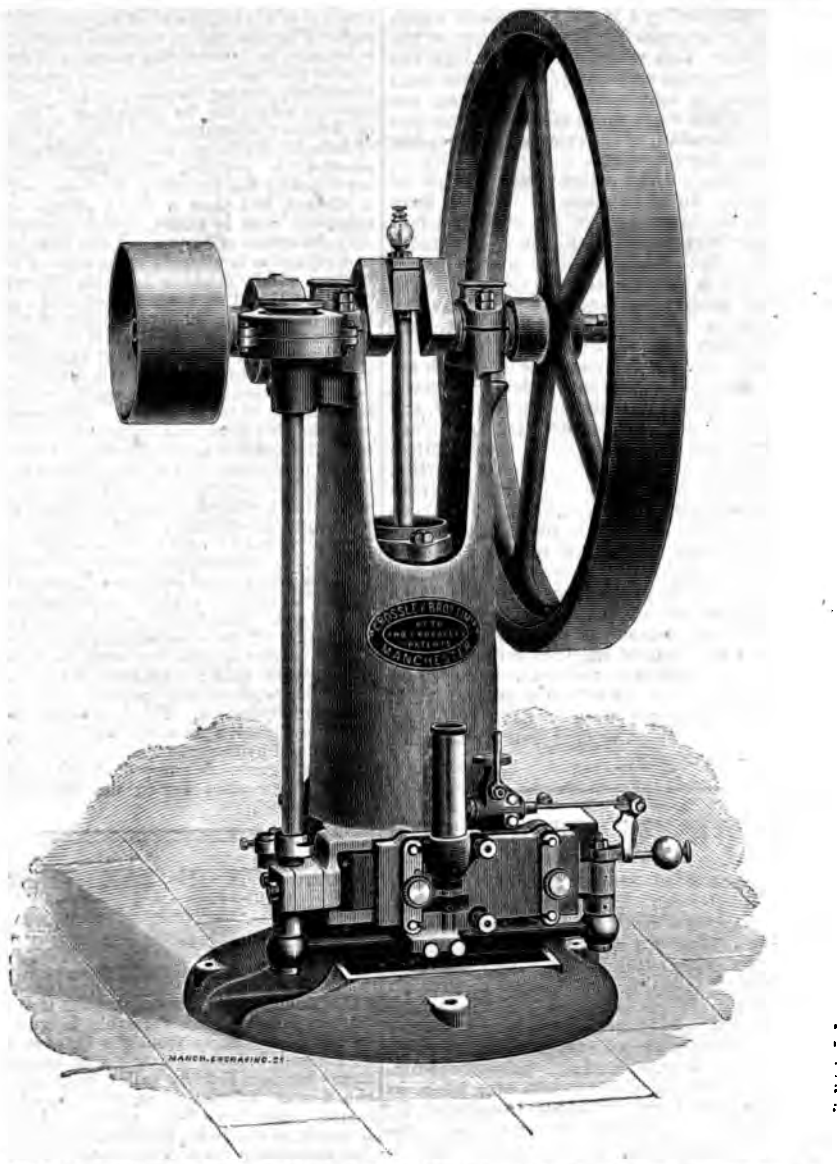
rd or cutting motion it is kept rigidly vable by the resistance of the tool box e cross slide.

actual tool holder is met with in various ications. The commonest form is that

FIG. 116.



in Fig. 111, where the hinged front is ed with T-headed recesses, in which slide ht iron or steel clamps, furnished with rews (Figs. 111, 112, 114, 115). These s or binding straps slide easily in the ded recesses, and the tool drops freely gh the slots with which they are pierced; e effect of tightening up the set screw on ol is to secure both it and the clamp y against the tool box. This hinged front extends the whole width of the plate D, Fig. 112, or it drops within side flanges, as in Fig. 111, the former allowing of a wider range in the position of the tool, and of a readier removal of the clamps than the latter.



CROSSLEY'S NEW VERTICAL OTTO GAS-ENGINE.—(For description see next page.)

The straps are occasionally in small machines made fast into the front plate; but more frequently they are dispensed with altogether. In Fig. 113 the holder forms a complete hollow rectangle, through which the tool passes, and is held firm by a pinching screw or screws. In the same figure a method of hinging is shown, where, instead of the long pin passing through a drilled hole, there are trunnion bearings and movable caps employed.

Instead of a hollow square block inclosing the tool on all sides, the holder sometimes forms three sides only of a rectangle, the open side placed to right or left being for the insertion of the tool, and a pinching screw, or screws, setting it from the front as before.

The sectional views (Fig. 115) in a vertical direction, (Fig. 114) in a transverse or horizontal line, illustrate the manner in which the movements of the tool-box are effected. Its longitudinal travel takes place through the traverse-screw within the cross slide actuating the nut *g*, attached to the back of plate A. This movement is automatic, but the discussion of the methods by which it is rendered so will come under their proper heading by-and-by. The rate of travel of this nut, and consequently the width, or traverse feed of the cut taken, are rendered capable of exact adjustment by the fractional portion of a revolution, which is imparted at pleasure to the traverse-screw, according to the means to be hereafter described.

The whole box travels longitudinally, but the plate C, with the tool-box proper, alone moves in the vertical direction. This motion is either effected by hand simply, or by an automatic self-feeding arrangement. In the former case the hand-wheel *h* is used to impart motion to the screw *c*. The head of the screw revolves in a bearing in the upper portion of the plate B, but while free to revolve, it is prevented from moving either upward or downward by a cover plate inclosing a collar. But it takes into a nut *i*, attached to the back of plate C, and hence when the screw revolves, the nut, and with it the plate C, must necessarily travel either up or down the face of plate B.

The feed is rendered automatic by an arrangement of bevel gear (Figs. 114, 115). The vertical screw, with its upper bearing and collar, and the nut, remain, but it carries a small mitre-wheel, *w*, at its lower extremity. This gears into a similar mitre-wheel, *x*, having its bearing in the plate A. Upon the back of *x* is attached another mitre-wheel, *y*, projecting within the hollow of the cross-slide, and gearing into a fourth, *z*, which moves along the plain shaft within the slide to the various positions occupied by the tool-box, but turns with the shaft by a sliding feather taking into the longitudinal groove. It is easy to see that if the shaft is made to revolve, wheel *z* will turn wheel *y*, and with it wheel *x*, and wheel *x* will turn wheel *w*. But as *w* cannot move upwards or downwards or revolve independently of the screw, the effect must be to turn the screw to which it is attached, and move the nut, with the slide C upwards or downwards, according to the direction of the screw's rotation.

The wheel *z* being a loose sliding-fit only, would obviously slip out of gear if no provision were made for retaining it in place. Hence it is carried in a bearing *l*, attached to a plate, *m*, which plate slides in a dovetailed groove at the back of plate A, and is thrust in and out of gear at pleasure by a small eccentric *s*, which is turned by a square key from the front of the plate. When this wheel is thrown back out of gear there is no automatic feed, but the hand wheel alone is employed. It is thrown out whenever fresh adjustment of the tool requires the rapid elevation, or lowering of the tool-box preparatory for a new cut.

The position of the mitre-wheel *w* is not of importance. In most cases it is as I have figured in the lower part of the slide, but it is also often above wheel *x*, and made to revolve in a bush, which takes the place of the nut *g*, in Fig. 115, a boss on the bevel-wheel being tapped to receive the thread of the elevating screw. It is retained in place by the bush bearing within which it revolves.

Machines planing 2ft. and less in length are seldom supplied with the vertical automatic feed on account of the extra parts required, and the increased and somewhat disproportioned width of cross slide demanded by the introduction of the second shaft with its gearing. Still, there are 24in. planers, both of American and English manufacture, furnished with both movements, and although the tool-box which we shall select for the amateur machine will be one with automatic movement in the cross-feed only, I will give dimensions also for a box and cross slide with self-acting feeds in both directions. Machines planing over about 6ft. in length are often supplied with a couple of tool-boxes moving upon the same cross slide, but actuated by different shafts, while the largest machines usually have tool-posts and boxes at the sides, so that four cuts can be taken simultaneously.

CROSSLEY'S NEW VERTICAL OTTO GAS-ENGINE.

WE mentioned on p. 272, last volume, that Messrs. Crossley were showing at the Inventions Exhibition a new vertical gas-engine which would attract much attention from those who require only a small power. The illustration on p. 5 will serve to give an idea of this useful little motor, which is technically known as the "5-man-power vertical Otto," but will yield one horse-power at the pulley. The engine occupies only about 3ft. square of floor space and is 5ft. 8in. high, so that those who have little room to spare can fit it into almost any corner. Being so small, the gas consumption is necessarily greater than is the case with the larger engines; but as this type is fitted with a sensitive governor, recently patented, unlike most small gas-engines its consumption of gas is in proportion to the power developed. That is a great advantage in small workshops, for when there is nothing in a lathe, for instance, sufficient gas only to keep the engine running and driving is used, but when work is put in and the tool brought to bear, the power is automatically increased up to about one-horse, if required. The crank of this engine is of steel, and the other parts are of materials which Messrs. Crossley's long experience has taught them are best. All parts are made to gauge, and are easily replaced, the makers undertaking to repair or replace any parts which may be broken or suffer from undue wear within six months of date of delivery.

PEPTONISATION.

THE investigations of Thénard, Paul Bert, Regnard, Béchamp, and others, have shown that fibrin and organic tissues can break up peroxide of hydrogen without themselves undergoing change. Some organic elements do not possess the property of disengaging the oxygen from the "oxygenated water." Weltzien has demonstrated that iron and aluminium, which do not decompose the peroxide of hydrogen, are yet transformed into hydrate. Chandelon suggests that certain organic substances may undergo an alteration of the same order. He has submitted an albuminous solution to the action of the oxygenated water, generated by passing a current of carbonic acid through water containing, the peroxide of barium. The albumen thus treated did not break up into leucin and tyrosin, which are the first products of its decomposition, but it was transformed in part into peptone. Chandelon repeated the same experiment, adding hydrocyanic acid to the solution of albumen, in order to prevent putrid fermentation; he then passed the current of carbonic acid for twenty-four hours. After the removal of the carbonate of barium, hydrated peroxide of barium, and an insoluble organic flocculent substance, he detected the presence of dyspeptone. Beside this the liquid in question contained (1) an albuminate having the characters of caseine; (2) a material which has the properties of the apeptone of Meissner, albuminose of Kühne, and propepton of Schmidt-Mulheim; and (3) a body giving all the reactions of peptone. The three substances are separated by the following processes:—The liquid is filtered, and then a slight excess of diluted sulphuric acid is added, which precipitates not only the excess of baryta, but also proteine. Next, neutralisation is affected by means of hydrate of barium. This mixture is again filtered, and the resulting liquid is concentrated, and a solution of salt is added, in order to precipitate the unchanged albumen, and then the liquid is boiled. The resulting liquid is filtered, and again treated with powdered salt to saturation. A precipitate of propeptone is formed, which appears in flakes at the temperature of the sand-bath. This propeptone is collected on a filter, and washed with a solution of salt. The liquid is again boiled in order to eliminate all the propeptone. It is concentrated to just upon the point of crystallisation of the salt, and then submitted to dialysis, until the liquid that passes no longer precipitates with nitrate of silver. Hydrocyanic acid ought to be added during this process, to prevent putrefaction. The dialysed liquid is precipitated with three times its volume of alcohol at 90°, and a white precipitate of peptone is obtained. Chandelon remarks that the relative proportion of these substances may vary, and in certain cases the quantity of proteine obtained is much greater than the quantity of peptone. These experiments prove that peptonisation is a phenomenon of hydration. The hypothesis is advanced that the digestive ferments act by giving birth to peroxide of hydrogen. This supposition, however, must be regarded as a very doubtful representation of what takes place during the different digestive acts.—*Lancet*.

EVOLUTION IN THE VEGETABLE KINGDOM.—III.*

(*Continued from page 558, Vol. XLI.*)

Geological View.

THE most ancient fossil remains that have been referred to the vegetable kingdom are two species of Oldhamia from the Cambrian deposits of Ireland, but the vegetable character of these forms has been latterly called in question. From the Lower Silurian forty-four species, chiefly marine algæ, have been named. Among these, however, are included the earliest terrestrial forms. Not to mention the problematical *Eopteris Morieri* of Saporta, we have *Sphenophyllum primævum* Lx., and two other vascular plants from the Cincinnati group. In the Upper Silurian thirteen species are recorded, five of which are vascular plants. One of these is *Cordaites robbii* Dawson, found in the Silurian of Hérault as well as in the Devonian of Canada. The Devonian furnishes 188 species of fossil plants, while from the Permo-Carboniferous nearly two thousand species are known, or nearly nine-tenths of the entire Palæozoic flora. With the Mesozoic a great diminution appears in the abundance of vegetable life that has been preserved. Only sixty-seven species have been found in the whole of the Trias. With the Rhætic a new impulse is felt increasing through the Lias and reaching a second but much reduced maximum in the Oölite, from which 419 species are recorded. The wave then again recedes until the close of the Gault is reached.

The Cenomain of Europe, with the beds of Atane in Greenland and the Dakota group of the United States which probably correspond to it, mark a new epoch, supplying together nearly five hundred species of fossil plants. That member of the cretaceous formation which immediately overlies the cenomanian, viz., the turonian, to which the Fort Benton group of American rocks seems to belong, is almost destitute in both countries of vegetable remains, but with the Senonian we meet again the increasing volume which was merely interrupted by unfavourable conditions for the preservation of plants. Here we have in European strata, in Patoot, Greenland, and in British Columbia 354 species. Although none have yet been described from this horizon within the territory of the United States, I have myself demonstrated their existence to a limited extent, and live in hopes of yet bringing to light an important upper cretaceous flora.

We are thus brought to the Laramie group of the Western Territories, which, though a brackish water deposit and difficult to correlate with other deposits, may be regarded as extreme upper cretaceous; 333 species have been thus far described from this group, which presents a flora of a still
more tertiary aspect than that of the Sen
proper, and fittingly ushers in the tertiary flo

From the Palæocene of Sézanne and Gelin
the Miocene the progress is uniform and
The Eocene of the old world (Paris basin,
Provence, Monte Bolca, Monte Promina,
Pastello, Isle of Wight, London clay, &c.) fur
over 650 species, while the Green River gr
America, including the rich beds of Fl
Colorado, probably of that age, has yielded
than two hundred. This is exclusive of
called Oligocene of the continent (Hæring in
Sotzka in Carniola, the Marseilles basin, Ar
near Narbonne, &c.) from which nearly 80
have been taken. We thus have over 1,
Miocene Tertiary plants, which is, however
less than half of the Tertiary flora. The
supplies nearly all the rest, yielding alon
3,000 species. It may be, as has been charg
this number is too great, and that a por
these plants belong to lower horizons.
Heer's determinations in Switzerland ha
been seriously questioned, his work on the
floras is doubtless open to revision, but t
not diminish the number of Tertiary plants
if we add to those already mentioned so
Pliocene species, will form an aggregate of
5,000.

The Tertiary virtually closes the se
vegetable remains, the Quaternary having
furnished less than one hundred species o
plants.

The development of plant life throu
successive geologic ages may be graphic
presented, so far as indicated by actual disco
a diagram in which the number of accredited
is taken as a measure of predominance,
space assigned to each horizon in the vertic
represents its duration in so far as the thick
the deposits can be regarded as a measure
The fact is thus brought clearly to view th
have existed two favourable periods for
servation of vegetable remains—the Carbo
and the Miocene—the wide interval betwee
is relieved by two less favourable perio
minating in the Oölite and the Ceno
respectively. To what extent the inte
great scarcity may yet be filled, it is impo
predict, but it is well to remember that it
quite recently that the Oölite has
prominence as a vegetable deposit, and this
through researches made in India and
With the further development of such
regions it is to be hoped that a much greate
of uniformity in the different geological
will be secured. But of this there is no ce
and it is perhaps equally probable that fu
search may tend to exaggerate the present e

Three things must combine for the suc
development of a fossil flora in any given
cal formation: 1. The requisite vegetatio
have flourished at the period in question;
conditions for its preservation and sub
exposure must have existed; and 3, the l
in which it is imbedded must be found and
As regards the first of these conditions, w
that great fluctuations of the land surface
globe have taken place, and periods may ha
passed during which these were much less in
than at others. Still, there can be little do
the variety at least, if not the abundance of
tion, has undergone a somewhat uninterru
crease since the earliest times. The seco
dition is a much more serious one.
periods may have elapsed without any reco
made, not because vegetation was scarce,
cause land areas were limited, but bec
seems now to be the case over most of the g
vegetation was allowed to decay and return t
mosphere. Again, vast beds may have been d
but never afterward raised up and exposed,
remain for ever inaccessible. It is only th
condition which it is within the power of
influence. But when we consider the ac
manner in which a great part of such dis
have been made thus far, we may well presu
the most precious scientific treasures wh
earth holds may remain undiscovered inde
although within the easy reach of the inve

Botanical View.

Most of the plants of the Palæozoic age
to archaic types long since extinct and havi
very much modified living representatives
is less marked in the ferns than in those
which have as their nearest modern descend
Equisetaceæ, the Lycopodiaceæ, and the C
The Palæozoic ancestors of the Equisetaceæ
Calamariæ, having the genus Calamites f
typical form. Those of the Lycopodiaceæ
Lepidophytes with Lepidodendron as the
while, according to the most recent researc
Coniferæ had as their ancestral form the Co
long classed among the Cycadaceæ, with C
as the principal genus. As a means of exp
the fact of this prolongation of living forms t
the geologic periods and of denoting the p
descent of modern from these archaic ty
vegetation, the terms Fillicineæ, Equisetin

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* By Lester F. Ward, A.M., in the *American Naturalist*.

Lycopodineæ have been employed as broader than the corresponding ordinal designations in common use. The Marquis Saporta has sought to accomplish the same object for the Coniferæ by the Acicularia, but this unfamiliar substitute will not be likely to meet with general acceptance. The cellular cryptogams, which, admitting Oldhamia to be a plant, had two representatives in the Cambrian, constituted the principal vegetation throughout the Silurian. Yet the ferns, if we accept Saporta's Eopteris, the Equisetineæ, and Lycopodineæ, all had their origin in the Lower Silurian, while the Coniferæ through Cordaites, made their appearance in the Upper Silurian.

(*To be continued.*)

CLEANING MARINE MUDS.*

LET us suppose the material comes to us from anchors of vessels in hard, dry lumps. The first step is to disintegrate these lumps in water. My method is to place a lump in a bucket or large basin of water, and let it remain for several days, until it is soft enough to break up with the fingers. I then place the material in a dish, fill with water, and thoroughly stir the whole, then allow it to settle for 15 minutes, and pour off the top. I repeat this until the top water becomes clear. If this is thoroughly done it will consume the best part of a week. The next step is to place the whole mass in a shallow dish or pan, fill it with water, stir the mass up thoroughly, and pour off the top into another vessel, repeating this process until nothing remains but the sand and mollusc shells. This is thrown away, and the material poured back again into the shallow dish and "sanded" as before. This process is repeated until there is no longer a deposit of sand, then place the material in an evaporating dish, cover with water, and with a movement of the arm in a circle revolve the dish gently, when the sand will ball up in the centre of the dish. Pour off the top and throw away the sand. Repeat this operation until satisfied all the heavy sand has been removed. The material is now ready for the acid, but before applying acid it must be dried. To obtain the best results, the best method is to let the water evaporate in the sun.

When the evaporation has taken place, transfer the material to a porcelain dish, pour nitric acid in with a free hand, and boil thoroughly, until all fuming has ceased; allow to cool, and wash thoroughly; again dry, and cover thoroughly with sulphuric acid, and boil until the fumes cease, then throw in pulverised bichromate of potash, little at a time, until the colour changes; boil in sulphuric acid about ten minutes. Allow the material to cool thoroughly and pour into a large vessel of pure water, allowing it to settle thoroughly before drawing off the top water—about ten or fifteen minutes; repeat this washing until all traces of the acid are removed; when this is accomplished, the former process of sanding must be repeated. Keep this up until satisfied nothing more can be done in this way. The next step is to place the material in the porcelain boiling dish, add water until the dish is about two-thirds full, place over the fire, and just before the boiling point is reached, throw in a stick of caustic potash about half an inch long, and let it boil thoroughly for four or five minutes, stirring from time to time. Pour this while hot into a large glass vessel, and let it settle for about one or two minutes—the appearance will determine the length of time necessary; draw off the top portion carefully and throw it away; the remainder must now be placed in a small bottle filled two-thirds with water, cork the bottle tightly, and shake vigorously, allow to settle ten minutes, then draw off the water; continue this process two days; then sand again by the rotary movement in the evaporating dish.

There must now be procured from a photographer two of the glasses used by them for embossed pictures, one large and one small, also from any drugstore one or two drop-tubes, with rubber bulbs. Now pour a little of the material upon the large glass, and gently move it from side to side, which will cause the sand to settle; slant the glass toward one corner, and draw off with the pipette and place in the bottle; add more water to the glass and draw off as before, until nothing but sand and spicules remain; repeat this process five or six times with the small glass. The material is now placed in the shaking bottle, and a few drops of ammonia added. Shake vigorously two or three minutes, allow to settle, draw off carefully, and repeat this process ten times. Sand again by means of the embossing glasses, and the work is finished.

In this work everything depends on the thoroughness of the sanding and the faithful manner in which the shaking is performed. The shaking is, next to sanding, the most important part.

In regard to the acid treatment, I may say that good results can be produced by either nitric, sulphuric, or muriatic acid, but muriatic acid should never be poured into sulphuric without great caution, for it will boil over. Muriatic acid by itself produces good results. So also does nitric acid; but I have found the best results are obtained by the use of the nitric acid, followed by the sulphuric. It does no harm to boil again in nitric; this must be done if the sulphuric acid is not thoroughly washed out, otherwise crystals would form on the glass.

The best stand I have ever seen for holding the boiling dish is a tin can, procured from any drugstore, with a tin top; it is about 10in. high by about 6in. broad. Cut a hole through the top to fit the dish, then cut a door large enough for the lamp to be placed through, one or two air holes near the top, and it is ready for work.

I use a dentist's chip-blower to draw the water out of my shaking bottle, and would advise others to do the same, as it saves many valuable forms from being poured off when decanting. My shaking bottles are about 4oz. vials, or vials that the tube of the chip-blower will easily reach the bottom.

In regard to my experience with Mobile Bay mud, I will only say that I took soundings every half mile for 12 miles in one way, and for 30 miles in another, and obtained samples of mud from any and every point I possibly could. I worked for more than a year before I found any forms except those that were worthless. My first find was from a dredge boat, 17½ miles from the city. I had only a small handful of this material. So I eagerly sought for more, but, alas! the dredge sank during a gale, and I was unable to procure any more for months. I next found good forms in mud from the bay one half mile from Fort Morgan. Again I obtained fine results from Lower Dog River Bar; I obtained this material by means of a tug-boat. I found a few good forms in Heron Bay, a small bay which makes into an island situated in Mobile Bay. The Pensacola material was procured for me by means of a row-boat, about one mile from Pensacola.

I do not like to speak of my trials and failures in working Mobile Bay muds, because when I look back upon them I am almost tempted to disbelieve myself. Suffice it to say, I spent eighteen months on this one deposit without reward. Many a night have I sat up watching my bottles, which were placed between two lamps on the chimneypiece. I can remember my delight when, after a week's work, I would discover a single form, perhaps two, surrounded by a mass of sand; and such sand! I dreamt about that sand, fought with it, but for eighteen months it was my master. This long work, without success, taught me the lesson of patience, and finally resulted in my success. I declared war against the sand, and tried to master it by watching the settlings, but in vain, until I adopted the plan of fighting it from the moment the raw material came into my hands; then, and not till then, did I receive my reward. To give an idea of how poor the material is in its original condition, I will state that the amount contained in a homœopathic phial a quarter of an inch deep cannot be procured from less than one quart of the raw material.

ELECTRIC CLOUDS AND PHOSPHORESCENT MOUNTAINS.

PROFESSOR COLLADON, of Geneva, has communicated to the local press a description of a remarkable atmospheric phenomenon noticed on August 6. Until after 5 o'clock p.m. the sky had been calm and serene over all the valley of the Leman; but at half-past 5, albeit the atmosphere above the lake and neighbouring mountain remained remarkably still, vapours were seen at a great height (evidently produced by a strong and warm south-west wind in the upper air) advancing rapidly towards the north-east, and taking the undulatory forms which characterise clouds strongly charged with electricity. At half-past 8 the aspect of the sky had become decidedly stormy. The thick cloud-masses were oscillated widely, albeit their general movement was still from south-west to north-east. After 9 o'clock these clouds, drawing away, rendered visible the sheet of cirrus which stretched above them. The cirrus was phosphorescent, and looked as if lighted up by a bright moon. On the north-western horizon the sky along all the chain of the Jura was obscured by thick clouds that from time to time were illuminated by flashes of lightning. It was the same over Mont Galène, above which the lightning played every few minutes. A long black cloud stretching from the Dôle to the Galène presented on each side a broad phosphorescent border, and about a quarter-past 9 there became suddenly visible in that part of the cloud nearest the Jura a luminous centre, whence escaped two or three phosphorescent rays pointing towards the south-west. This phenomenon lasted some 20 minutes, and was sufficiently striking to be remarked by many observers. From a quarter past 9 to 11 o'clock, moreover, the south-western extremity of Mont Galène was illuminated by a phosphorescent light so intense that its rays were visible from every part of the horizon. The general appearance of this south-west section of the Galène resembled that which is presented by the city of Geneva in thick weather when the mists of evening are lighted up by the gas of the streets. Some rare instances are on record of forests of resinous trees becoming phosphorescent in stormy weather, but the distance from Geneva was too great to enable observers to determine whether the light resulted from the phosphorescence of the fir trees which cover the sides of the Galène or from that of other parts of the mountain. The Central Meteorological Bureau at Zurich publishes about 8 o'clock every morning daily accounts of the general condition of the atmosphere throughout Europe, and special reports from 12 stations in Switzerland at 8 o'clock a.m. and 1 o'clock p.m. These reports are received at Geneva on the follow-day, and those of August 5th and 6th show that on the dates in question there took place a complete change in the atmospheric equilibrium of Western Europe, and that the high pressures which for several weeks previously had prevailed over England and the Channel suddenly ceased, and gave place to warm, vapour-charged winds from the south-west.

COLOURED GLASSES.

THE oxides of lead naturally give a yellow tinge to glass, but only considerably so when in very large quantity. Their use as a flux has been repeatedly mentioned, and they will readily verify most completely in a moderate heat without addition, or will unite with any other vitrifiable matters and most powerfully assist their vitrification. This oxide is seldom used directly as a colour, on account of the enormous proportion required, which should be at least three-fourths of the glass to give a yellow of any intensity, and this would give a compound extremely soft and one that would powerfully corrode the pots. The perfect oxide of antimony gives a full yellow to glass, which is much used, both alone and in compound colours in which yellow is a necessary ingredient. When not in contact with carbonaceous matter the proper colour given by the oxide of manganese to glass is a purplish red, rather muddy when in full body, but still very beautiful. It is almost always combined with nitre when thus employed. The colour is totally destroyed by all the arsenical salts as before mentioned, and therefore arsenic in any form should be avoided when manganese is used as a colouring matter. It also is the principal ingredient in most of the black glasses.

The colour given by the oxide of cobalt is a fine deep blue, which is unalterable in any fire, and succeeds with any flux. The colouring power is also very intense. Zaffre is usually employed for this purpose. Cobalt is also used for some of the finer blacks mixed with manganese and iron, and with the yellow of antimony and lead it composes a green.

Though the oxide of nickel is not actually used, it may here be mentioned that the oxide gives a violet blue glass with fluxes of potash and to those glasses in which it largely enters, but with soda or borax. Klaproth has fully ascertained that in his analyses of the chrysoprase, which from its giving a blue to potash glass, was thought to contain cobalt; but this is not the case, the colouring matter being nickel. Thus 1 part of the rough chrysoprase, and 2 parts carbonate of potash fused into a violet blue glass; and 80 parts of silex, 60 parts of carbonate of potash, and 3 of oxide of nickel from the chrysoprase, also gave a violet blue glass. The same result was given by using an oxide of nickel from a known ore of that metal. Equal parts of the chrysoprase and of carbonate of soda gave a tourmaline brown glass nearly opaque. Equal parts of the chrysoprase and of carbonate of soda gave a tourmaline brown glass nearly opaque. Equal parts of chrysoprase and calcined borax gave a brown transparent glass. Silex, phosphoric acid, and oxide of nickel in the same proportions gave a honey yellow glass, but not quite clear.

Though tungsten is not used it may be mentioned that with fluxes of phosphoric acid it gives a blue glass, but not when borax or alkalies are used.

Chrome, which is the natural colouring matter of the ruby and emerald, would be a most valuable ingredient for the artificial gems if it could be procured with tolerable ease. It has been found to give a fine red and also a most beautiful and exquisite green to glasses, but its great scarcity until recently has prevented its frequent use.

Having thus generally described the colouring properties of the several metallic oxides, some of the actual recipes for the different coloured glasses may be mentioned. These we shall chiefly give from M. Fontanieu, and from Neri and Kunckel, to which may be added the actual composition of a few of the beautiful antique coloured glasses, as found by the analyses of Klaproth. With regard to the recipes, however, it may be added that there appears such enormous difference in the relative proportions of the metallic oxides to the fluxes used, as either to give a suspicion of extreme inaccuracy or to show that it must in most cases be determined by individual experience.

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* By Dr. GEO. H. TAYLOR, in the *American Monthly Microscopical Journal.*

Of the ruby red, purple, violet, &c., by gold, little may be added here to what has been said before under gold. The particulars of the process have always been carefully kept secret by the successful artists, and from the frequent failures there can be no doubt that it is a very difficult process to manage. According to Kunckel and others who have succeeded, it appears that the colouring power of the purple precipitate of Cassius, or the mixed oxides of gold and tin, is so great that one part will give a full rich body of colour to from 600 to 1,000 or more of glass. The glass of antimony, too, seems an important addition. This ruby glass comes out of the fire colourless, but assumes its beautiful hue as it cools. It has been thought that the colour is also further brought out by exposure to smoke.

Of other reds, purples, and violets, some are composed of a colourless glass basis, such as one of the five before mentioned, with the manganese either alone or with the purple precipitate of gold, or, more commonly, with the oxide of cobalt. The colour given by the manganese being of a violet red, the cobalt will give it a more decided purple by adding its natural blue. It is impossible to pick out from the various recipes any other proportions than that the oxide of manganese will colour very fully about 100 times its weight of glass when used alone, and when employed with cobalt, 200 parts of glass will be highly coloured with 1 of manganese, and (for purple) about one-third to two-fourths of zaffre.

Neri gives the following recipe for a glass to imitate the garnet, namely, 2oz. of rock crystal, 6oz. of minium, 16gr. of manganese, and 2gr. of zaffre. Kunckel gives for a violet red glass a common lead glass basis with 1-320ths of manganese, mixed with nitre. Fontanieu gives for the imitation of the amethyst, 24oz. of his glass, No. 5 (as already described), ½oz. of manganese, and 4gr. of purple precipitate of gold, together with 1½oz. of nitre. But the quantity of colouring matter here is so enormous that the vitreous basis should probably be 24lb. instead of ounces.

A fine red has been mentioned to be procured from the oxide of copper (with or without oxide of iron) mixed with the due proportion of glass and with carbonaceous matter stirred in. For a full deep red the oxide of iron should be three or four times as much as the copper, and in proportion as the latter predominates the colour approaches to carmine. The glass at first should appear when hot only of a faint, greenish yellow, and, when in full fusion, some tartar is stirred in, which instantly reddens the whole and causes it to swell prodigiously, after which it again subsides into a clear red glass, which should be worked off without delay. Probably charcoal would answer as well as tartar.

The antique red glass analysed by Klaproth must probably have been made in the same way—that is, by carbonising glass containing the oxides of iron and copper. The colour was a lively copper red, perfectly opaque, and bright at the point of the fracture. The earthy and metallic parts of 400gr., as given by analysis, were as follows:—

Silex	142
Oxide of lead	28
Oxide of copper	15
Oxide of iron	2
Alumina	5
Lime	3
	195

It is observable that this was opaque, whereas the former mentioned glass is transparent. Klaproth conjectures that the antique glass was made not by any intentional proportion or selection of ingredients, but from the scoriæ of some copper ores.—*Pottery and Glassware Reporter.*

LAYING OUT SHEET IRON AND BOILER WORK.—II.*

The Cone and Frustum.

THESE are the simplest forms to be laid out. They are, as here referred to, simple, plain ones; others will, in the future, be noticed. To lay out a cone of any size, it is well to make a full-sized sketch of the piece you require. Fig. 1 is a side view of a cone, Fig. 2 that of a frustum of a cone. To lay out this piece, where practicable set your compass or trammels, one point at A, Fig. 1, and the other at B, and describe a segment or part of a circle, sufficiently large to equal the circumference of cone at large end; and from any point on this circle measure off your circumference according to rule laid down in last paper, adding or subtracting thicknesses of iron as described. If you desire to make a cone, you will then draw lines from the measured points up to A, add your laps, and the figure is complete. If you desire to form the frustum of a cone, you will describe a segment of a circle as already stated, then alter your compass points to the height you require the cone to be, and strike another segment of a circle, and the measured points on the base or large end of cone carried up to the apex of cone at A will give the circumference at the small end, after which add laps as already described. It may be necessary to say that in laying out work, accuracy in measuring distances and squaring of lines are absolutely essential for producing good work. In Fig. 1, by dotted lines, I show the upright or perpendicular line square with the base or bottom of cone. I also show a dotted line on same figure representing the height of frustum. In Figs. 3 and 4 the work laid out, according to Figs. 1 and 2, is represented. The dotted lines represent the lap allowance. In laying out this piece the diameter to be calculated is represented in Fig. 1 by B and C, not by the circle described, that being the shape of the piece when laid out, and having no connection with diameter or circumference. I mention this as I have found many young men to whom I have given instruction calculating the circumference of the circle rather than the base of cone, and the same error I made when I first took instructions in this problem. The sketch, Fig. 4, gives a view of the piece laid out, as in the preceding case dotted lines represent lap allowance. This piece, if cut out and rolled up, will be equal in dimensions to Fig. 2. Should flange be required on one or both ends it would be necessary to make allowance for same; this should be taken into consideration when selecting the plate of proper width from which to lay out the piece. It is at times necessary, in order to prevent waste of stock, to lay out a cone in more than one piece; in such case lay out in equal parts as ⅓, ¼, or whatever number may be best adapted for the greatest economy of material.

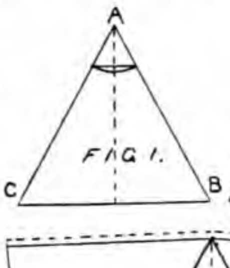

FIG 1.

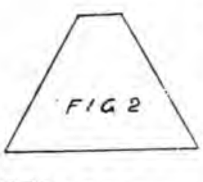

FIG 2

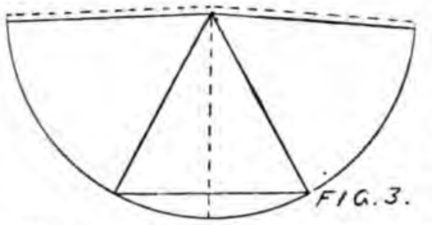

FIG. 3.

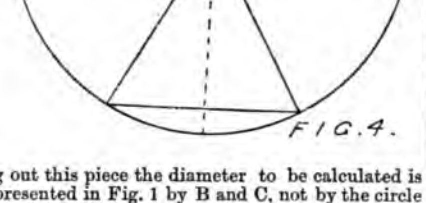

FIG. 4.

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[*] By G. MARSHALL, in the *American Machinist.*

CELLUVERT.

THE following description of a manufacture which appears to resemble celluloid is extracted from an American paper, but we presume the process has been patented in this country. The object of this invention is to treat sheet paper, sized or unsized, or woven fabrics or similar fibrous material, so as to produce therefrom sheets or slabs tough and strong in texture, and capable of resisting the action of most acids and alkalies. The material thus produced is termed "celluvert." Paper, or equivalent fibrous material, is taken in sheet form and passed through a bath of nitric acid or one of its salts, the paper being immersed in the solution for a sufficient length of time to dissolve the surfaces into a glutinous or pasty condition, but not long enough to effect a complete solution. Two or more layers of the material with their dissolved surfaces are then brought together under pressure, either with or without heat, so that they will adhere firmly together and so produce the material "celluvert." Among the salts of nitric acid which may be used are nitrate of zinc and nitrate of lime, which possess the same solvent tion on the vegetable fibre as does the nitric itself. Either the nitric acid solution or the nit solution may be used alone or may be combi with other acids, bases or salts, or solvents of ce lose. For instance, good results may be obtai by adding muriatic acid or other acids to the ni acid bath. Again, cupra-ammonium, zinc-am nium, or chloride of zinc may be combined the nitrate bath. If nitric acid alone is used i thought best to use it at the strength of from to 49° Baumé. If the nitrates are employed are concentrated to a syrupy condition of a 55° to 75° Baumé. In either case the solvent be heated and agitated if desired.

The apparatus for the manufacture of cellu is described as follows:—The sheet paper or o material if preferably in the form of a roll, wh is unwound continuously, and the sheet pa down into the solvent solution into a long sha trough, the sheet being kept immersed by pas under transverse rods. From near the oppo end of the trough the sheet passes out of the s tion and between a pair of squeezing roller scrapers in order to remove the excess of solut For convenience the solution thus remove allowed to run back into the bath, and the sur of solution soaked out of the sheets or slabs be recovered for use again by evaporation. length of time the sheets are submerged mus governed to a great extent by the character of bath employed, by its temperature and the th ness and permeability of the paper or other m rial, as well as the extent to which it is desire dissolve the surfaces of the sheets in orde cement them together. Under ordinary circ stances the time of submersion is about hal minute or so. The sheet of material, after pas from the scrapers or squeezing rolls with its faces partially dissolved, is impacted and con trated in layers, and wound on a horizontal hea drum, provided with flanges. On this cylinde mounted a pressure roller which simply rests its weight on the roll of paper as it is being wo up, the pressure roller being free to rise or with its journals in grooved guides. This rolle preferably heated, and by its weight it imp solidity to the slab formed by the cementing gether of the layers of paper wound up. Whe roll of the desired thickness is obtained it may removed from the cylinder by splitting it longi dinally of the drum. The sheet or slab is t soaked in alkaline or clear water, according the character of the mixture or the amo of flexibility desired. It is then slowly dr and pressed, and its surface is given a c of gum, oil, glycerine, or saccharine matter, any mixture of the same. The sheets or sl thus produced are useful for various purpo —such, for instance, as journal bearings, belti trunks, washers, cop-tubes, skate-rollers, &c. Th may also be made into knife-handles and vari forms and shapes of non-conductors of electrici The sheets or slabs may be made either hard horn-like or pliable and leather-like, according the use to which the "celluvert" is to be put. T sheets or slabs may be softened or made pliable immersion in a bath of glycerine or sacchar matter or both, and the said bath consisting about two-thirds water and one-third glycerine saccharine matter, or glycerine and sacchar matter combined. If desired a compound sh may be formed by cementing a sheet of wov material between sheets of paper by the proc described above. Starch, gum, mucilage, dextri or any form of cellulose may be advantageou added to the paper or fabric, either during manufacture of the same or before treatment the manner above described, or these substan may be dissolved in the nitric acid or its equi lent transforming fluid before described previ to the immersion of the paper or similar mater therein. If desired, any mineral or earthy s stance—starch, gum, dextrine, or any other form cellulose—may be sifted in or between the lay of paper or similar material as they are bei wound on to the roll.

ON THE COLOUR-CORRECTION O DOUBLE OBJECTIVES.*

BY CHARLES S. HASTINGS.

SECOND PART.

IT will be observed that the term colour, and considerations relating to colour, have be entirely omitted from the discussion. This is wh we might have anticipated, as a necessary featu from the remarks on p. 560, Vol. XLI.

One consequence of the solution above develop may be here noted—viz., the focal plane is defi by P_0, and not by two like values of P_n grea than this minimum. This is contrary to the d trine of some writers, but in accordance wi critical experiments.

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[*] From the *American Journal of Science.* Third ser Vol. XXIII. No. 135.—March, 1882.

III.—Method of Applying the Results to the Practical Construction of an Objective.

The solution obtained cannot be directly applied as a guide in the construction of an objective, for P is by no means the simple function of n, A and B, as implied in equation (1') when real lenses are in question. Even if we confine our attention to central rays and employ the exact formulas of Gauss, the process becomes so involved that we would naturally seek an easier, even if indirect, method, to a still greater degree if we wish to consider the far more important marginal rays.

There are several evident methods of finding indirectly the constants of the objective; but the most practicable one has seemed to me the following:—

We have as data a, β and γ in the formula—

$$n' = a + \beta n + \gamma n^2;$$

Also F, the required focal length of the objective. Then set

$$\frac{1}{\circ} = \frac{1}{F} = (n_{5614} - 1)\,A + (n'_{5614} - 1)\,B.$$

$$A = -\,B\,(\beta + 2\,\gamma\,n_{5614}).$$

The two last equation yield the values of A and B. In the general equation (1') substitute these values of A, B, a, β, γ with some known value of n, other than n_{5614}, e.g., I have generally used the value n_c. Its solution will give the value of the focal length for light of the refrangibility C. Let this value of P be substituted in turn in equation (1'), and solve with respect to n. We shall thus obtain two values of n, one of which is n_c, and the other a value greater than n_{5614}, which we may call n_c, and if we substitute this in the equation connecting n and n_1, we shall be able to derive the corresponding value of n'_c. This is all that the consideration of infinitely thin lenses can do for us; but from it we have found that rays of refrangibility, denoted by C and c should have a common focus, and we have also the values.

$$\begin{array}{ll} n_c & n_c' \\ n_{5614} & n'_{5614} \\ n_c & n_c' \end{array}$$

Having given the thicknesses of the lenses, and the distance between them, and having assumed radii proper to correct spherical aberration, we calculate the courses of three marginal rays of refrangibilities defined above, and of one central ray of refrangibility, 5614. By successive trials and modifications of three of the radii we can meet the three conditions that the marginal and central rays 5614 unite in a point on the axis; that this point is at a distance F from the second principal point of the system, and that the marginal rays C and c unite at another point on the axis. The remaining arbitrary constants—viz., the thicknesses, distance, and fourth radius may be utilised for the purpose of satisfying other conditions; but the consideration of such conditions is at present foreign to our purpose.

IV.—Practical Tests of the Value of the foregoing Theory.

There are two evident methods for determining the value of the results which we have obtained. One is to construct a telescope according to the principles developed in the theory, and study its performance: and the other is to find how the practice of the most approved makers agrees with that as founded upon the theory. Both of these tests I have applied with thoroughness, and will here give the results in the order named.

Three object-glasses, involving the use of six varieties of glass, have been constructed according to the principles developed above. The first was of 4·1in. aperture and 5·3in. focal length, with the flint in advance of the crown. The materials of which this objective are made are the flint glass of Feil, No. 1237, and the crown glass of the same maker, No. 1219.*

The second objective has a clear aperture of 6¼in., and a focal length of 91in. The crown lens is in advance, and the curves are such as satisfy for a first approximation the conditions proposed by Sir John Herschel. This form, though ordinarily known as Herschel's, cannot be said to differ from that chosen by Fraunhofer at a date earlier than that of the publication of Herschel's paper.

The third experiment was tried at the instigation of my friend Mr. C. H. Rockwell, who bore the expense of the fine discs employed. These were procured from Feil, at Paris, and were of exceptional thickness in order to allow greater latitude in the selection of radii. The objective has a clear aperture of 9·4in., and a focal length of 141in. It has undergone a critical investigation at the observatory of Cincinnati. As it possesses a number of novel features other than that of its colour-correction, I may give a complete description of it at another time.

All of these lenses were finished strictly in accordance with the theory developed in this paper, that is, the curves were ground very exactly according to the values yielded by calculation, and the objective finished before testing. An extremely delicate spherometer was employed to determine the radii. As all the objectives are of the highest excellence, the usefulness of the theory may be regarded as demonstrated.

For the second test proposed, we possess the results of the studies of two distinguished spectroscopists on the character of the colour-correction of several large telescopes. To these I can add two more.

Professor Vogel, in the *Monatsbericht d. K. Preuss. Academie d. Wissenschaften* for April, 1880, has described three large telescopes in respect to their colour-correction; one by Schröder of 298mm. aperture, another by Grubb of 207mm. aperture, and a third by Fraunhofer of 243mm. aperture, as determined by observing a stellar image spectroscopically. A fourth objective, by Steinheil, of 135mm., less completely investigated, is of little importance to us here, on account of its smaller size. The method was to determine the various lengths of the telescope when a stellar image, observed through the eyepiece armed with a prism, was caused to exhibit the greatest contractions at recorded intervals in its spectrum.

Professor Young, in this journal for June, 1880, gives the results of his measurements on two telescopes by the Clarks, each of nearly 9½in. aperture. The method employed was analogous to that of Vogel, except that a very powerful spectroscope was used, and the limb of the sun taken instead of a star. By this means, the focal planes for various wave-lengths of light were determined by the position of the slit-plate of the spectroscope.

In the summer of 1879 I determined, by the method last described, the colour characteristics of Mr. Edgecomb's telescope at Hartford, Conn., a 9·4in. objective by the Clarks, and with Professor Van Vleck's assistance, those of the 12in. Clark at the Wesleyan University.

To compare these various successful practical solutions with that given by the theory embodied in this paper, I found, by interpolation, using the first two terms of Cauchy's formula, the wave-lengths corresponding to the various values of n_c, that is, those wave-lengths which should have, according to theory, their focal point coincident with light defined by the Fraunhofer line C. They are for—

		W. L.
Crown glass	1219	500·4
„	of 6¼in.	499·5
„	of 9·4in.	498·6
Flint glass	1237	500·7
„	of 6¼in.	499·7
„	of 9·4in.	498·9
	Mean	499·6

The corresponding values as derived by measurements from various telescopes are as follows:—

W.L.	Makers.	Authority.	Remarks.
530·	Fraunhofer.	Vogel.	—
465·	Schröder.	„	—
494·	Grubb.	„	—
490·	Clark.	Young.	Princeton telescope.
522·	„	„	Dartmouth.
495·	„	Hastings.	Edgecomb's.
497·	„	„	Wesleyan Univ.
499·0	Mean.		

The close agreement of these means may be taken as a decisive proof of the correctness of the theory.

The almost identical values of the wave-lengths of light which should unite at the focus with the light C for six varieties of glass suggest another method of applying the results of the theory in practice, which is a very simple one. The nearest prominent Fraunhofer line to this wave-length—that is, the nearest one which can be readily measured in a spectrum produced by a small crown glass prism, is W. L. 500·5. Hence, in practice, determine the indices of refraction for the line C, W. L. 561·4 and W.L. 500·5 in both materials to be used; calculate the curves of the objective so that the spherical aberration for ray 561·4 shall vanish, while marginal rays C and 500·5 have a common focal point. This method, though simple and direct, is without doubt sufficiently correct for all telescopes of moderate apertures, and all varieties of glass hitherto used in their construction.

Johns Hopkins University, January, 1882.

ACCORDING to the estimate of Mr. Hansell, the quantity of laminated spring at present in use on English, Scotch, and Welsh railways is 231,920 tons, and there are used annually nearly 12,000 tons, Sheffield makers producing about 10,000 tons.

SCIENTIFIC NEWS.

THE British Association meets at Aberdeen on the 9th instant, under the presidency of Sir Lyon Playfair, M.P., F.R.S., who will deliver an address. On Thursday, the 10th, there will be a soirée, and the Friday evening discourse will be on the "Electric Light and Atmospheric Absorption," by Prof. W. Grylls Adams, M.A., F.R.S.; that on Monday evening by Mr. John Murray, F.R.S.E, on the "Great Ocean Basins." On the Tuesday evening there will be another soirée, and there will be excursions on the Saturday and on Thursday after the conclusion of the meeting. There will probably be a large attendance of members and associates, as several interesting subjects are down for discussion by experts, and without anticipating we may mention that it is probable Mr. Francis Galton, the president of the young section H, will give some particulars of the results obtained from the "family records" he received last year. Prof. T. G. Bonney, D.Sc., F.R.S., resigns the secretaryship at the end of the meeting, and will probably be succeeded by Mr. A. T. Atchison. The local secretaries are Mr. J. W. Crombie, M.A., Mr. Angus Fraser, M.A., M.D., and Prof. G. Pirie, M.A. The presidents of the sections are:—A, Mathematics and Physics, Prof. G. Chrystal, M.A., F.R.S.E.; B, Chemistry, Prof. H. E. Armstrong, F.R.S.; C, Geology, Prof. J. W. Judd, F.R.S.; D, Biology, Prof. W. C. McIntosh, M.D., F.R.S.; E, Geography, Lieut.-General J. T. Walker, C.B., R.E., F.R.S.; F, Economic Science and Statistics, Prof. H. Sidgwick, M.A.; G, Mechanics, Mr. B. Baker, M.Inst.C.E.; H, Anthropology, Mr. F. Galton, F.R.S.

The Iron and Steel Institute is holding its autumn meeting in Glasgow this week, from the 1st to the 5th, and a large attendance is expected, many of the members afterwards proceeding to Aberdeen. The president is Dr. Percy, F.R.S.

The death is announced of Mr. William Fraisse, a distinguished Swiss civil engineer, at the age of 84 years. Amongst his more notable works are the great Dorana Canal, for supplying the City of Marseilles with water, and the entire system of the Western Swiss Railway Company.

A special jury of scientists have awarded Mr. F. W. Brearey the largest money prize for his wave-action principle, as demonstrated by actual flight at the Aëronautical Exhibition held at the Alexandra Palace. The jurors were Prof. Hele Shaw, Mr. E. A. Barry, C.E., and Mr. U. Tingle, A.I.C.E.

The Executive Council of the International Inventions Exhibition have completed arrangements with the whole of the railway companies of the United Kingdom, whereby parties numbering 25 and upwards can from the present time and until the close of the Exhibition, obtain at greatly reduced rates through tickets, combining the journey to London, carriage over the underground railways, passage through the South Kensington subway, and admission to the Exhibition, and back. The arrangements made by the Council practically concede half-price admission to all country excursionists under this scheme.

Mr. W. Bellasis, writing from Roehampton, describes the remarkable effects produced by a flash of lightning which struck two fine oaks in Richmond Park on August 6th. The storm seems to have been local, and "there was but one flash of lightning, which, singling out two fine oak trees, completely destroyed the top portion of one and shattered to pieces the solid base of the other, depositing the immense upper part, neatly severed and intact, some feet away. The explosion must have been terrific, as trees close by are damaged by the large splinters, which, dried up and sapless, lie about in all directions. The spot can easily be found on inquiry at any of the lodges."

Mr. Ellis Lever has offered a prize of £100 for the invention or discovery of a new method or composition for treating canvas or other material used as brattice cloth and air tubing in mines, which shall, at a moderate cost render such material air, damp, and fireproof, and superior to that at present in use. Particulars as to terms of the offer can be obtained of Mr. Ellis Lever, Colliery Offices, Bowdon, Cheshire.

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* The optical properties of these glasses, as well as those of the 6¼in. objective, are given in a paper entitled, "On the Influence of Temperature on the Optical Constants of Glass." See ENGLISH MECHANIC, page 420, Vol. XXXIX.

[illegible]

[illegible]

Prof. [illegible]

It is stated that [illegible] Arctic Explorer [illegible] of the Scottish Geographical [illegible] through about the middle of [illegible]

The two Portuguese explorers [illegible] and Commander Ivens, arrived at [illegible] on July 16th and left again [illegible] for Mozambique with the [illegible] ing to Europe via the Congo. [illegible] traversed a region which no European [illegible] set foot in, as leaving Mossamedes [illegible] 1884, they reached Quilimane on the [illegible] coast to the south of Mozambique [illegible] having travelled over [illegible] miles [illegible] 3,000 miles of which were previously [illegible] They discovered the sources of the [illegible] affluent of the Congo which has been [illegible] quently referred to at recent [illegible] cussions. They also came upon a region [illegible] be extraordinarily rich in copper [illegible] district of Yarangana, situated [illegible] Lualaba and the Luapala. They also [illegible] discovery which may be of great [illegible] merce and science. It has often been [illegible] that the venomous African fly the tsetse [illegible] did so much mischief to cattle in the [illegible] of Africa, and had almost [illegible] between Delagoa Bay and the Trans[illegible] totally disappeared of late. Messrs. [illegible] and Ivens found that this fly was [illegible] abundant further north, and that, as has often been stated before, it was always [illegible] where there were plenty of elephants [illegible] in the course of his travels, had observed the same phenomenon, and it follows, therefore, that the region explored by the two Portuguese travellers is rich in ivory.

Mr. W. J. Stillman says that the catfish is only at home in sluggish water, and thrives most in the muddiest. He is a night feeder, greedy, and as he feeds along the bottom, is destructive to spawn, but does not feed on other fish. His habits, in fact, are much the same as those of the eel, and the flesh is very like that of the eel, as well as the skin, which has the same texture. Those who like the flesh of eels will, he says, like catfish; but why the latter should be considered an acquisition he does not understand, as it presents no advantages over the eel, and lacks some that the eel has.

At the meeting of the San Francisco Microscopical Society on July 11, Mr. F. L. Howard read a paper on "Epizoa," a group of parasitic crustacea, in which he described their life-history, and gave an account of his methods of preparing and mounting them. At the conclusion his collection of slides were effectively displayed by dark-field illumination. Mr. Breckenfeld exhibited a slide of *Argulus* [illegible], called by fishermen the fish louse. Mr. Wickson exhibited eggs, larva, and perfect insect of a fly found in the experimental garden of the university affecting the [illegible], commonly known as the quinoa plant, which was introduced from Chile last year as likely to be valuable as a forage plant, and bearing a seed which is used for food purposes in Chile and Peru. The fly has a leaf-mining larva, which feeds on the leaf substance between the upper and lower epidermis. The fly deposits its eggs upon the surface of the leaf and the maggot, when hatched, immediately begins mining into the leaf. The maggots appear in such numbers that they bid fair to destroy the plant, and may interfere with its usefulness in this State. The plants at the University have been saved so far, by destroying [illegible] which can be plainly seen [illegible] surface of the leaf. The fly has a [illegible] to the common house-fly, [illegible] summer.

Prof. S. A. [illegible], of the Illinois State Col-

[illegible]

J. A. [illegible]

Automatic Sprinklers.—[illegible] A [illegible] extinguished the fire. A similar [illegible] melting [illegible] in Philadelphia; but a more [illegible] in Chester, U.S., where a [illegible] pails were filled with water, and hung [illegible] of leakage. A sharp fire melted the [illegible], and as the pails fell from their handles the water was splashed upon the fire.

Removal of Flood Rock.—Analogous to the work done at Hell Gate, near New York, is that now in progress for the removal of Flood Rock. At some date in October next, not yet fixed, the works for removing this rock, in progress for the past ten years, will be exploded, the work of loading the 13,700 holes having just begun. It will be by far the vastest explosion which has ever taken place. The American journals state that 225,000lb. of "rackarock" powder and 75,000lb. of No. 1 dynamite will be employed, or over six times as much as was exploded at Hell Gate in 1875 (49,900lb.) The holes are about 9ft. by 3in. diameter, at an angle of 35° to 40° with the vertical, and chiefly in the roof, instead of—as at Hell Gate—in the pillars of the 21,670ft. of galleries which have been constructed under an area of about nine acres. Making these galleries has involved the removal of 80,160 cubic yards, from which it follows that the average section of the galleries is a little over 4ft. by 8ft. The average thickness of the rock above the galleries is about 13ft., which makes the quantity of rock to be broken up and removed after the explosion, by dredging, fully 200,000 cubic yards.

[illegible] THE EDITOR.

[illegible]

[illegible] STARS—POWERS USED ON [illegible] TELESCOPES.

[illegible] Mr. [illegible] letter [illegible] successful with the [illegible] have seen [illegible] pair of the five, [illegible] aperture, and [illegible] consult Mr. [illegible] the latter. [illegible] five objects, [illegible] I have added Mr. Gra-[illegible]

	Dis.	Grad.
[illegible] A. [illegible]	[illegible]	[illegible]
[illegible] A. [illegible]	[illegible]	[illegible]
[illegible] Σ. [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible] A. [illegible]	[illegible]	[illegible]

[illegible] Σ. [illegible] is rated [illegible] Σ. [illegible] the mean of two [illegible]

[illegible] statements in my letter on [illegible] impres[illegible] Mr. Franks [illegible]. I looked [illegible] over one hundred [illegible] of most of [illegible] very familiar, in order to [illegible] and possibly I may [illegible] errors in reading so very [illegible] figures; but I have assuredly [illegible] cases which Mr. Franks mentions. Lord Crawford's Index is exceedingly [illegible] Mr. Franks should have consulted the original work if he wished to criticise my statements. I said in the case of Struve "A power of 848 used frequently on close pairs after October, 1832." I naturally chose this date, as the powers called by Struve "" 1,000 and [illegible] by Σ. 848 and [illegible], were not procured till that time: a date at which, as I may remind Mr. Franks, over three-quarters of all the measures made with the Dorpat refractor and included in the "Mensuræ" had already been completed. Σ.'s words are (and *he* at least ought to know what powers he used) "Ocularium vero vii. et viii. inde [illegible] mense Octobri 1832 usus est frequentissimus in stellis duplicibus praesertim vicinissimis et splendidissimis." I presume that Mr. Franks has counted up to xii. hours in Lord Crawford's Index, as he says he has waded through the first half of the book, i.e., from Σ. 3053 to 1691 (pages 1 to 59). In this he counts two objects only, on which 848 was used; I count *nine*. Moreover, Lord Crawford's summary does not usually give the number of nights on which a star was observed, or in every case the power employed by Σ. According to Mr. Franks's method of counting, if A. and B. set out to measure five stars on five nights, and A. measured four of them on five nights with 200, and the fifth star on all five nights with 1,000, while B. measured all five with 200 on five nights, and 1,000 on the fifth night, B. has made five times as many measures with 1,000 as A. has!—a method of counting which, as Tom Sawyer observed, "is interesting, but tough." One star alone, ξ Ursæ Majoris (I do not know whether this star is one of the two Mr. Franks mentions), Σ. measured on *ten* nights in 1833, 1834, and 1835 with a power of 1,000 (848). I should advise Mr. Franks to read the "Mensuræ" and the "Additamentum" in the originals. The Dorpat telescope was badly mounted, and the glass was not so perfect as those made nowadays, while the climate is not very suitable for the use of high powers. In winter the stars are often not seen for weeks together, and Σ. frequently observed with the temperature 30° below the freezing point of Fahrenheit's scale. In summer the nights are light.

Of the Chicago refractor I said: "Most of the close pairs were measured by Mr. Burnham with the highest power, 925." From the notes from which I wrote my letter I extract the following: "Burnham 'Memoirs,' Vol. XLVII., Pairs, Class

I. [i.e., 1·00″ and under], about 190. Powers used: I. (190) 0 times; II. (292) 12 times; III. (390) 95 times; IV. (638) 87 times; V. (925) 198 times; not given, 18 times. "Not given" includes such pairs as Σ. 2 (where 292 was certainly not used), &c. Mr. Franks can draw his own conclusions from these figures. I cannot spare the time to go over them again; but I have no doubt that they are substantially correct; however, Mr. Franks no doubt possesses the volume in question, and can see for himself. It would have been better if he had taken the trouble to do so before writing his letter.

The powers, 386 and 540, mentioned by Mr. Franks are, of course, those belonging to the old micrometer of the 5ft. Troughton, and used by Σ. on the 9·6in. from the 19th of November, 1824, to July, 1825. They were scarcely employed after.

August 24. **H. Sadler.**

Σ. 3037 CASSIOPEIÆ—ERRATUM.

[24698.]—THE star mentioned by "H. D." in letter 24670, page 563, was discovered by Mr. Holmes. "H. D." will find notices of it in letters 23167 and 23255. I am not aware of any measures except the rough one in letter 23255. There has been no change in the relative positions of the components of Σ. 3037 since its discovery by Σ. The fourth star is too distant to have been noticed by him, and the triple has seldom been measured.

In letter 24628, page 539, for H. 5122 read H. 5112.

H. Sadler.

61 ANDROM., 1 CYG., 2666 CYG., VEGA.

[24699.]—ONE cannot but be sensible that some of us who have made but small advance in the study of astronomy must at times somewhat strain your courtesy by sending communications which may have but little interest for the generality of your astronomical readers. This, I suppose, in the nature of things, must, more or less, be expected from that class of amateur observers to which your editorial amenity extends, and which I am sure we all duly appreciate.

So then, with this apologetic prelude, I beg leave to make some further queries; trusting, should you insert this, that Mr. Sadler will kindly write a note or two about them when sending one of those valuable contributions which from time to time appear from him.

61 Androm. (7, 11 : 50″ : 355°.)—Your lamented and respected contributor, the late Prebendary Webb, from whom I received much kind help, says in "Cel. Objects," "I failed to see the companion, 1851. (Fr. less, than 11, 1876.)" Variation is not suggested.

The comes for a long time past has been very plain with any power on my 3in. Wray. Would Mr. Sadler or Mr. Gore please inform me of its present magnitude, and whether it is a known variable?

1 Cygni (6½, 9 : 316° : 3·5″).—"Cel. Objects" says: "Franks, two comites, 35″, 40″." These, in good air, are tolerably plain with 120 on 3in.—the *s.p.* one especially so; that *n.f.* is faint. I should feel obliged by some information respecting the magnitudes and distances of these.

Σ. 2666 Cygni (6½, 8½ : 242° : 2·7″).—This has two faint *s.p.* comites, beside the 8½ mag. one, which, I imagine, are sufficiently near that the star might be classified quadruple. The details of these two comites would oblige me.

Vega.—I have suspected a very faint *comes* in the neighbourhood of the well-known *n.f.* one, at P.A. 40°, distance 140″.

Is a small star there, which might be seen with a 3in. ach.? If so, would Mr. Sadler oblige me with its P.A. and distance? **H. Dowsett.**

August 25, 1885.

DOUBLE STARS—36 OPHIUCHI, H. V. 75, H. 5112, &c.

[24700.]—ALLOW me to thank Mr. Numsen (letter 24592) and Mr. Gore for the information they supply respecting 36 Ophiuchi. I have given this pair special attention during the present season, and am very glad to obtain any additional particulars concerning it. When measuring it in June for the purpose of determining the position of the "intermediate" star. I found on three occasions the magnitudes apparently reversed (as given by Webb), although the two stars usually appeared equal in size. Still, I think the question of the variability of the components is one that would well repay a careful examination by any one situated sufficiently far south, as terrestrial radiation seriously interferes with estimates of magnitude in this latitude. I inclose a few particulars of different objects recently observed, which I trust may prove interesting.

T. Coronæ XVh. 54·41m. + 26° 14′. This curious object (the "Blaze" star of 1866), has recently appeared to me remarkably hazy or nebulous, with all powers, rendering it almost impossible to focus. It is also fluctuating in light and apparently larger than the mag. assigned to it in "Celestial Objects." It should be watched for any signs of unsteadiness, as there may possibly be another outburst.

H. V. 75—the place of which for 1885 is XVh. 56·15m. + 26° 28·5′, near T Coronæ, was catalogued by H as a wide double, 8 – 9½, 47·7″, 110·6°. Wallaston, however, says of it, "It is really quadruple, the small star being itself double, and there is a still smaller at about 240° from the small ones." It has been examined several times with all powers, but without success, the small stars (if existing) being beyond the reach of my aperture. Several other stars were also looked up in the neighbourhood, on the supposition that Wollaston's description might apply to some other pair, but without result.

B 464—the red star referred to by Mr. Sadler in his valuable letter (No. 24539), was observed on the 16th ult. It was rated at about 9th mag., and the colour very fine (dull crimson), the faint *comes* at 14·3″ 240° ± forming β 969 was seen with difficulty, and was estimated at about 12 Σ.

There is a remarkable blank space about 10′ in diameter in the Milky Way XVIIIh. 9m. – 18° 20′ about 2m. *p.* and 7′ north of the cluster 24 Messier, Clypeus Sob., mentioned by H. I have only been able to detect two stars in it, one 10th mag. and the other excessively faint; several others were suspected, but these probably do not exist, as I find Prof. Holden observed the space with the 15½in. refractor at Madison, May 2nd, 1881, and only saw two. The stars immediately around it are exceedingly crowded, which makes the vacancy within all the more apparent. It would repay a survey with a really large aperture to detect any change.

H. 5112.—This star, mentioned by Mr. Franks (letter 24594), as "a pretty 8 mag. triplet, 12 not seen," is really quadruple, there being a minute star to the S. forming a triangle with A B C, and converting the figure into a somewhat irregular square. This may be the 12th mag. referred to in the above letter, and in Webb; in which case it would almost seem to be variable, for it was missed at Cincinnati when A B C were measured by Mr. Gore, and by Mr. Burnham with the 6in. refractor, which could hardly have been possible had it been as conspicuous as now. It is, however, much below the 12 mag., and is not a very easy object. H 5112 is easily found, being about 1m. 45s. *f.*, and 10′ ± north of φ′ Sagittarii, and, therefore, in a low-power field with it. It is preceded at 33s. of time by a beautiful little pair (Hour unnumbered) which was estimated at 9 – 9·5, 3″ ± ·90 ± both white.

Hind's Nova, 1848, near η Ophiuchi, was also observed on the 16th, but is not a very interesting object, being at present about the 13 mag., and no very decided colour. Several minute stars were glimpsed in the field (probably some of those referred to in the Harvard observations); but the small star suspected by Schmidt *f.* the Nova was not seen.

There is a pretty quadruple star *n.f.* 53 Ophiuchi, which, so far as I am aware, is not in any double-star catalogue, formed of Arg. + 10°, 3252, and Arg. + 9°, 3434. Each star has a faint *comes* at almost exactly the same distance and mag., and there are two more small stars in the field, the whole group forming a very tolerable miniature of ε and 5 Lyræ, although the two pairs are wider. Its place for 1885 is Arg. + 10°, 3252, XVIIh. 31m. 39s. + 10° 2·5′, and Arg. + 9°, 3434, XVIIh. 31m. 40s. + 9° 57·3′, mags. 9·2 and 9·3. The group is one that suggests the idea of more than mere optical connection.

The full aperture of my 10¼in. Calver has been in use in all the foregoing powers 60 to 320.

Kenneth J. Tarrant.

Letchford House, Pinner, Aug. 24th.

[24701.]—LIVING at this side of the world, I have only just seen Mr. H. Sadler's letter 24166, in which he has made a statement about my work upon southern double stars which is not in accordance with fact.

I can hardly believe that even Mr. Sadler would make such a statement without having reasons for it. If these have been published, perhaps he would be kind enough to tell me where I can see them, or otherwise publish them now, so that I may have the opportunity to reply.

H. C. Russell.

Sydney Observatory, July 17th.

ASTRONOMICAL.

[24702.]—"H. D.," letter 24670, *re* Σ. 3037, will find the 4th star announced in "E. M." of Aug. 22, 1884, and the distance and P.A. given in the No. for Sept. 12. By the way, there was no need to engrave to announce such a discovery.

The rough sketch of 53 Ophuichi on p. 539, of Aug. 21, labours under the serious disadvantage of having too many stars numbered alike, so that it is difficult to refer to it; but either the positions are either very badly laid down, or some obvious stars are omitted. Anyway, the sketch as printed is useless. "Celestial Objects" gives the P.A. of Σ. 1964 as 86°. The angle is now reversed, as the following star is the brighter, and is closely visible in direction of 360° ±.

Is not 11 Aquilæ in motion? I think P.A. has increased, and distance decreased, since the data given in "Webb." **Edwin Holmes.**

EQUATORIAL MOUNTING.

[24703.]—SOME years ago I had an equatorial head without circles made for my 4in. telescope, which is still in use, and which is quite a success in every respect. It has slow motion in right ascension, but not in declination. The slow motion in R. A. is given by a pinion gearing into a wheel of about 8in. diameter; this is always in gear and cannot be taken out except for oiling or repairs. The top of this wheel is flat and smooth, and upon it lies another flat disc of metal, rather smaller than the wheel, and revolving upon the same pin. This disc carries two collars for the declination axis. There is quite sufficient friction between the wheel and the disc to revolve the disc and telescope when slow motion is required, and when requiring to move the telescope through a large angle to find a star, the friction is so small as to be almost imperceptible, but is quite sufficient to retain the telescope in any position. Of course the telescope is counterpoised by a weight in the usual manner. **Ascalon.**

THE CASSEGRAIN.

[24704.]—WILL Dr. Royston-Pigott kindly inform me as to the propriety of the following corrections in his letter No. 2 on p. 672, the figures of which do not seem to agree with the specified particulars of the two telescopes referred to?

In the paragraphs headed "Magnifying Powers," the convex is given as 28½in. focus; but as it is stated to be one-fifth that of the concave, it should apparently be $\frac{129}{5} = 25{\cdot}8$in.

Substituting 25·8 for 28·5 in the equation, the magnifying power M would work out about 160 instead of 175. On the other hand, if 28½ is correct, the division 4·9 must be wrong, as that would only be true if $f = \frac{F}{f}$, which it would not be if $f = 28\frac{1}{2}$.

In the centre column, second line, the focus of the convex of the Melbourne Cassegrain is given as 74·71, and from this the value of $x = 14{\cdot}5$ is obtained; but in the paragraph beginning "The Melbourne telescope's concave mirror, &c.," the convex focus is said to be 71·74in., and this latter value is used in determining the magnifying power. By substituting 74·71 for 71·74, M would come out 247·75, instead of 237·9, and thus give a result somewhat less accordant with the value 240 assigned at Melbourne.

The formula for x is in one instance printed so that the sign of the square root includes the quantity $\frac{F}{2}$ which it should not do.

In the third column, the sentence "The small convex being 20·9 outside or beyond the convex," should apparently read, "The small convex being 20·9 *within* the focus of the concave." This would, as Dr. R. P. says, give a small margin (about $\frac{1}{18}$in.) all round on a convex of $3\frac{1}{16}$in. diameter.

Further down, in the same column, 28½ again appears instead of 25·8.

It shows the enormous power of these compound telescopes, that an equivalent Newtonian would have to have a focal length of 166ft. to match the Melbourne Cassegrain. **A. S. L.**

HYDRAULIC RAMS.

[24705.]—IN No. 1060 of the "E. M." I sent a query on the subject of Hydraulic Rams, asking various questions as to what rule governed the weight of the beat valves, and how the best weight was calculated when the height of fall and diameter of inlet pipe are known. Also how the size of inlet pipe should be calculated, and what proportion it should bear to the delivery and length of fall. To this query, a gentleman evidently possessed of the information, kindly replied; but he was afraid of occupying too much space in answering it, so referred me to Morin's book in French, stating at the same time that no English book yet published gave the information. Now, sir, I unfortunately am not a sufficiently good French scholar to be able to read the book with any benefit, so that the one source open is denied to me, unless you are willing to afford the required space in your much-valued paper, to this gentleman and others who have studied these machines. I am, like many other of your subscribers (as is shown by the numerous queries that have appeared lately), much interested in this subject, and it is a subject that may well find a place in a paper such as "Ours," seeing the valuable qualities of the machine and the general ignorance that seems to envelop it.

There are a few firms in England who make hydraulic rams, but I believe even the information they possess themselves is incomplete, and on this point I can write with some authority. The Americans are also manufacturers; but I believe, as a rule, their machines do not give satisfaction. The reason for these failures is, I believe, that makers stick to rule-of-thumb too much, and do not treat each case as a distinct problem, working out the weight of the valves, diameters and lengths of pipes on some sound scientific basis. You will find these makers give lists in their catalogues giving sizes of pipes, &c., for the various rams they make, regardless of the special conditions of any particular case. For example, in a catalogue now before me a certain ram is said to be suitable for a supply of from 20 gallons to 40 gallons per minute, with an inlet 25 to 50ft. long, and discharge any length that may be desired; inlet to be 2¾in. diam., and discharge 1½in.; and another, suitable for 25 to 50 gallons, with pipes 4in. and 2in. respectively. Thus, supposing you have a supply, say, of 35 gallons per minute, how are you to tell which ram is the better of the two, and whether the pipes are to be 2¾in. and 1½in., or 4in. and 2in.? Of course, the makers would recommend the larger size (as they have invariably done in cases that have come under my notice); but this is obviously because they are the most expensive, and is, to say the least, unsatisfactory to an intelligent inquirer. Again, they will tell you that a ram will deliver one-seventh of the water supplied when the elevation to which it is delivered does not exceed five times the fall; one-fourteenth for ten times, and so on, regardless of length and diameters of pipes, and all other special conditions. This must obviously be incorrect, as friction would retard delivery in proportion to the length of discharge pipe, to say nothing of diameter. As a matter of fact, the makers prepare certain patterns and make lists to correspond, and then, on receiving an inquiry, apply the nearest they have to suit the case. This being so, is it to be wondered at that one constantly hears of rams failing? The apparatus gets into bad repute, and people won't have them at any price. If, on the other hand, the rules that govern the parts were better understood, this would not be the case, and the hydraulic ram would undoubtedly have a larger and much extended range of usefulness.

If you would, therefore, open your columns to a discussion on this subject, or give us some articles upon it, you would, I feel sure, be doing that which would merit the thanks of other subscribers besides myself. May I ask you to insert this letter in your correspondence department, to see if "W. A. S." and others would take the matter up?

Aug. 21. **F. A. R.**

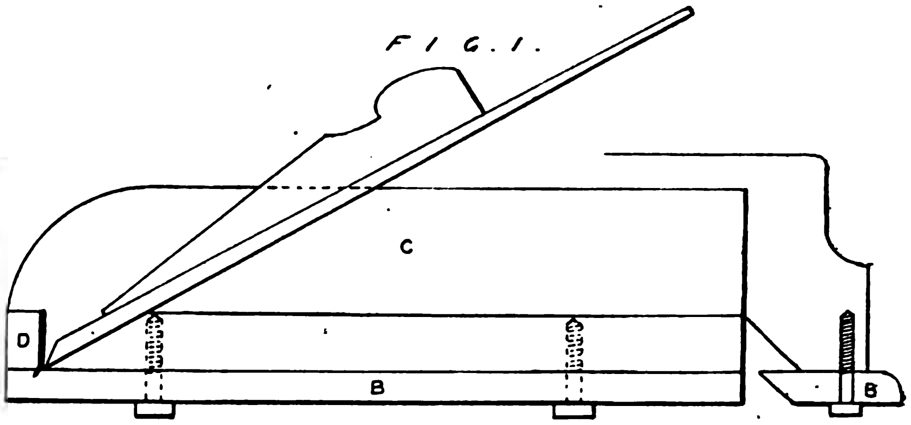
NEW FIRE-ALARM.

[24706.]—I HAVE noticed the letter by Mr. Rothnie in the issue of Aug. 14th (24622, p. 522), in which he says that he invented "exactly the same" fire-alarm as illustrated Aug. 7, p. 495, and patented an improved form of it in 1870. In that year Mr. Rothnie left a provisional specification at the Patent Office, which has the endorsement, "This invention received provisional protection only," and it is headed "Thermometers." There is no illustration attached; but in the description it says—"The improvements may be performed by using a tube of glass in a flattened coil-shape giving four layers or more or less," "part thereof filled with spirit"; "mercury is inserted on the top of the spirit." "The coil is balanced on an axis"; "when the spirit is affected by the temperature the mercury is moved, and the balance is altered." Now, Mr. Pritchett's invention consists of one main tube of glass, preferably filled with air, which, expanding with heat, drives mercury from one upright cylinder at one end of a small tube into a corresponding cylinder at the other end of the fire-alarm, as is plainly seen by your illustration of Aug. 7. The whole construction of Mr. Pritchett's fire-alarm is *very different* to Mr. Rothnie's spirit thermometer, which was brought out 15 years ago, and which Mr. Pritchett had never seen or even heard of. Mr. Rothnie's damaging statement that he *invented exactly the same* as Mr. Pritchett is contrary to fact. (See *Gardeners' Chronicle*, November 5, 1870, and *Gardeners' Magazine*, November 26, 1870.) He remarks that one of the papers containing a fine account of his spirit thermometer removed the words "Rothnie's Patent." This paper had a wholesome regard for truth. I don't know if it is illegal (I almost think it is) to affix labels on articles with "Patent" on them when they are not patented; but certainly it must be against the law of equity to do so. I leave the public to form their own judgment on this matter, and feel quite safe in their hands. Mr. Pritchett's fire-alarm can be seen any day at Messrs. J. T. Mayfield & Co., 41, Queen Victoria-street, E.C., and in action at their show rooms, 35A, Queen Victoria-street, London.

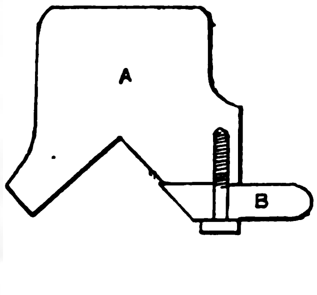
G. E. Pritchett, F.S.A., F.R.I.B.A.

20, Spring-gardens, S.W., August 24.

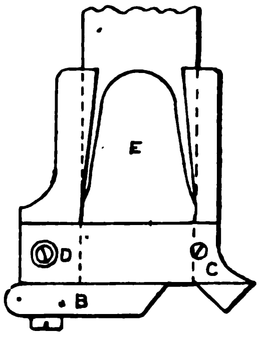
F I G. 1.



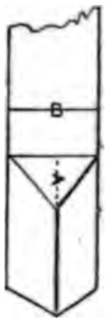
F I G. 2.



F I G. 3.



F I G. 4



A HANDY STOP-CHAMFER PLANE.

[24707.]—THINKING it would be interesting to many of your readers, I have sent the drawings of a stop chamfer plane, which has a great advantage over all others, inasmuch that it will cut the stop without the use of a chisel. It will chamfer, finish the stop, and angle perfectly clean, straight, and smooth, better and much quicker than it is possible to do in the usual way. I have sent the drawings, half-size, of the plane I use myself, and I find it answers very well indeed for all class of work. It will work, stop, and chamfer from ⅜in. (see Section E, Fig. 3) to 1⅜in. (see Section A, Fig. 2). Now, one word concerning the pitch of the iron (see Section C, Fig. 1). The pitch here given will bring the length of stop A, Fig. 4, equal to width of chamfer B, the same with any width chamfer that the plane may be set at.

To set the stop for a given chamfer, remove the point of B, Fig. 3, the required distance from C, Fig. 3, and screw it fast: it will then be ready for work.

I have made frames with 96 stops in less than three hours with this plane—about one-fourth of the time it would take in the usual way.

Fig. 1 shows the longitudinal section through centre. D is a piece of iron to form the bed of the plane and also the mouth. F 2 is section of back-end, B showing the movable stop. Fig. 3 shows section of front end with iron and wedge. Fig. 4 shows chamfer and stop. **J. L. C.**

ARTIFICIAL HONEY.

[24708.]—I SEE in the last issue a paragraph with the above heading stating that "one of the latest American novelties is artificial honey," &c. This is an error. It has the appearance, but not taste or aroma, of honey. It has been on the English market for two or three years, and the British public have been purchasing it, eating it and grumbling at English beekeepers asking such a high price for genuine English honey, when it could be brought from America and sold here so much cheaper—not knowing that glucose or the sweet extract of maize can be sold to a profit at about 3d. per pound, even when it is imported from the land of "wooden nutmegs." The British Beekeepers' Association have been cautioning the public for two years at least against this so-called honey, and have gone to the expense and trouble of having 20 or 30 samples of this stuff under its various names bought and analysed, the result of which appeared in one of the issues of the *British Bee Journal*, and if you care to read it, I will look it up and give you number and pages. Several prosecutions have been entered, and the vendors have in some cases escaped, and in some have been fined under the Foods and Drugs Act. There has recently been a British Honey Company formed, which is now in operation, whose objects are to bring producers and purchasers more together, to supply a pure reliable article, and so drive these pleasant but spurious decoctions out of our markets.

J. I. S.

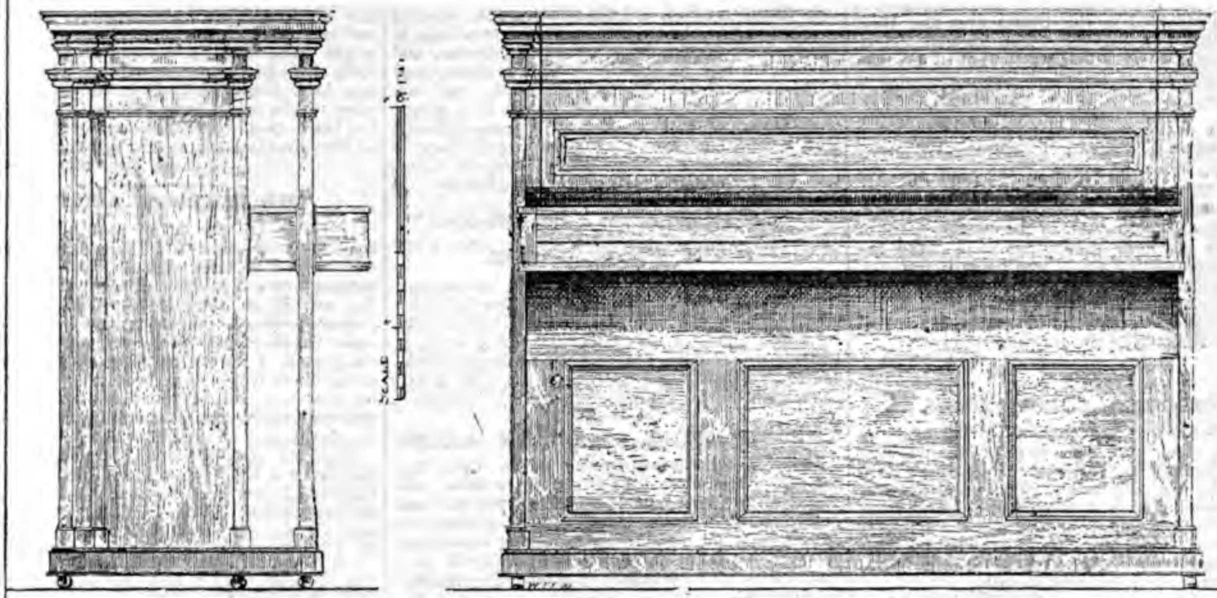
PIANOS AND THEIR SHAPE.

[24709.]—I HAVE wondered that no response has been made to "Kappa's" letter (24484, p. 340). I quite agree with all he says, and with the view of eliciting some comments from Mr. W. H. Davies I ask you to reproduce the inclosed illustration of the piano "Kappa" describes as having seen at the Inventions, which is taken from the *Building News* (see opposite page). The editor of that journal, in describing the piano and the other furniture of the Music Room at the Inventions, says:—"This is a new departure altogether from the general idea of a piano (at all times a difficult piece of furniture to design), and we think with an amount of originality about it which deserves special remark. The back of the piano is treated, therefore, in a decorative and architectural manner with a series of pilasters, between which are perforated panels. The end is treated so as to get away from the conventional shape, and this is enhanced by providing a pilaster with moulded capping, and thus forming a convenient recess for a lamp. The music cabinet is very good in proportion and detail, and provides a cleverly-contrived receptacle for loose music, and a place for bound books; the panels are walnut, and contrast well with the mahogany. The table calls for no special remark, except that the mouldings are good and the curves are good, and it is strong and well made. The chair we cannot say as much for; the back appears out of all proportion to the rest of the work, and the heavy cornice at the top is quite unnecessary, and is liable to injure the paper on the walls, and also people's heads if care is not taken. The whole room is one of the nicest that has been exhibited either in the Healtheries or in the present exhibition." I have inquired, and I find the price of the piano is £130. I dare say it is worth the money, though I hardly see where it has been spent; but I re-echo "Kappa's" inquiry, Cannot Mr. Davies, or some of the other makers of good cheap pianos who favour us with their ideas in these columns, make us a piano on a model of this kind at a low price, discarding all needless ornament?

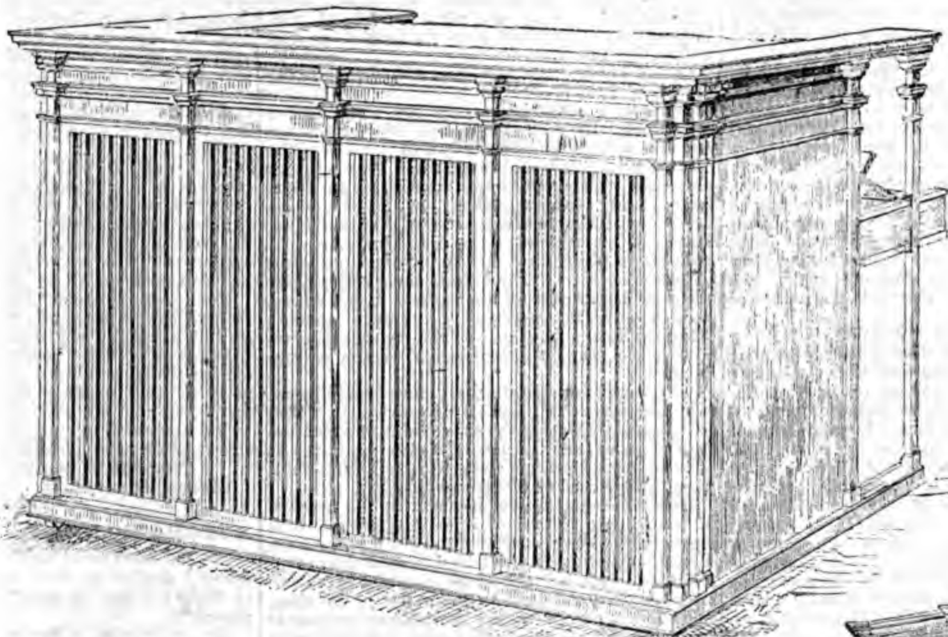
Vivian Treleaven.

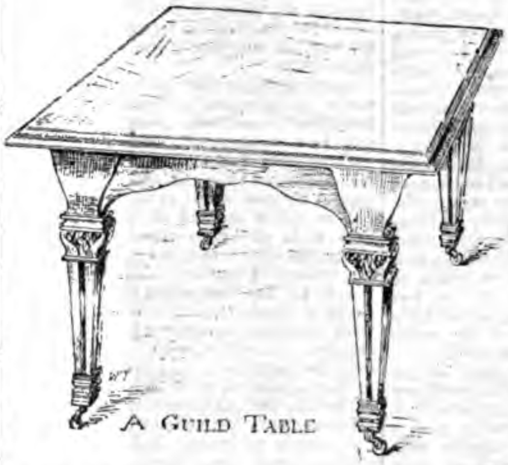
MIDLAND ENGINES.

[24710.]—I DON'T think "Shylock" has improved his position by the letter which appeared on p. 566. There may have been some delay about the times indicated, but I know that the traffic has not been blocked "for the rest of the evening" (p. 541). The only occasion within the last six months on which I have been "inconvenienced" (save the mark!) was when there was the smash at King's Cross, and even then the Midland Company had a train which suited me very well, ready at St. Pancras. So far, then, "Shylock" must be mistaken about the traffic being blocked, and as to the engines referred to, they are about as good as they make them nowadays, and are scarcely likely to have broken down as suggested. If so, the pieces were soon cleared away. **Nun. Dor.**



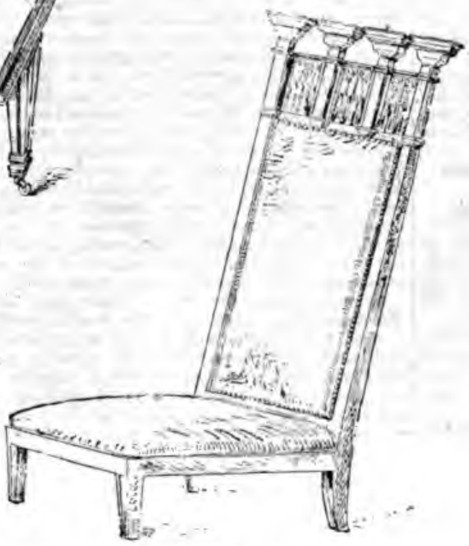
A ·· Mahogany · · Piano



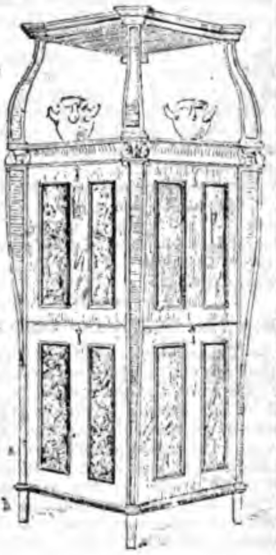


A Guild Table

A·Music Room
By The·Century·Guild
At The·Inventions·Exhn



A·Guild·Chair



A Music Cabinet

RAILWAY SPEEDS.

[24711.]—I would like to call the attention of our readers to some remarkable speeds reported to have been attained in the States over the West Shore Railroad on July 9th. The *Scientific American* of Aug. 1st gives full particulars of the trip, which briefly are as follows:—Train consisted of engine, tender, and three cars—total weight [illegible]. Total heating surface of boiler, 1,212 sq. ft.; cylinders, 17in. by 24in.; drivers [illegible] 5ft. 8in. The run was from East Buffalo Junction to the New York terminus of the road, and the distance, [illegible] miles, was covered in the average running time of [illegible] miles per hour; [illegible] miles of the distance were done at the average speed of [illegible] miles per hour (excluding stops), and the fastest speed attained was [illegible] miles in [illegible] minutes, i.e. [illegible] miles an hour (!), while the last [illegible] miles was run at an average rate of [illegible] an hour (!!).

Have any of our friends on this side received reliable particulars of the above running?

A. F. H.

COMPOUND LOCOMOTIVES.

[24712.]—On no less than three occasions at least have compounds come to grief on Shap Fell. From the summit to Tebay the line falls 1 in 75 most of the way—5 miles. The particulars of one of these mishaps I have never learnt; but Thunderer is said to have blown out the end of a high pressure cylinder, and Mammoth to have smashed up its valve gear. The accident to Mammoth occurred comparatively recently.

I have previously expressed a disbelief in the possibility of a compound keeping time to Rugby with the [illegible]. A friend informs me that compounds have taken this train; they usually lost four or five minutes, but on one occasion only dropped a minute. I must take a run to Rugby shortly with the [illegible] to see for myself.

That back-pressure is really the cause, or at any rate one of the causes, of the limited speed attainable by compounds, would seem to be clear from a remark I once heard a driver make. He said that in descending the 1 in 70 gradient from Camden into Euston, with steam off, his compound had a tendency to run faster than any engine he had ever had; but with steam on, in ordinary running, he could do nothing with her. The big compounds on the Preston-Carlisle section ought to do fairly well, for they can climb steep banks better than the Precedents; whilst the descents might, to a great extent, be made with steam off, the gradients being so severe.

I am glad to see from "Adiabatic's" letter (24642, p. 542) that he is disposed to defend the compounds from the assaults of their enemies; but with some forty built and ten or more building, it is too late in the day to claim for the compounds privilege from criticism, as for engines in an undeveloped stage. A compound, if it does not save coal, is nothing. Even if the N.W. express compounds did economise, it would still be a question whether their defects in other directions did not disqualify them. I contend (1) that small compounds, when working express traffic, burn as much as Precedents, if not more; (2) that big compounds, in similar circumstances, do likewise; (3) that the reason Crewe compounds burn less than London compounds lies in the fact that they receive more attention than Precedents; (4) that the speed of both small and big compounds, especially the small, is considerably inferior to the Precedents, and is *a fortiori* inferior to the best G. N. and Mid. engines; (5) that repairs generally are heavier; (6) that more oil is used; and, lastly, in consequence of the foregoing, that the cost of working is greater.

I hope these contentions are specific enough, and that "Adiabatic" (or anyone else who disagrees with me) will reply, giving reasons and figures also, where possible, that we may be able to see both sides of the case.

August 31. **Kappa.**

G.E.R. COMPOUND LOCOMOTIVES.

[24713.]—These engines do not run freely at all; but they are not troubled with excessive back-pressure. Their coal consumption is rather less than that of Mr. Bromley's single expresses, but the compounds use more oil than the "singles."

Going round the curves at Stratford and Stepney, the noise the new engines make is sometimes worse than the noise made by the so-called "bone-shakers," but I think the compounds run more easily round the above-mentioned curves.

On Saturday, July 11th, I went to Colchester by the 4.5 p.m. express from Liverpool-street. The train consisted of eighteen coaches and a truck, and it was drawn by one of Mr. Bromley's single expresses. The distance is 45 miles, and it was done in ten minutes under the hour, usually taken by the drivers (the schedule time is 65 minutes). This gives an average speed of 54 miles an hour; but on the level beyond Chelmsford it reached the pace of 62 miles per hour for three miles.

On Tuesday, the 21st of July, I had occasion to go again to Colchester by the 4.5 express, drawn this time by the compound No. 230. There were only fifteen coaches, and the rails were in splendid condition; but the train was 10 minutes late at Chelmsford, 15 minutes late at Colchester, and 23 minutes late at Ipswich. The average speed to Colchester was [illegible] miles per hour, and the greatest 52 miles per hour. I think this proves the superior merits of the "bone-shakers." The compounds are very showy, and have a neater appearance than Mr. Bromley's; but the old proverb, "Appearances are deceitful," is fully proved in their case.

A Friend of the "Bone-Shakers."

G.W.R. BROAD GAUGE.

[24714.]—My friend, Mr. M'Muir, having gone to the Continent, has only left the few following particulars of the new engine:—Cylinders, 18in. by [illegible]in.; diam. of driving-wheels, 7ft.; diam. of trailing-wheels, 4ft. 6in.; diam. of bogie-wheels, 4ft. [illegible]in.; capacity of tender for water, [illegible] galls.; capacity of tender for coal, [illegible] tons. **Tyrol.**

THE BREAKING OF CRANK AXLES.

[24715.]—Since my former letters upon this subject, pages [illegible] were written, the Board of Trade returns of accidents for the past half-year have been published, from which it appears that, during six months ending 30th June, 1885, 86 crank or driving axles failed; 66 were made of iron, 20 were made of steel. The average mileage of—

66 iron axles = [illegible] miles.
20 steel axles = [illegible] miles.

These figures again prove, as upon former occasions, that there are more failures of iron, but yet they run a much higher mileage than steel before the failure occurs.

Out of 13,483 crank axles in use during the year 1883 (see list, p. [illegible], &c.), 70 were broken in running with passenger trains, 108 were broken in running with goods trains, and 680 were taken out in the shops defective. Out of 1,365 straight driving axles, 10 were broken when running with passenger trains, 19 when running with goods trains, and 24 were taken out in the shops defective. Therefore, of a total of 14,848 driving axles, 80 broke with passenger trains, 127 with goods trains, and 704 were taken out after detection of flaws. These facts show very plainly the great importance of the subject under notice, and, to quote the words of the general report: "No less than 1 in every 16 driving axles in use during the year 1883 were either broken or condemned."

At present, perhaps the most important information necessary is full details of every axle which fails, specially stating the exact point at which the failure occurs, and the nature of the fracture. It is to be hoped that this data will in future form part of the Board of Trade returns.

Reference should here be made to the practice of continuing the use of a crank-axle after it is suspected, or has even shown a slight flaw. At the Penistone inquiry it was given in evidence that if a flaw was detected the crank and pair of wheels were scotched and fixed to the rails in the shop, and another pair of wheels run against the pair to be tested, and if they stood that test they were considered all right. The writer has known many suspected cranks break when working fast trains, and at the present moment he knows of several "doubtful" ones which may be the cause of a disaster any minute. Major Marindin, in his report, stated: "It is manifest that the more frequently cranks are examined thoroughly, the greater probability there will be that growing flaws will be detected;" he therefore recommended that the big-ends should be taken down at the weekly examinations, instead of only monthly, as at present; and as regards the Manchester, Sheffield, and Lincolnshire Railway Company in particular, he observed that there must be considerable and unjustifiable risk in running a suspected axle under observation, when an apparent flaw has not been extended by the test to which it has been subjected, which, according to the evidence of the superintendent of the works at Gorton, is the present practice upon this line."

In conclusion, the writer trusts that Major Marindin's suggestion as to the careful consideration of the subject, will receive every attention, and that, as a practical result, a more perfect crank-axle will be employed, which, together with the universal adoption of a quickly-acting automatic continuous brake, will render the recurrence of such a terrible disaster as that which occurred at Penistone impossible.

Clement E. Stretton.
Hon. Mem., A.S.Ry.S.
Coalville, Aug. 31.

BRAKE EFFICIENCY.

[24716.]—Having seen no mention of the following in "Ours," I send these particulars. On Monday night, 17th inst., an accident occurred near Brampton, on the Great Eastern Railway. The rear carriages of an excursion train broke loose, the Westinghouse brake instantly applied itself and stopped both portions, thus preventing what might have been a serious accident. Without such a brake the carriages would certainly have run back down the incline, and no one can tell what results might have followed. The action of the brake in this instance, and of the "leak-off" at Swadlincote, form a striking contrast.

A Railway Traveller.

THE BINEGAR ACCIDENT.

[24717.]—In my letter, page 542, I gave the details of this case, and I am sure your readers will be glad to know that in consequence of the steps afterwards taken, and the publicity given to the matter in the ENGLISH MECHANIC and railway journals, the unfortunate signalman has, since Tuesday last, 25th, been employed by the company as a porter, pending his trial for manslaughter in November. It is unnecessary to point out that total loss of work and wages for three months must have meant nothing short of ruin to the signalman and his family.

Since my letter appeared pointing out that the accident was due to rule 149 a having been disregarded, it has been argued that the signalman was responsible. Now, to clearly show the facts, and to remove any such misunderstanding, I quote the following rule:—

"No. 144. During the erection or removal of signals, or the prosecution of other work in connection with points or signals which may interfere with the safe working of the line, the foreman signal-fitter who has charge of the work must, unless the work has been previously arranged for between the signalling and the traffic department, and the necessary notice issued by the general manager or superintendent of the line, communicate with the traffic inspector, who will make any special arrangements that may be necessary in connection with the working of the traffic during the time such alterations or repairs are being effected."

In accordance with the wish expressed at the meeting of the Amalgamated Society of Railway Servants, recorded p. [illegible], last week, I have visited the scene of the accident; and the more I examine the facts of the case, the more strongly does it appear that the committal of the signalman for manslaughter was a very great injustice.

Your correspondent "Signalman" asks if "your readers can explain why they did not have a man at the points as required by Rule 149 a?" The question is a very important one; but I am of opinion that it had better not be answered through your columns pending the trial. But "Signalman" may rest assured that the question *will* have to be answered by the traffic superintendent in course of his cross-examination at the assizes.

Clement E. Stretton, C.E., of Leicester.
Binegar, Somerset.

AUTOMATIC MUSICAL INSTRUMENTS.

[24718.]—To avoid unduly lengthening my last letter, I omitted to refer to two or three items in G. Fryer's letter, on page 365, so will deal with them now.

My impression is strong that G. F.'s original promise was given in reply to a correspondent who asked for details of an "Organette," and I do not see that the compass of the instrument affects the name of it.

Quite agreeing that the "Organina" with levers beats similar-sized instruments without them, I hope the 31-reed instrument (whatever it is called) may be so constructed. The "Organina" was the variety that I described and illustrated in the "E. M." some time ago, and G. F. has practically quoted my own words in his commendation of it.

I am rather amused at G. F.'s assertion that: "'A. S. L.' does not seem to have properly studied the mechanical arrangements of the various classes of automatic musical instruments." Anyhow, "A. S. L." has just jotted down the names of [illegible] *varieties* (exclusive of his own experimental ones) with the construction of which he is more or less familiar, and which, with four exceptions, he has examined and tried. As the series ranges from the earliest specimen, made in 1848, to the latest exhibited in 1885, the assertion made by his would-be critic seems rather wide of the mark.

I cannot, of course, tell whether G. F.'s inability to understand the preparation of the paper bands arises from the cause he names, or from others that may suggest themselves; but, perhaps, his difficulty may be removed by his looking at it in the following way:—

As there are 32 demisemiquavers in a semibreve, let the perforation for a demisemiquaver be $\frac{1}{32}$ of an inch in length, then a semiquaver will be $\frac{2}{32}$, or $\frac{1}{16}$in., a quaver will be $\frac{4}{32}$, or $\frac{1}{8}$in., a crotchet will be $\frac{8}{32}$, or $\frac{1}{4}$in., a minim will be $\frac{16}{32}$, or $\frac{1}{2}$in., and a semibreve will be $\frac{32}{32}$, or 1in.; while dotted notes will in each case be half as long again.

As all whole bars in a tune are of the same length, it is only necessary to subdivide every bar according to the number of similar (or equivalent) notes contained in such bar, and thus obtain the sizes of the perforations according to the scale of lengths decided on—whether that just given as an illustration, or any other that may be preferred.

The actual number of subdivisions in each bar will evidently depend on what time the air is in—common time, or otherwise. If G. Fryer has himself got an "organina," I will, if he likes, send him part of a tuneband with the divisions marked on it, so that he may compare them with the actual notes of the score, as well as with the air as played.

The compositor has made me indulge in rather peculiar English in my own letter just preceding that of G. Fryer, though the sense is tolerably evident. "I do not propose," however, should have been, "I do not profess": and "nor did I think," was intended to be, "nor do I think." I fear bad writing is at the bottom of it all!

A. S. L.

AUTOMATIC MUSICAL INSTRUMENTS.

[24719.]—"A. S. L.," in his first question, letter 24695, mentions $\frac{3}{4}$in. as the distance the keys of a piano are required to be depressed. This is something awful. Such an instrument must be quite out of date. In four pianos that I have recently had in my house, the limit of the depression at the extremity of the black keys has been only $\frac{3}{10}$in., and the descent of the white keys in the same line is only $\frac{1}{4}$in., being $\frac{1}{20}$in. less; therefore the plungers for the white keys are made barely $\frac{1}{20}$th shorter than the extra length required from the black to the white keys. In this case, when the vibrating or finger bar is at the bottom of the stroke, all the keys will be fully depressed, and the notes equally sounded. The edge of the vibrating bar that catches the plungers may have a range given to it of $\frac{3}{4}$in. more or less, quite irrespective of the stroke of the keys, and this bar being moved by a crank action, is stationary for a while on the bottom centre, which pause is favourable for the music. In reply to question 2nd, the space represented by the length of each note is equal to a *semidemi-semiquaver*—that is, the shortest interval required in music. This also represents the time of a single stroke of the vibrating bar; consequently if a number of these notes have to be repeated in succession, which sometimes occurs in music, producing a kind of tremolo effect, the holes in the paper, from their proximity, just cut one into the other, and consequently the plunger is not withdrawn from under the bar during the continuance of the notes. In double this time, or for demisemiquavers, there is a septum between the notes, which are each repeated by the withdrawal of the plunger from under the vibrating bar.

I have found the continuous cartridge paper amply strong enough to work the notes, but it does not hinge well, or is apt to crack in the folds. I am now using "Manilla web paper," which is very tough and fibrous, and is one-third the price of the cartridge. After long use the keys do not even mark the edges of the holes in the music band. There is no trouble from the inertia of the two bell-cranks, and the pulling and pushing wires, as the longest set to the end keys weigh together less than two drachms, and the shortest lot only half a drachm; and as the music sheet creeps through the machine at the rate of only 5ft. per minute, the lever ends are depressed too slowly to cause anything like a blow. Of course they spring up into the holes smartly when clear of the paper, but are carried down again gradually.

F. H. Wenham.

NEW OPTICAL GLASS.

[24720.]—EVER ready to assist with lucid theory and sound practical instruction, "Orderic Vital," on page 519, calls our attention to what he thinks a new optical glass, and desires others to supplement his information. If I might add my mite, I would say that this glass is not of very recent invention, for I have supplied it to leading London prism makers for years. It makes excellent prisms for small direct-vision spectroscopes: in such instruments many of your readers are no doubt acquainted with it. I have been told by more than one scientific man that, along with the usual ingredients of flint glass it contains zinc, but have not seen the statement in print yet. If it is not identical with what is known as Faraday's flint it may be a slight modification of it. Faraday's flint is composed of lead oxide, silicic and boracic acids, and has a density of 5·44, whilst Frauenhofer's has only a density of 3·77. There are several varieties of flint, and the densities vary greatly. With the same ingredients and the same proportions it is scarcely possible to produce a glass twice exactly alike. Hence for best work the curves have to be specially prepared for a certain cast of glass, and even then they are not certain to suit the top and bottom metal, or first and last pourings alike, which we can easily understand when we consider the different densities of the ingredients, the difficulty of keeping the temperature even throughout the process, of avoiding draughts and other influences that affect the crystallisation of the mass. We have as yet little control over the mighty forces that regulate molecular arrangements.

"Orderic Vital" may think himself favoured to obtain a specimen of this glass direct from Feil. My own, and the inquiries of several other intending purchasers remained unnoticed, though accompanied by golden promises. Such large firms, as a rule, do not care to retail to amateurs, and are chary of information.

A. Caplatzi.

THE SOARING BIRD—A MECHANICAL PROBLEM.

[24721.]—OH, those textbooks—(i.e., a certain class), they have much to answer for, as is shown by the curious ideas set forth in a portion of a letter under this head and over the signature of "A., Liverpool." This gentleman writes, more in sorrow than anger, of the obtuseness of "our savants," in suffering the "universal and ceaseless production of electricity," by friction, to go on without "endeavouring to turn this feature of the electric problem to the advantage of mankind." Alas, that miserable law of the conservation of energy asserts itself, and decrees that nothing, however much "to the advantage of mankind," that does not harmonise with it, can be.

It seems that persons interesting themselves in methods of flight are somewhat liable to overlook this, for Mr. I. Lancaster starts with the proposition "that a body can do work by falling without losing its energy of position," and from this continues, logically enough, that given the reliability of the Newtonian laws of motion and the mathematical accuracy of certain "writers," then the "possibility of a device enabling gravity to become a continuous motive power is established." Lucid if not sapient.

B. B.

LAYING OUT SHEET IRON AND BOILER WORK.

[24722.]—I AM very much pleased to see this subject started in the "E. M." I have been a constant reader for fifteen years, and many an hour have I spent reading my friend, as I call it.

And now, in the days of high-pressure, and everything done by science, I often look for a good sound series of articles on boiler-making, something similar to what we had on plumbing from our friend, Mr. Davies. Not one of those run-over articles, but a good practical one. I am sure a number of our readers will be glad if anyone will take it up.

We are never without articles on telescopes, and microscopes, dynamos, musical instruments—all very good; but I am sure there are a number of men who will welcome a series of articles on laying out sheet-iron and boiler work. I shall be happy to render a little help.

M. B. M.

WATCHMAKERS' QUERIES.

[24723.]—SEEING letter No. 24655 headed "Watchmaker's Queries," by J. Brierly, I wish to say I think "Carribbean" is right in his answer; so is "Peganredstuff."

First, to calculate the vibrations of a balance. Multiply together the numbers of the teeth of wheels, commencing with centre wheel (as that makes one rev. in the hour), but exclude 'scape wheel; then multiply leaves of pinions, commencing with one that engages with centre wheel. Divide first product by second, which gives number of revolutions of 'scape wheel in one hour. Multiply this figure by twice the number of teeth in 'scape wheel, and you get the number of single vibrations performed in one hour. Isn't that simple?

Secondly, if a watch does come in for repair with a quick spring in, say balance vibrating at 20, 200, as J. Brierly suggests, "Peganredstuff's" rule holds good: because Mr. B. can listen to the vibrations while he has his eye on the regulator, and find out precisely how quick the spring is; for instance, 4 per second, or 240 per minute, means a train of 14,400 to the hour; $4\frac{1}{2}$ per second, or 270 per minute, means 16,200 per hour; 5 per second, or 150 per half-minute, means 18,000—a train usually met with in Swiss work, and so on; a little practice will soon get Mr. B. over the difficulty.

I am only one year out of my apprenticeship, and don't pretend to know much; but any springing jobs I have done have been by the above rule.

I was for a few months in Liverpool, and when I required a spring I had only to tell the material dealer how many teeth in fourth wheel, and number of 'scape pinion, and bring regulator with me so as to give him diameter, and I always got the spring I wanted.

Thirdly—Springing verge. Lay spring on, press collet after it; place verge in its place, without the cock; if spring is too large, one, two, three, or four coils will go beyond stud or curb pins. Say four coils go over; then you see that your spring is four coils too big; but you need not break these off. Take out verge, lay it on bench, catch fourth coil with spring-tongs, lift verge until cock-pivot just rests on bench; then set balance vibrating and count. You will soon be able to tell at a glance whether spring is too weak or too strong.

The above applies to lever and Swiss; from jewel hole to spring stud is always the radius of balance spring. Duplex and chronometer springing is different; but if Mr. B. requires any assistance on the latter, I shall be happy to forward it.

Annie.

PHOSPHORESCENCE OF THE SEA.

[24724.]—NOT having seen the "E. M." for some weeks, I do not know the exact terms of the question responded to by "A Fellow of the R.A.S." in the third paragraph of his letter on page 562. This gentleman contributes so much valuable information to readers of the "E. M." that when he asks a question I feel bound to answer it, if I can. His inquiry is: Why should this (i.e., the so-called phosphorescence of *Noctiluca miliaris*) not be visible in smooth water?

I reply, because this luminosity is due to something in the nature of an electrical discharge, which is reserved by the little animals for defensive purposes. The flashes of light occur simultaneously with correspondingly feeble shocks, which no doubt affect other marine inverterbrates of small size unpleasantly, if not injuriously.

When merely drifting or swimming in smooth water there is no need to expend vital energy in causing the phenomenon, and therefore no luminosity is seen; but let the water be agitated in any way, the little creatures are at once irritated, and promptly resent the disturbance by a discharge. This having been done once or twice, cannot be repeated by the same organisms until they have had time (say 15 to 20 minutes) in which to recover strength. *Noctiluca* often occurs at the surface of the sea in such abundance in favourable weather that the flashings appear to be well-nigh continuous as long as the cause of irritation exists.

Of course, a ship in motion will constantly encounter and alarm different and vigorous individuals, and thus the duration of the beautiful spectacle is prolonged. I have seen them so numerous about here as to form a pinkish scum by their aggregation. Being about the size of a small pin's head, they can be seen at any time in summer by dipping a clear glass bottle in the sea, and then holding it between the eye and a source of light.

When troubled with wakefulness at night, I once found benefit by having a jar of water containing them at my bedside and studying their habits in the dark.

On disturbing them with a finger, the flash was seen at the same instant that the little shock was distinctly felt. Agitation directly repeated produced a very feeble result, and the third time none at all. After the lapse of a sufficient interval, the same phenomena could be reproduced.

In the jar were some small crustaceans, whose movements I could easily follow by observing the luminous track caused by the flashing of the individual Noctilucæ that happened to be disturbed.

In sending this brief and hurriedly-written note, I take the opportunity of expressing my strong desire that zoological subjects should oftener obtain notice in these columns.

Sheerness-on-Sea. **W. H. Shrubsole.**

COTTON-SEED OIL AS A FOOD.

[24725.]—MUCH of the so-called salad oil and olive oil sold in this country is really refined cotton-seed oil, and it is well known that large quantities of the latter are imported into Italy, it is stated for the purposes of adulteration. The following, then, may interest your readers, some of whom may prefer to have the article at its commercial instead of a fancy price.

Mrs. J. P. Walker, of Bay St. Louis, Miss., in the *Sugar Bowl*, says:—

"I have been using cotton-seed oil for more than ten years. In view of this long experience, I think I am fully prepared to pass judgment upon its merits, and I unhesitatingly say that I regard it as far superior to lard for culinary purposes. When properly used it is imperceptible to the taste, except perhaps in the case of biscuits which are to be eaten cold for lunch; in that case lard or butter is preferable, but for everything which is to be eaten immediately, the oil cannot be detected. For frying fish and oysters it is less liable to burn than lard, and a much larger quantity can be used without waste or extravagance, as what is left can always be strained into a jar and kept for repeated use, with the addition of more as needed. It does not become stale or rancid, and does not retain the odour of fish. For frying fish or fritter or baking waffles and batter cake, it should be kept hot on the stove in a suitable vessel or they will absorb too much of the raw cold oil. For corn bread I add it hot the last thing; this makes the nicest egg bread without eggs. For waffles made with cold boiled rice

[illegible]

I am not prepared [illegible]

E. C. C.

BOOKWORMS.

[24732.]—[illegible]

1. To forward [illegible] the necessary stamp for postage.

2. To return [illegible]

3. To forward [illegible] that may be of service.

I may mention that the worms were in the [illegible] away nearly the whole of the paper of which the boards were composed [illegible]

I think I have found the [illegible] of the worm: [illegible]

J. W. Zaehnsdorf.

36, Catherine-street, Strand, London, W.C.

WHAT IS CREATION?

[24737.]—I should like to be allowed to suggest that some of your correspondents who venture to write [illegible] should be requested to define what they mean by the terms they use. I see on p. [illegible] that a gentleman who has "carefully studied the whole of Darwin's works" has not met with one instance in which the great naturalist [illegible] to "creation." After that I think it might be profitable if someone would tell "H. B. P." what is meant by "evolution," and it would certainly help to expose something if the correspondent would say what he means by "creation."

Nun. Dor.

[24738.]—In reply to "H. B. P.," letter 247[illegible], I am sorry to say I have not yet read all Darwin's works; but what I have read I have read "carefully," and they certainly seem to me to point to one conclusion—viz. that all now existing forms of life have sprung from previously existing, different, and simpler forms. There are, no doubt, exceptions; but they only seem to prove to me the rule. This process of simpler forms developing in course of time into more and more complex ones—whatever time it may be—I believe is called evolution, and is in direct conflict with what is commonly termed "creation." Why I object to the term "creation" for anything [illegible] cannot at present explain, is simply because it "explains nothing"; but as I said in my last letter, it is merely the substitution of a greater mystery for a lesser one. In fact, I am content to explain the problems of life in a "natural" way as far as science and experience will take us, and leave to the metaphysician the "supernatural," "creation ab initio," &c. &c.

F. W. H.

THE London and North Western Railway Company began to experiment with Mr. Webb's steel permanent way in May, 1880; there are now on various portions of the line over 32,000 sleepers at work; the first have been down nearly five years and are showing very well at the present time. The advantage of the system is, that it is applicable to the present standard rails and keys without alteration. The weight of one sleeper and chairs complete as used on the London and North-Western Railway is 164lb., the weight of the sleeper, 9ft. long, being 130lb., and of two chairs and liners, 34lb.

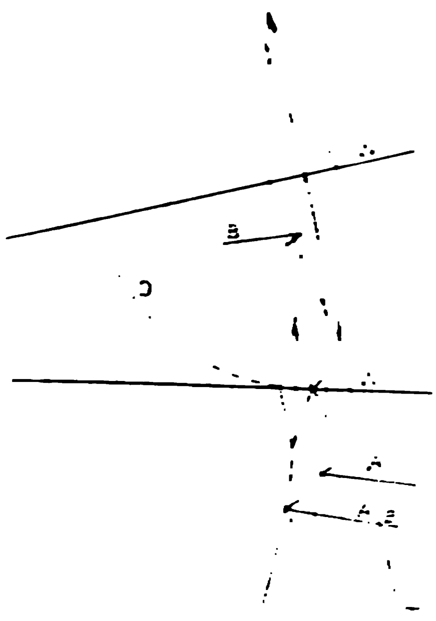
REPLIES TO QUERIES.

⁂ In their answers Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[5[illegible].]—**Organ Building.**—[illegible]

[5[illegible].]—**Photographing Sun.**—[illegible]—John Grigg, Observatory, Thames, N.Z., July [illegible]

[5[illegible].]—**Bicycle Turning.**—As "J. R. T." [illegible] Let A 1 [illegible] represent track of



front wheel: then A 2 will be track of hind wheel. B dotted line backbone: D. dotted line formed by hind wheel in riding smaller circles, that is, the different angles it will make with front wheel; therefore, as centre line of both wheels always forms a tangent to their respective circles, no drag whatever can take place as shown by dotted line T T. The size of wheels, front, 60in., hind, 20in. —A COUNTRY CHIP.

[56923.]—**Bleaching Shellac.**—It seems to me that as this querist is apparently in want of a bleaching process for trade purposes, it would pay him to read up back volumes—to help himself [illegible]—Nun. Dor.

[5[illegible].]—**Ball-Bearings.**—[illegible] Bicycle-makers have never [illegible] He evidently [illegible] Patent Office [illegible] "Bicycle Rider" [illegible]—CHAS. H[illegible].

[5[illegible].]—**Planing Machine.**—[illegible] I described to work with double vee [illegible] I should say the weight would [illegible] be doubled at least to enable it to [illegible] guides, and that would make it a dreadful affair. I should say also that the [illegible] machine used for iron cutting plan[illegible] than 6ft. in length ought to be left to [illegible] guided by its own weight alone. Neithe[illegible] any need to make the experiment. B[illegible] the rack of the shape shown in Fig. [illegible] you can retain the double vees, and yet [illegible] table running without tipping.—J. H.

[5[illegible].]—**S.E.R. Engines.**—The new [illegible] steam and run very well; indeed, so far, t[illegible] proved great successes. They take the [illegible] less time than the old engines, and burn l[illegible] but they cannot do an impossibility. The [illegible] b.g. could not run 70 miles under the b[illegible] with their level line, and it is impossible [illegible] engine on the South-Eastern Railway, [illegible] gradients and tunnels, to do it. This is all [illegible] about them at present; but if "W. B. P. [illegible] for further information, I will endeavour [illegible] out for him full particulars of their runni[illegible] A FRIEND OF THE "BONESHAKERS."

[5707[illegible].]—**Fire, Acid, and Moisture [illegible] Card.**—The requirements are, I think, r[illegible] much; but has Mr. Collins seen the [illegible] "cardboard"?—NUN. DOR.

[57077.]—**Boracic Acid.**—Boracic [illegible] rather Barff's boro-glyceride, will prevent [illegible] tation. For full particulars see p. 3[illegible] XXXIV.—NUN. DOR.

[5708[illegible].]—**Spirit Varnish and Polis[illegible]** This is a peculiar query. Spirit varnish [illegible] hard) is made by dissolving shellac in me[illegible] alcohol, or in mineral naphtha; but in th[illegible] case it is called French polish. The [illegible] method of polishing is to size well, dabb[illegible] brush into the pores, and when dry ap[illegible] polish; but it is a botch at best. The pro[illegible] is to fill the pores with whiting or plaste[illegible] with oil or grease.—NUN. DOR.

[57090.]—**Copper and Zinc Polishing** [illegible] plates should be planished perfectly [illegible] scoured with a slab of sandstone, finishing [illegible] flat piece of wood and rouge.—J. T. M.

[57091.]—**Coating Cast Iron.**—Nothing [illegible] than plumbago and pure grease, mixed ab[illegible] and half.—ESSAR.

[57095.]—**Covering Electric-Light [illegible] with Lead.**—The molten metal is forced t[illegible] the annular die by hydraulic pressure, the [illegible] wires passing through the centre.—SELIM.

[57097.]—**Tinning Copper Wire.**—Either pass the wire through molten tin, or boil in a mixture of grain, tin, and cream of tartar.—ESSAR.

[57111.]—**Is the Earth a Conductor?**—Yes, in the ordinary technical language the earth is a conductor, which is just as good a term as receiver or dissipator. See back numbers for a discussion on the subject.—S. P. T.

[57111.]—**Is the Earth a Conductor?**—Certainly it is. You do not suppose Silvanus Thompson's book is in error—do you? If you will read his work carefully, you can have no misunderstanding upon this point. Try the experiment yourself. All long-distance telegraphy, including the Atlantic cable, is worked with a single wire, and an earth return, as described in Professor Thompson's book. The earth is not a dissipator in the sense you take it. To answer this question would be more than I am capable of. You must draw your own conclusions from the different theories put forward by their exponents in various textbooks. See the preface, and also paragraph 6, page 7, of the work you quote.—C. D. R.

[57122.]—**Problem.**—The " – 4," as pointed out by "J. K. P.," is an error—whether mine or the printer's I cannot say. My rough copy has got "·16"—i.e., 4 divided by 25 (not – 20), which is, of course, what it ought to be.—W. A. S.

[57141.]—**Gas-Engines.**—In reply to "Invicta": In the first instance, I must say the engine of which we now write is not the same as the one I advertise as the "Radcliffe." I have made a small model of the "Rodgerson" engine, and am able to get it to go all right for a time. As to the consumption of gas, the engine being so small, and the cylinder ports and slots so proportionally large, and the engine being made of three kinds of metal—i.e., iron, gun-metal, and copper—it seems to me that to measure the consumption of gas would in no wise supply a criterion of the larger sized engines. The gas is heated by the products of combustion or "waste charge" passing round a jacket covering the compression or charging cylinder. I think, ere time and expense were expended on this matter, it would be preferable to seek your private opinion, and also that of our friend "J. H." If, therefore, communications are addressed to me, as per my advertisement top of p. vii. in "E.M." of Aug. 14, I shall be glad to send full working drawings of an 8-h.p. engine.—W. BUNDY.

[57142.]—**Planing Machine.**—To "J. H."—I am obliged for your answering my question; but what I require is a planer to work by foot power capable of doing work. Could you not oblige by giving a sketch of a small planer to admit, say, about 24in. by 16in., working one way only? If you could kindly do so, I could arrange treadle motion. The article would suit more than one other reader.—W. BUNDY.

[57172.]—**Dynamite.**—It is rather risky to have dynamite about nowadays; but it depends much on the stone. Dynamite shatters more, and if the stone is wanted in large slabs the rock powder, by its slower action, will throw down more for each shot. Could you not set up one of the little windmills to help the pump? A pulsometer is the thing, but then you would want steam boiler.—JEROME.

[57183.]—**Clamp v. Cramp (p. 569).**—I have always thought that "clamp" and "cramp," as used in the workshop, were synonymous terms. When writing of mechanical subjects, no one would be misled because clamp has reference also to the burning of bricks. I have heard both terms used scores and scores of times to signify precisely the same thing—the act of binding together materials, or the tools or means by which they are bound together. Pinching screws are called clamps and cramps indiscriminately, and no one is ever misled thereby. But on seeing the answer of "J. K. P.," I looked for the first time to the dictionary for the word. The Encyclopædic Dictionary gives the word thus:—Clamp (*s.*) (Dut., *Klamp*; Ger., *Klampe* = a clamp, a cleat; Dut., *Klampa*; Dan., *Klampe* = to clamp, to fasten tightly; Icel., *Klömbi*, a vice; Dan., *Klemme*; Swed., *Klämma*; Ger., *Klemmen*, to pinch, to squeeze). Then follow several definitions of the term having reference to special meanings, among which the carpenters' screws are mentioned. Used as a verb transitive, the definition is: "To unite, fasten, or join together by means of a clamp, &c." I have looked into "Holtzapffel," and find that when speaking of vices he invariably uses the term clamps, to signify the projecting "clams" of soft metal (see pp. 859, 860). In the first Vol. (p. 56) he uses the same term to denote the keys or joint pieces which bind strips of timber together in joinery. Lastly, in "Churchill's Catalogue" (pp. 94, 126), screw-cramps are termed "clamps."—J. H.

[57187.]—**Repairing Marble Ornament.**—I should try benzoline applied along the join; but it will not allow the parts to separate until it has well soaked down. The "gloss" on the ornament is simply polish, probably dry rouge applied with the hand, if a flat surface.—J. M. T.

[57195.]—**Iron Rusting.**—Take equal parts of clean washed hog's lard and powdered plumbago; mix thoroughly, and smear over the metal very thinly.—NUN. DOR.

[57202.]—**Driving Cotton Machines by Electricity.**—1. Cost about double in your case. 2. Depends upon the maker. 3. Nominal. 4. The power is applied to the cotton machine through a motor. You will require a steam-engine to drive the dynamo to generate the current, insulated wire to convey it, and a motor of sufficient power to drive the machines. If, therefore, it requires one horse-power to work them direct, you will want a two-horse engine at least if worked by electricity.—C. D. R.

[57205.]—**Over-dry Leather.**—I am afraid the book backs are spoiled by the sulphurous fumes from the gas-stove; but "B. A." might try the effect of a little castor-oil well rubbed into the leather.—BIBLIOPHILE.

[57208.]—**Speaking Tubes.**—I don't see why you should not speak through that length if the corners are taken round; but why not use a mechanical telephone?—J. M. T.

[57209.]—**Case - Hardened Iron.**—Heat the article to a dull cherry red, then, with a stick of wood, rub sufficient muriate of potash over the iron to completely cover, then plunge into a pail of cold clean water.—W. BUNDY.

[57209.]—**Case-Hardening Iron.**—Put them in iron box, surrounded (buried) in bone black, or leather clippings, hoof shavings, or things of that kind. Close the box tight with clay luting and raise to a red; keep it at that for a couple of hours, and then shoot your studs into water while still red. A piece of gas tubing makes a good iron box for the purpose: one end can have a cap, but the other end should have a plug of clay. See that each stud is surrounded by the bone black (dust from animal charcoal) or other material.—ESSAR.

[57233.]—**Fret-Saw.**—The best fret-sawing machine I know of, and one which I have found sell best, is on the principle made by Messrs. Wm. Marples and Son, Hibernia Works, Sheffield.—W. BUNDY.

[57244.]—**Dentistry.**—It is evident from the remarks of A. Mallard that he is not a "superior sort of dentist," and that he overrates the power of the Transactions of the Odontological Society. Having retired from practice, and being absolutely without interest in the profession (I beg Mr. Mallard's pardon, "trade"), I may say that with a fair knowledge of chemistry and materia medica, and a good knowledge of mechanics and tools, it took me four years' hard work to be something inferior to a "superior sort of dentist," and after ten more years' steady work and experience, the daily work taxed my patience and skill to its uttermost limits. So great was the strain, that I determined to get out of the profession and take to the practice of medicine as a relief, as others have done who were qualified. There is perhaps no work in creation which requires so much patience and manipulative skill as that of a dentist, and if A. Mallard can get into the operating room of a "superior sort of dentist" for a few hours, or to any of the clinics at the dental conventions, he will see some demonstrations of manipulative skill which will be a revelation to him. There are quacks and incapables in every profession and every trade, but their existence does not cause the necessity for so sweeping a condemnation, and I have no doubt that those who know will agree with me, that the same amount of skill expended on anything else will bring a far larger income than dentistry. It is very certain that I have found it so in my own case, and that it has paid me to throw up a large and successful practice for a special branch of mechanical engineering, and it is also very certain that it would take a very long time to get back the manipulative skill in dental work which was the result of years of constant practice.—998.

[57244.]—**Dentistry.**—With reference to the statement of A. Mallard on p. 570, that "a diligent study of the *Transactions* of the Odontological Society would enable anyone who is already a decent mechanic to become a superior sort of dentist," it may be remarked that it would be just as logical, and equally near the truth, to say that the mere reading of the *Lancet* or any other medical journal would make anyone a superior sort of a doctor. His other remarks as to the prevalent amount of quackery in the profession are unfortunately too true, and how this comes to be so let me endeavour to explain. Prior to 1878 any person could practise dentistry without possessing any qualification whatever, call himself "dentist," "surgeon-dentist," &c., there being no law in existence to prevent him, and, as a consequence, there were throughout the kingdom a large number calling themselves dentists who had had no professional training. When the Dentists' Act passed into law in 1878, it contained a provision whereby all who were at that time in the *boná-fide* practice of dentistry were allowed a given time to register, and thus continue to have a right to practise without any other qualification. What constituted the *boná fide* practice of dentistry was not very clear, and taking advantage of the loose wording of the Statute, men of every description of calling—the butcher, the baker, the candlestick-maker—amateur tooth-drawers of all kinds and conditions got their names placed on the register, and there they will remain so long as they live. The promoters of the Dentists' Act calculated that there were not more than 2,000 *boná-fide* practising dentists in Great Britain; but so large was the influx of those who rushed in where they had no right to be, that the first Official Dental Register issued contained nearly 6,000 names. Looking to the composition of this motley crowd, what wonder if there be quackery and incompetence?—and the best advice which can be given to those requiring efficient professional aid is—Employ no dentist, be he registered or not, without due inquiry as to professional standing, and specially avoid those who issue puffing advertisements. A small percentage of those on the register are licentiates in dental surgery; and now that no one can register who has not first obtained that qualification, the profession will gradually become freed from much of what at present degrades it, and the public cease to be victimised by ignorance and quackery. The requirements for the dental license, to a certain extent fall little short of what is required for the full surgical diploma. A candidate for examination must have passed the regular medical preliminary examination, and is required to produce certificates of having been engaged during not less than four years in the acquirement of professional knowledge, and of having been during that period, or at some time previous to examination, engaged for not less than three years in the acquirement of a practical knowledge of mechanical dentistry with a registered practitioner. He must also have attended the following lectures and other courses of instruction at a recognised medical school:—Anatomy, one winter course; dissections and demonstrations, nine months; physiology, one course of not less than 50 lectures; chemistry, one winter course; surgery, one winter course; medicine, one winter course; materia medica, one course of three months; practical chemistry and metallurgy, one course of three months; clinical instruction in surgery at a recognised hospital, one course of six months; dental anatomy, dental surgery, and dental mechanics, one course of each; two years' attendance at a dental hospital or the dental department of a general hospital. Satisfactory examinations must be passed in all the above subjects to entitle the candidate to receive the L.D.S. degree. The total fees for lectures, examinations, &c., amount to something like £75. If all this is required to prepare a man for the intelligent practise of the dental specialty (and the highest authorities declare it is so), surely the absurdity of supposing that the purchase of a few tools, or the reading of Society Transactions, can make a man a dentist must be apparent to the meanest capacity of mind.—DENTAL REFORM.

[57250.]—**Coke Cracker.**—"P. W. R." should get drawings of the stone-breaking machines, especially those with the "tapping" motion, for he wants to break, not crush, his coke, though coke dust, when small, is commercially valuable nowadays.—T. M.

[57251.]—**Agglomerate Blocks.**—To "C. D. R."—I am much obliged to you for your answer to my question, which was not clear enough. My reason for asking in such a manner was to see if anyone would arrive at the same conclusion as the people from whom I bought the blocks did. They said I used the wrong acid. My question is, Will common salt smash carbons which work well with sal-ammoniac? If so, why?—F. E. M.

[57252.]—**Free Reeds.**—I am much obliged to "Amateur Tuner" (p. 570) for answering my question which appeared on p. 550. I must, of course, now admit that I was mistaken as to the identity of the authorship of the two queries recently referred to. "G. L. B." has now been asked to give instructions in making a tuning apparatus, such as is used in American organ factories. If he does not do so it will not be difficult to define the reason; but I shall leave that matter to him, as he has indirectly assumed that he is a "professional," and as such is the right person to deal with the matter, and give definite and correct instructions, which a person beneath his position could hardly be expected to do. It is one thing to talk and assert: but quite a different thing to act. The required information will be useful to many, no doubt, as it has not yet appeared in the pages of "Ours." I trust "G. L. B." will do as requested, and give us a little benefit of his superior knowledge, for we really want thorough practical information. I am quite willing to do my best for the readers of "Ours" in the future, as I have in the past. If Amateur Tuner [illegible] was more definite in his [illegible] cannot [illegible] understand [illegible] Has the thickness of [illegible] If that is [illegible] when placed in the [illegible] so many different conditions [illegible] definite reply [illegible] wording. If it is [illegible] explain some of the [illegible] varying in the tuning [illegible] Perhaps "G. L. B." will [illegible] a few notes [illegible] the subject, if he [illegible] request of "Amateur Tuner," which I [illegible] he will, as we shall then have [illegible] something good. G. FRYER.

[5[illegible].] **Quick-drying Paints.**—If the querist means what he says, that he has used "spirits of wine" and shellac, he [illegible] recommended to try methylated spirit, or wood naphtha.—H. J.

[5[illegible].] **Dynamos for Practical Purposes.**—You do not appear to understand the nature of your query. What sized motor do you wish to drive? Is it a toy, or one giving out horse-power? You are aware, I suppose, that the dynamo generates a current not of itself, but must be driven by power. If you have a steam engine from which you can obtain the necessary motive force, by all means construct a dynamo, but don't waste your time with a machine to work 2½ candle-power lamps and toys. C. D. R.

[5[illegible]1.] **Queen's Taxes.**—If the querist is asking for advice to avoid the payment of taxes justly due by him, I trust the advice will not be forthcoming. Any individual who shirks the payment of his share of taxation is making the burden all the greater for those who of necessity must pay a portion of his liability in addition to their own. There are a class of shufflers who, by hook or by crook, manage to evade the collector. If "Victimised One" is of this community, I hope the brokers will make short work of his effects. Victimised forsooth! The boot is on the other leg.—C. D. R.

[5[illegible].] **Watch Work.**—For ordinary pivoting you require brass turns, 2s. to 4s. 6d.; bow (whalebone), 8d.; screw ferrule, 9d.; gravers, 1d. each; piece of soft steel for polisher, 1d.; red stuff, 1d. per oz. Experienced workmen sometimes use a Jacot pivoting tool, price 12s. 6d. For this you do not require gravers and red stuff, but a pivot file and burnisher, 6d. each. This tool is more useful for repairing pivots than cutting new ones, although many do so with it. Of course, you also want an oilstone for the gravers, and an eye-glass to work with. C. A. W.

[5[illegible]86.] **Bed Sores.**—Lie prone, or on the face, not supine. Touch slightly occasionally with nitrate of silver. Employ water dressing.—A PHYSICIAN.

[5[illegible]88.] **Machine for Tearing Rags.**—I know of a machine which would suit "A Farmer," but it would be difficult to describe in detail and take up much space; but if "A Farmer" will advertise in this paper, I will communicate with him. MUNGO.

[5[illegible].] **Woolwich Exam. Questions.**—On referring to the Woolwich papers, I find that "M. I. C. K." has got hold of an incorrect version of the question. It is as follows:—Find $\log_{10}$ ·0001 and the logarithm of [illegible] to the base $3\sqrt{11}$. Also to find certain other logarithms, for which the logarithms of 3, &c., are required, and are given. In the above cases it is easily shown by first principles that the first logarithm required is −4, and the other one is [illegible]. I have not quoted the rest of the question, as it is of an elementary nature, and presents no special difficulty.—C. W. BOURNE.

[5[illegible].] **Ebony.**—You had much better get [illegible] with strong soda water; clean the [illegible] stain and French polish. [illegible] C. D. R.

[5[illegible].] **Ebony.**—If this querist would say what [illegible] get a better answer. He should [illegible] and polish with coach-maker's [illegible] but it means much [illegible] for cleaning [illegible] a good stain he [illegible] French polish. If so, put a [illegible] into the polish, and [illegible] with a splendid black.—[illegible]

[5[illegible].]—**Faulty Dynamo.**—If you have been [illegible] dynamo without [illegible] armature it reads [illegible] second. Read [illegible] Cambridge.

[5[illegible].]—**[illegible].**—[illegible] not work the [illegible]

[illegible]

[5[illegible].]—**Bronze.**—[illegible]

[5[illegible].]—**Wheatstone Bridge.**—[illegible]—J. R. [illegible]

[5[illegible].]—**Turbine Wheel.**—[illegible] maker claims [illegible] recommend [illegible] experience [illegible] fall [illegible] mean diameter [illegible] off. I shall [illegible] information.—FRANCIS M. R[illegible], Finsbury-pavement.

[57316.]—**Turbine Wheel.**—If [illegible] correspondent inquires of Thomas McKenna, [illegible] Holborn Viaduct, London, and Belfast and Dublin, he may get a high-[illegible] wheel [illegible] James Leffel's patent. Their [illegible] perhaps, because this [illegible] gives valuable information and I [illegible] page 9, that 9ft. fall and [illegible] gives [illegible] a 40in. wheel, some 27[illegible] in a [illegible] wheel, some 31·8h.p. The valuable work on Hydraulics, by N. Beardmore, C.E., gives [illegible] effective h.p. for overshot, 21·7h.p. [illegible] breast, 18·7h.p.; turbine [illegible] — BREAK'S BUILDINGS.

[57322.]—**Violoncello.**—I quote the following dimensions from Mr. Heron Allen's work on "Violin-making," and the measurements given are those of an instrument by Stradivarius, belonging to M. Franchomme, the celebrated violoncellist:—Length of body from base of button to tailpin, 2ft. 5$\frac{1}{12}$in.; breadth across upper bouts, 1ft. 1$\frac{9}{16}$in.; breadth across lower bouts, 1ft. 5[illegible]in.; breadth across inner bouts, 9[illegible]in.; length of inner bout from corner to corner (perpendicular), 6[illegible]; length from base of button to notch of ff holes, 1ft. 3¾in.; height of sides upper bouts, 4[illegible]in.; height of sides inner bouts, 4[illegible]in.; height of sides lower bouts, 4$\frac{11}{16}$in.; neck from chin of scroll to base of button, 11ft.; length of finger-board 1ft. 10¼in.; length of peg-box, 4¼in.; breadth at widest part of peg-box (inside measurement), 1½in.; breadth at narrowest part of peg-box (inside measurement) 1$\frac{1}{8}$in. The last five measurements are not given by Mr. Allen, but I have taken them from from an old violoncello of my own, and of course they are only approximately correct. The best material is the same as that used for violins—namely, maple for the back and sides and good even-grained pine for the front, avoiding, if possible, all blemishes and discolourations in any of the woods. I have found it somewhat difficult to procure the pine without annoying resin marks, although I have paid £1 5s. for sufficient to make a good front. The maple back could be procured from Messrs. Broadwood, or from Mr. Hill, of Wardour-street, London. As these firms use good wood, and well and naturally seasoned, it is best to pay for it at once, and not undergo the dissappointment of seeing the wood warping and cracking when worked. The maple back is expensive, £2 being about the price for a back, although some firms have cheaper qualities; but they are not always to be depended on, being often artificially seasoned. The ribs cost 5s. a set; but see that they are long enough, as it sometimes occurs that ribs are given for a smaller-sized violoncello than was designed. Pear-tree wood and beech have been used for backs; but as the latter is very wormy, and neither of them very ornamental when compared with maple, it is a pity to throw away time, hard work, and skill on inferior material. The Scotch plane tree has occasionally very finely-marked wood, and is very good to use if it can be had properly cut and well seasoned. On a first violoncello it would do well enough. When I attempted making my first violoncello I found great difficulty in getting information about the thicknesses of the back and front, or finding any approximate scale to work with; but on asking a question through this paper, Mr. Lisle kindly answered, and advised me to proceed to the result [illegible]. I cannot lay my hands on the [illegible] in which the answer appeared, but it was in April or May last. In that answer Mr. Lisle [illegible] that the use of the [illegible] for making a new model of a [illegible] and Davidson, would be [illegible] a line of about 14in. [illegible] the various proportions [illegible] rules. To apply this to a violoncello is a mistake, because it is built upon a [illegible]. A violoncello is not [illegible]. If so, it would be an [illegible] and clumsy instrument. [illegible] thinness, and to get the proper [illegible] vibration, it is shortened and deepened. I never found any other reason, although I have read a good many books on the subject, but I think it is reason enough. Davidson has a short paragraph on the subject; but the information is [illegible]. The violoncello is [illegible] I mean practical ones, seems to be [illegible]. This shortening and deepening of the instrument must necessarily make a difference in the scale when applied to the thicknesses of back and front, and as I had not the courage to take an [illegible] to satisfy my curiosity, I [illegible] the rule recommended by Mr. Lisle; [illegible] against my conscience at the time, and the result has justified my opinion. The [illegible] has a very good tone; but the quality is [illegible] less than nowhere. The remedy [illegible] easy; but it is a pity to show nothing for spent time, and the instrument is a [illegible] of warning to the ambitious. The back at the thickest part was ¼ decreasing to ⅛, and the [illegible] was [illegible] of an inch in thickness. The front a little over a [illegible], decreasing to [illegible], and all round a little over an [illegible] of an inch. They were both well and carefully cut in the same way as a violin would be; but I am satisfied the measurements are [illegible]. Would any reader kindly compare the above when the opportunity occurs, and point out discrepancies? If it is a fair question, how does Mr. Leech propose to bend the inner-bouts? I used an [illegible] Italian iron; but it was not easy to work with, and it was difficult to avoid cockling. Could any reader recommend a plan for bending them—by boiling or some such, and add a little information for the sake of improvement in future [illegible]?—A. H. SMITH, Edinburgh.

[5[illegible].]—**Atoms.**—The atoms are an abstract idea of the smallest volume of matter that can be acted on by any form of force. This volume is experimentally unknown, and always will be, as atoms belong to the science of metaphysics, which is quite distinct and separate from the physical or natural sciences, because the primary principle of life comes between them. There is much confusion of ideas sometimes when this distinction is not made by physicists in dealing with the supposed atoms, molecules, monads, &c. In physics certain relations have been made and established between force and matter by experiment; but the apparatus made to illustrate the imaginary motions of the atoms is never quite satisfactory, although it often leads to new theories and experiments. If you make a few dozen magnets from 1in. to 2in. long, you can get some good illustrative experiments of molecular actions by fixing them to pieces of cork and floating in a basin of water. The figures may be shown on a screen by attaching thin pieces of looking-glass, which will reflect the light thrown on to them by a lamp. The magnets may be thus arranged: 1. Six magnets, with their north poles fixed in a single cork float painted red, and cork balls, painted white, fixed to each south pole. Make six of these, and the same number with their south poles in a white float and six red balls on their north poles. 2. Six magnets to float with their north poles on the surface, and the same number with the south poles up. You may also make sets of threes and fours, as desirable. 3. Pieces of soft iron similarly fixed, but painted red and white in lines. The whole of the magnets should be arranged in a box, so as to be easily taken up and replaced, and great care must be taken to have white and red on the north and south pole of each magnet respectively. I made some molecular models with resonators, which moved by sound when an organ pipe was blown, but they are not easy to work. The rotary apparatus, described in my letter last week, is a case of molecular motion, and can be made much larger. Do not, however, make models with springs or clockwork; they are more misleading than an orrery, and about as useful for instruction as an image of the Hindoo god Siva.—J. SUTCLIFFE.

[57328.]—**Tinman's Tools.**—These in their entirety are extremely numerous, and consist of a number of machines, in addition to hand tools; and a kit for any particular shop would depend upon the class of work to be there dealt with. But as many of the tools have a number of different uses, a little ingenuity and skill can do a great deal with a few of the most generally useful. If I knew exactly what work the querist wishes to do, I could advise him accordingly; but I will name a few that would meet a moderate range of work:—Square, compasses, and shears for striking out and cutting forms required; mandrel, sidestake, beak iron, and funnel stake for forming cylindrical and conic shapes; an ash block and set of block hammers for convex forms; anvil and set of hammers for setting plates flat, streething, raising, planishing, and other uses; rollers for curving and flatting plates, tubes, &c.; hatchet, stake, and several bottom stakes for folding and edging straight, hollow, and round forms; a jenny for edging and flanging; a crease iron for wiring, making beads, &c.; a horse and heads of various shapes for awkward work; a swaging machine for making beads and ornamental patterns; square-faced and paning hammers, about three hand-groovers for grooving seams, a set of punches, set of chisels, dome rivet sets, several boxwood mallets, several soldering-irons, firepot, pliers, wire nippers, &c. If I can assist the querist any further with sheet-metal work I shall be pleased to do so. —ED. STUCKEY.

[57330.]—**Legal.**—The offence of obtaining money by false pretences consists in a misrepresentation of an existing fact and knowledge of its untruth, and the parting by the person defrauded of his money on the faith of the pretence, and an intent to defraud. Where the case is an attempt only, the third of these ingredients is, of course, wanting. In a tradesman seeking to obtain from a parent payment of an "infant" son's debt, the intent of the tradesman is to get his money—not to defraud anyone. No one need pay the debts of a relative unless he likes, and as the tradesman can get nothing except by legal proceedings, no harm can be done, for if he is in the wrong, he will lose his case.—KAPPA.

[57333.]—**Solder.**—"Ex-Garrison Gunner" can make good solder, with a little experience, from old pewter teapots. Melt the pewter down in a ladle, but do not make it red hot, and then add some small pieces of pure lead, about the size of a penny, giving it a stir-up with a piece of iron, so as to mix it well, and then pour just a little on an iron or stone slab, and watch it till it gets cold; it ought then to be as bright as a sheet of new tin; if not, drop in some more small pieces of lead till it attains the right colour.—JIM.

[57333.]—**Solder.**—By "hard" solders is meant spelter for brazing; also gold and silver solders, which melt at red heat and upwards. "Soft" solder, 2 tin 1 lead (which must be pure), melts at about 310°. A little bismuth makes it run easy and nice. There is no secret whatever about it, and the casting and recasting you saw was merely telling by colour if the proportions were right. If the solder looked dull and leadlike he would put more tin, if too white more lead; but it is not worth while to make it unless to use up metal you may have by you. The solder sold is generally fairly good.—ED. STUCKEY.

[57347.]—**Heating Surface, Condensed Steam, &c.**—There is a printer's error in my query in the last number. The word "conduct" should be *condensed*. I want to condense the exhaust steam in a surface condenser. Will some correspondent kindly help?—THANET.

[57348.]—**Back-ache.**—I would recommend, as having been of inestimable value to myself and as being cheap, a cold sponge bath every morning with a good rough towel rubbing down after it; or sit for about three minutes each morning in about 9in. of cold water. This, with a few doses of "chemical food" or Fellow's syrup of hypophosphites, should put "Hammer and Tongs" to rights, and I hope will.—A FORMER SUFFERER.

[57348.]—**Back-ache.**—If doctors do not understand your case, it can hardly be expected that anyone else should. Thirty years is not a very near approach to old age, with which your complaint has nothing whatever to do. Back-ache may arise from a variety of causes. In what part of the back is the pain located? If across the loins, it is probably due to some disordered action of the kidneys. The disease, from whatever cause, is not incurable. Be careful as to diet, drink no intoxicants, get plenty of fresh air, and as much out-door exercise as you can bear. Avoid fatigue in any form or degree. For advice as to medicine consult a respectable physician. The query is not sufficiently definite to enable anyone to define the exact cause of the back-ache.—G. FRYER.

[57318.]—**Back-ache.**—In reply, first then, there is something very wrong in your diet, and your symptoms only the accumulated effects of the same. Now for the relief. Avoid coffee entirely, and take only one cup of tea a day, and that after work is over. You may drink cocoa instead of coffee, and take no supper; but once each day, to one meal, take some of Nichol's Food of Health. Oatmeal porridge is good in changes, too. Avoid cheese, bloaters, cod, salmon, pork, veal, bacon, salted meats, new potatoes, cold puddings, and cold water at meals. Eat slowly always, and never eat too much. White of egg is bad; so is any fat, and all kinds of sauces and pickles. Milk, too, at supper time is also bad, and so are some kinds of preserves. Stewed rhubarb is the worst of them, perhaps; marmalade, perhaps, the best. Then, to expedite the cure, wash every night, at first, in hot water and soap, especially all over the seat of the pain, at the back of the neck, and round the ears; no half-washing, but thorough good scrubbing, not forgetting the feet and legs up to the knees, remembering that it is possible to draw away, through the feet, by continual perseverance, almost all our chronic diseases; so this must not be half-done. Repeat with cold water in the morning. Then, by-and-by, you may take an apple or two before breakfast every morning, and again in the forenoon. Vary this with a cup of cold water, occasionally with a dessertspoonful of lime juice (pure) in it. Never drink at dinner time; half an hour before that, if thirsty, and then only cold water.—SENEX.

[57355.]—**Small Dynamo Worked by Town's Water.**—There were two hydro-motors such as you describe, one being in a glass case showing working parts, the other just at entrance of the east arcade, driving a dynamo lighting four or five three-c.p. lamps (for such they appeared to me). As far as I could judge the principal working parts were as follows:—Around a cylinder, about 2in. diameter 4in. long, were fixed five rows of projecting cups, about the size of a threepenny piece, there being six in the row along length of cylinder at equal distances apart, so making 30 cups in all. Above this waterwheel, at a distance of about 4in., the water-pipe (from main), having six small nozzles corresponding to number of cups in wheel, parallel to axis, discharged six small jets on centre of cups. The nozzles being exactly above row of cups when plane of same is at right-angles to jets from nozzles; thus making cylinders revolve by jets on rows of cups successively. The above was contained in a tin or glass case, having outlet for water at bottom, with a small hole drilled in glass through which axle of water-wheel passed at the side where dynamo was driven; from the axle armature of dynamo is driven direct, and where axle passes through hole in glass fix a small cone of tinplate, with concave side towards water-wheel, so as to prevent any possibility of spray on armature. The only part of above motor I am not quite sure about is whether there were seven rows, therefore 42 cups, or five as described. I hope "Gormless Lad" will be able to understand this somewhat hazy description of—A SCEPTIC.

[57373.]—**Genuine Humber Tricycle.**—In answer to "Cyclist," I think his experience of the genuine Humber machine is much different to that of most of your readers. I think his best course would be to return his machine, less the wheels and backbone, to the makers at Beeston, who will, I am sure, set it right, and save him the trouble of attempting to adopt Bown bearings.—WHEEL.

[57373.]—**Genuine Humber Tricycle.**—If by "checks" you mean the cages, I would suggest that a remedy might be effected, if they are removable, by replacing them with others of better quality. As regards the recent discussion on ball bearings, it seems to me that one of their many advantages consists in their capability of allowing an axle that "whips" slightly under a heavy load or strain to revolve without binding.—B. B.

[57376.]—**Electricity in the Microscope.**—Although not strictly an answer to the question of "E. B. F.," it may suggest a useful hint to state that when, in 1866, I was investigating the disruptive effects of the electric spark—more especially with regard to the peculiar shape of the perforations made by it through various materials—many experiments were carried on upon the stage of the microscope. I then found that a very simple and convenient method of holding and insulating the terminal wires was to pass each through a small glass tube held by a brass spring clip, mounted upon a jointed pillar at the corner of the stage in the same manner as the stage forceps. The pointed end of a glass dipping tube answered the purpose admirably. When it was desired to pass sparks vertically through an object in focus, a glass stage-plate was used. This consisted simply of two pieces of glass, about an inch longer than the brass stage, cemented together with a wire between them, the point of which turned up at right angles in the centre of a hole drilled through the upper plate. The other terminal, mounted as above, could then be adjusted over it in any required position. A small induction coil was used for the purpose, giving about a ½in. spark with a single bichromate cell. If a Leyden jar was placed in the circuit, discharge sparks of much greater size and brilliancy were obtained, giving beautiful effects when viewed through the micro-spectroscope. Caution is desirable in conducting experiments of this kind, since manipulation, during observations which engage the attention closely, is apt occasionally to produce very startling results.—R. T. LEWIS.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

56887. Drying under Pressure, p. 375.
56897. Organic Chemistry Examination, 375.
56905. Mal de Mer, 375.
56906. Deed of Gift, 375.
56916. Telescope Eye Tube, 375.
56922. Twine, 375.
56927. Co-ordinate Geometry, 376.
56934. File-cutting Machines, 376.

57074. Lens for Mirror Galvanometer, 462.
57082. Hydraulic Leather Collars, 462.
57085. Heating Surface of Vertical Boilers, 462.
57089. Electric Cement, 462.
57093. Beam Engine Slide-valve, 462.
57095. Photography. To Mr. Lancaster, 462.
57099. Watchwork, 463.
57103. Analysis of Copper-wires, 463.
57105. Street Coil, 463.
57114. Cylinder for Reservoir, 463.
57117. East Coast Express, 463.
57118. Paper Caps for Toy Pistols, 463.
57119. Herb Beer, 463.

QUERIES.

[57377.] **Dynamo.**—To MR. BOTTONE.—I am making a dynamo with laminated armature, on which will be wound 1lb. 10oz. No. 20 s.c.w.; on fields 10lb. No. 16 c.c.w. How many lamps and of what c.p. will it light without undue heating? I have also a dynamo with Siemens armature, on which is wound 2lb. of No. 18 s.c.w., and on field magnets 11lb., No. 16 c.c.w. I intend using the latter machine as a motor, to drive my lathe, and the current to be produced by the other machine some distance off. What alterations will be required to give best results as a motor, the armature being 6in. by 2½in., while the other is 6in. by 2¾in., and wound in four sections?—A MARINE ENGINEER.

[57378.]—**Condensing Engine.**—I was much interested in "Invicta's" reply to query No. 56699 some time ago. I should like to make an engine about 1½in. bore, 2in. stroke, into a condensing engine. Would "Invicta" kindly tell me about the right sizes for condenser, cold-water pipe, exhaust pipe, and size of pump necessary? An idea of the size of rose head would help also. If a non-condensing engine were worked at a pressure of 20lb., and the same engine were converted into a condensing engine, I suppose it would be equivalent to working it at from 30lb. to 33lb. pressure, according to the vacuum obtainable? Would you also give me size of steam ports for the above cylinder? also the size to drill passages to meet the ports in valve face? and much oblige.—I. L.

[57379.]—**Horse-power of Engine.**—To "J. H.," or "INVICTA."—I have a small engine; the diameter of cylinder is 2⅝in., the length of stroke 5¾in. If I run it at a speed of 100 revolutions per minute, with steam at 30lb. per square inch, would you kindly tell me the h.-p. and oblige?—W. P. B.

[57380.] **Cracked Boiler.**—Will anyone oblige by saying what is best to stop a crack in a cast-metal kitchen grate boiler, in the side next the fire? Have tried black-lead and sulphur, but this, in time, peels off. Is there any cement, enamel, lute, &c., that would withstand the heat and water, without rusting or affecting the latter, as the crack, about 9in. long, can only be got at from inside the boiler? What is the best anti-rust and mode of application for such boilers, pots, and kettles?—NEW READER.

[57381.] **Trouser Stretchers.**—Would anyone be so good as to suggest or give design for an appliance of this kind to free trousers from creases, and prevent them from shortening from wet, &c.? I have already used two wooden sliding cramps, but, as these leave an unsightly impression, would like something better.—J. T.

[57382.] **Deepening Colour in Red Bricks.**—We make a light-coloured red brick of a rather brittle nature. We should be glad if anyone would tell us how to make the colour a deeper red, and what would strengthen the brick without spoiling the colour?—BRICK-BURNERS.

[57383.]—**Painting Bath.**—Will some one kindly inform me what sort of paint I should use to repaint in white colour the inside of an ordinary bath?—PAINTER.

[57381.] **Noise in Flushing Pipe.**—Will some correspondent kindly say if it is possible to stop the unpleasant rushing sound which always follows the last of the flushing water from the waste-preventer, or small cistern, to the pan of a watercloset? The sound is peculiar and great, and is like that in a wash-hand basin when the water runs away down a pipe, and begins as soon as the air-way is formed, like a miniature whirlpool, and stops when all the water has gone.—PAINTER.

[57385.] **Piston Rings.**—Will any of our engineer correspondents be kind enough to inform me how to make the piston rings in a horizontal cylinder wear a while longer? They are only 1¼in. steel rings, with no kind of springs inside them, and they don't touch the top of cylinder now it is worn slightly oval. It seems to me that, if there was some sort of springs fitted between piston block and the inside of rings, it would hold them up; but I don't like to try without asking my friends.—AN INK WIRER.

[57386.]—**Throttle-Valve.**—Can anyone tell me of a good throttle-valve for a horizontal winding engine? I have one of the ordinary ones, that shuts across the pipe; but that kind the makers say they cannot make perfectly steam-tight. I want one that would be easily worked and shut dead off. I have been thinking of a large tap; but I doubt if they could make one to fit a 6in. pipe.—AN INK WIRER.

of affixing a stem to the bent bar. :n, or screwed?—W. H. SHRUBSOLE.

:ngines.—Would any subscriber, -engines, say how the new Griffin gas it appears to have a cylinder closed t more economical than the Otto by If so, how?—A. B.

,ulics.—Would any correspondent, h above, state if it is feasible to punch plate discs, say, about 6in. dia.? I ow about what the pressure per square purpose making a hydraulic press to

e.—Could any of our readers give me ; the diameter and weight of flywheels? nk shafts to resist deflection as well as :R.

ust Injector.—I have an exhaust boilers, which works well if the steam). to the square inch; but I want to injector will not force the water in. s could help me I should esteem it a .

a Lubricator.—How does the :icator act, and what is the wick for?—

aing Micro. Objects.—I am at result is obtained by the following ·ide of lime dissolved in one pint of solved in one pint of water; mix the ow the mixture to settle; drain off the [want to know is, What is the clear bleaching microscopic objects (vege-

:t under Cover.—Can any of your idents give me the information for :ricket ground, the cheapest kind of ld be the most suitable floor for bowl- wanted large enough to bat and bowl inter. Any information will be gladly

ipply.—Wanted, the rule to ascertain s in cubic feet per hour through pipes s and lengths at different pressures, ·5 :hes's "Gas Works," but want the rule therein are calculated.—GAS-FITTER.

. Eaves.—Thanks are due to Mr. E. etter, finishing the construction of the certainly avail myself of so excellent follow his very lucid instructions. In gives particulars of a 10-lighter; but, i, that machine is series-wound. What ·tion of wire on "F. M.'s" for a com- :ould a comp. machine be made, yield- s at 10 volts pressure? I hope I am h of Mr. E., who certainly has got a obliging helpfulness which forms so ristic amongst the "E. M." brother- E.

cing Pivots.—To "ESCAPEMENT." ou. Will you, please, inform me how broken off pinions? I cannot drill ıe. Is there a machine on purpose for Also say how I can repolish after ıe pinions? I don't properly under- ın by being particular as to the edge . Please oblige by full explanation.—

:ing Broken Bubble of Level. 's ago, broken the large bubble of my)y"), I should be very much obliged if of the "E. M." will inform me as to eplacing same, the amount opticians ıe out of all proportion to such an (as : can obtain the use of another level essary.—THOS. H. HALL.

eater's Skin.—Will some reader cipe for composition put on the gold- ı chemists' shops?—F. M.

ıl under Canal.—Will some reader if the exigencies of trade require it, ın be made under a canal from one ithout an Act of Parliament?—FOR-

—What would be the expense of a , say, a laden truck with eight tons of t. to the level of a railroad?—FOR-

ıs Fumes.—Can any reader of the any method of suppressing the nitrous ıtive of a Bunsen Battery, and is there he nitric acid without materially les- notive force? Any suggestions will

)static.—In an abstract of hydro- ies I read:—"Fluids press in all direc- y the artifice of preventing the regular ıat the heaviest metals may be made ıe lightest woods refuse to swim in reader kindly mention an illustration

'on.—Will any reader of the "E. M." ıe best and cheapest method of melting ig iron, from 28 to 56lb.?—JOHN.

ıry.—I use only gas in my house, and ·ning the vegetable, &c., refuse, which dustbox, and there makes a most offen- ıstmen object to remove same, saying some reader suggest a method of avoid- I do not wish to light a fire for that ıagine I am not the only gas-user who : difficulty.—R. B. W.

tion Coil.—Will some fellow-reader ulator to put between the layers of wire l of an induction machine? Is paraffin sh the best, and how thick ought it to be .E.

ning Paper.—Will any reader kindly t solution paper is dipped to make what .ng paper"?—H. C. P.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Batteries: No. 741.
Bookbinding: No. 613.
Copying processes: Nos. 750, 753.
Electric machines: Nos. 628, 759, 840.
Electro-magnets: Nos. 756, 772.
Lacquers: No. 866.
Pattern Making: Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 965, 969, 973, 974, 978, 981, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,010.
Silver-plating: No. 830.
Telephones: Nos. 695, 747, 865.
Varnishes: Nos. 478, 619, 675, 691, 723, 775.

A NEW VOLUME.

THIS number is the first of Vol. XLII., and is printed throughout, as our readers will notice, with new type. Readers willing to oblige us by recommending "Ours" to new subscribers should do so now, when a new volume is commencing. The index to Vol. XLI. will be published on Sept. 18, and cases and bound volumes will be on sale shortly after. Readers desirous of making up their sets for binding the past volume are recommended to do so at once, as the back numbers soon run out of print.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 2, and unacknowledged elsewhere:—

R. E. QUINN.—W. R. Strange.—W. A. Hunter.—Glover and Co.—E. C Ames.—R. H. Bow.—D. H. Littlejohn.—Razors.—W. Habgood.—Bobadil.—W. Laurie.—Techna.—Anxious.—Geo. Mitchell.—Rev. Abner E. Brown.—H. S. Williams.—Extract.—Limestone.—Chilly One.—John J. Holtzapffel.—Gerard Smith, M.R.C.S.—D. W.—J. Spooner.—Perplexed.—Turk.—Retina.—F. A. M.—Belgian.—Telegraphist.—Dentist.

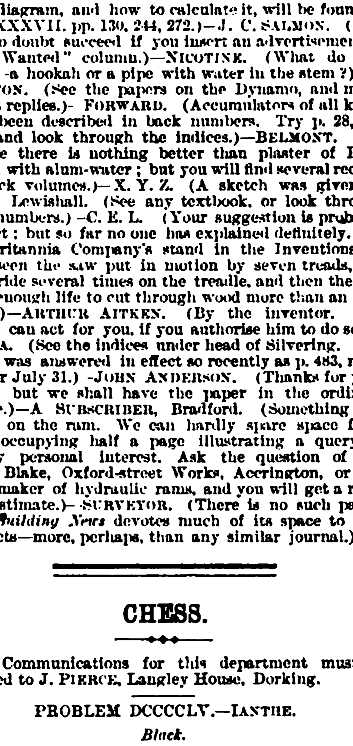
CHAS. READER. (No price marked on it, and we gave the author's address on purpose to prevent such inquiries as yours.)—SHAVINGS. (The question has been recently answered. Apply personally to the superintendent.)—G. O. (The simplest plan is to scrape it off with a chisel or some other sharp-edged tool.)—CO-OPERATIVE. (No one can say without analysis.)—AFFLICTED. (For all that can be said about polypus, without personal examination, see pp. 328, 360, 480, Vol. XXXV., and p. 109, Vol. XXXVII.)—NIL DESPERANDUM. (Any optician will supply you with suitable lenses, &c.; but see pp. 479, 502, 527, 574, 618, Vol. XXXII., or any of the well-known textbooks of physics or optics.)—BELMONT. (Procure the "guide" from the secretary, Science and Art Department, South Kensington.)—ENQUIRER. (See answer to "Young Beginner." 2. Three of the numbers containing articles on Pattern-Making are out of print, but you can have the others for 6s. 0½d. post free.)—G. A. BOLTON. (The "beads" to which you refer are used for obtaining rough approximations, but they do not supersede the hydrometer. You can obtain all particulars from Messrs. Dring and Fage, 145, Strand, W.C.)—A. B. C. (The citrate of iron and quinine will probably answer the purpose, but you should consult the Pharmacopœia.)—NEW SUBSCRIBER. (Procure a catalogue from Messrs. Lockwood and Co., Stationers' Hall-court, E.C. You will find several in that, and can then choose the one one most likely to meet your wants.)—PIVOT. (There is the *Watch and Clockmaker*, published monthly, 1d., by Robertson and Gray, Coventry, and the *Watchmaker and Jeweller*, published in London, which any newsagent will procure for you.)—E. F. N. (Thaumа was described sufficiently in No. 1,024, p. 226. The body rests on a plank.)—FRANK H. START. (The addresses should be advertised for in the Wanted Column.)—T. SPRING. (If you will tell us what you have had we may be able to advise. Have you tried Spencer's in Weale's Series, published by Lockwood and Co., Stationers' Hall-court, E.C.?)—GEO. C. FULCHER. (You can find very many in back volumes; but such a communication should go into the Wanted Column.)—CONSTANT READER. (The catalogue of the Inventions Exhibition can be obtained of any bookseller, price one shilling. It is published by Clowes and Sons, at the Exhibition. 2. No, there is not. You will find them in our back numbers. 3 and 4. See No. 2. 5. At Worcester, Mass., U.S.A.)—A. F. N., Antwerp. (Holtzapffel's Vol. V. is published by Holtzapffel and Co., 64, Charing-cross, London, and we believe the price is a guinea. Vol. VI. is to contain the "principles and practices of amateur mechanical engineering.")—VULCANITE. (It would be a gratuitous advertisement. There is no circuit breaker—that is all. Any of the magneto-machines recently described will do.)—RIVABELLA. (There is no book of the kind. Humber's treatise on "Bridge Construction," published by Lockwood and Co., is the best; but it costs six guineas. Hurst's edition of Tredgold's "Carpentry," will do for wood, and Matheson's "Works in Iron" for another; but as to stone, you will have to consult treatises on civil engineering generally. If you procure the catalogue issued by Mr. Calvert, Great Jackson-street, Manchester, you will find a list of works. See Hints No. 5.)—DYER. (It is not an easy matter to dye black cloth scarlet, green, or yellow; but as to books, procure the catalogue mentioned in previous answer.)—NEW READER. (For full descriptions of Turkish, hot-air, or vapour baths, see Vol. XXXV. pp. 130, 157, 181, 289, 354, 378, 384, 403, 454, 597, 599. 2. There is no remedy but to keep it warm, or sufficiently so to prevent it congealing.)—DESIDERATUM, D. H. (It is necessary to state the nature of the stone containing the silver; but you will find many useful hints in back volumes. Try a small piece by crushing it and dissolving the silver in nitric acid.)—YOUNG BEGINNER. (A full account of the indicator diagram, and how to calculate it, will be found in Vol. XXXVII. pp. 130, 244, 272.)—J. C. SALMON. (You will no doubt succeed if you insert an advertisement in the "Wanted" column.)—NICOTINE. (What do you mean—a hookah or a pipe with water in the stem?)—J. NEWTON. (See the papers on the Dynamo, and many recent replies.)—FORWARD. (Accumulators of all kinds have been described in back numbers. Try p. 28, No. 1016, and look through the indices.)—BELMONT. (We believe there is nothing better than plaster of Paris mixed with alum-water; but you will find several recipes in back volumes.)—X. Y. Z. (A sketch was given.)—J. B., Lewishall. (See any textbook, or look through back numbers.)—C. E. L. (Your suggestion is probably correct; but so far no one has explained definitely. At the Britannia Company's stand in the Inventions we have seen the saw put in motion by seven treads, two men ride several times on the treadle, and then the saw have enough life to cut through wood more than an inch thick.)—ARTHUR AITKEN. (By the inventor. Any friend can act for you, if you authorise him to do so.)—ZAMPA. (See the indices under head of Silvering. The query was answered in effect so recently as p. 483, number for July 31.)—JOHN ANDERSON. (Thanks for your offer; but we shall have the paper in the ordinary course.)—A SUBSCRIBER, Bradford. (Something depends on the ram. We can hardly spare space for a plan occupying half a page illustrating a query of purely personal interest. Ask the question of Mr. John Blake, Oxford-street Works, Accrington, or any good maker of hydraulic rams, and you will get a reply and estimate.)—SURVEYOR. (There is no such paper. The *Building News* devotes much of its space to both subjects—more, perhaps, than any similar journal.)

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLV.—IANTHE.

Black.



White. [8 + 6

White to play and mate in two moves.

SOLUTION TO 953.

White.	*Black.*
1. Q-K 2	1. Anything
2. Q, Kt, B, or P Mates	

(Six variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 952, by F. O'N. H. (skilful, yet, somehow, not pleasing) and E. Stanley Follwell (solution extremely intricate: the best three-mover that has appeared).

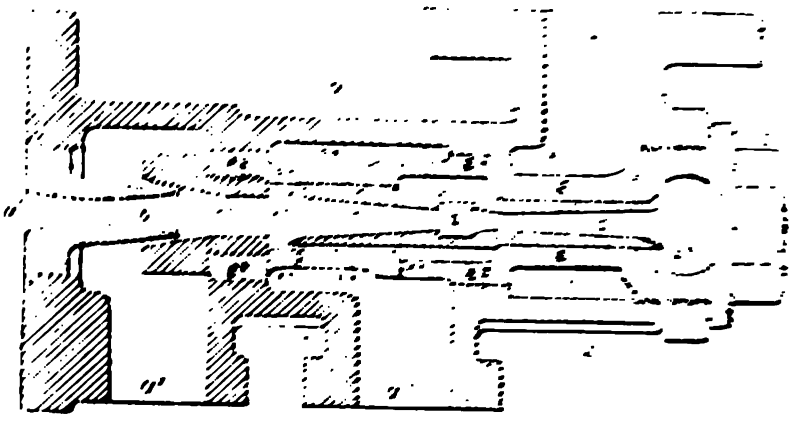
TO 953, by E. Stanley Follwell, V. S. Pochin, F. A. Vincent, Rev. W. Anderson (Old Romney), and Handescombe Rodd (neat and rather difficult).

TO 954, by E. S. and Streetgate.

INQUIRER.—No doubt you saw in the last number that the rules have been altered. There would now be nothing further to pay beyond the entrance fee.

THE following gentlemen have already joined the Third Game Correspondence Tourney:—W. T. Pierce, F. A. Vincent, W. Nash, J. Bourn, and J. Pierce.

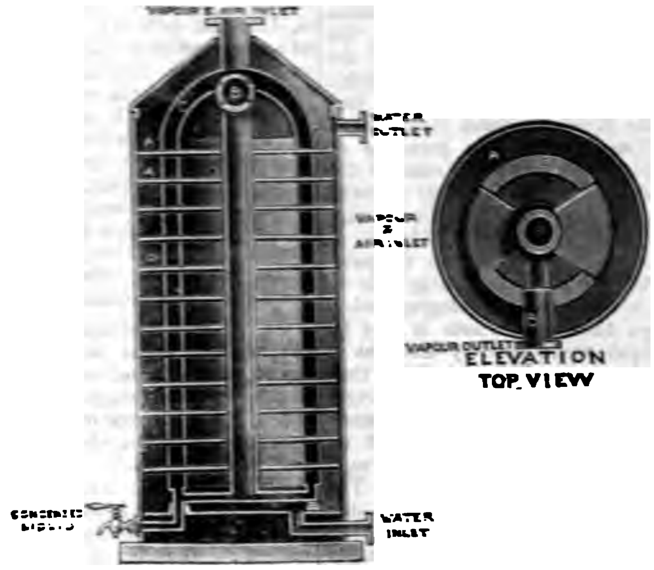
IT might, perhaps, be acceptable to have a Supplementary Game Tourney for junior players, with the same rules as the other, but with entrance fee five shillings. We shall be glad to receive names.



of the combining cone [illegible] connected with the discharge cone [illegible] distance from the end of [illegible] first part of the combining cone and the steam can freely escape both at that point and at the ordinary overflow orifice [illegible] drawing its water supply, but when the jet has established its reactive force [illegible] combining and discharging cones [illegible] close the space between the two parts of the combining cone. According to another modification of the invention, the inner end of the inner casing forms the first part of the combining cone, and the bore of the inner casing is enlarged to receive the other part of the combining cone, which is either movable or fixed, leaving a space between the first and second part of the combining cone as an escape space. The second part of the combining cone has ribs or wings on its exterior to keep it central and secure it in the bore of the inner casing so as to form an annular space between the bore of the inner casing and the exterior of the combing cone. The annular space and the combining cone terminate at the same point, which is in about the position of the ordinary overflow orifice. The discharging cone is made separate with a flange or flat head, and it is, or may be, fitted to slide in the axis of the inner casing.

When the steam is turned on it will escape at the escape space between the two parts of the combining cone, and pass along the annular space on the exterior of the second part of the combining cone; the fluid will also pass out at the end of the combining cone, and both escapes of fluid will enter the inner casing (when used) and pass out through holes in its sides to the compartment in connection with the overflow branch of the casing until the injector has drawn its water supply, and when the jet is established the reactive pressure then coming upon the cone will cause it to move and bring its flat or valve head to close both the outlet from the escape space, and what corresponds to the ordinary overflow at the same time. The injector thus arranged will work well and feed water of greater temperature than ordinary injectors; but to provide against temporary overflow or leakage, a small hole is formed in the side of the discharging cone so that the passing jet will draw in all leakage or overflow, and cause the injector to work "dry," as it is termed. The discharging cone, according to one modification, is in the axis of the outer end of the inner casing which screws into the inner end of the inner casing, so that all are withdrawn together. In another modification, the junctions for all the pipes are on the sides of the casing, and the steam cone can be unscrewed and withdrawn at one end, and the other internal parts from the other end of the casing without breaking joints with the pipes, and instead of making the discharging cone a good fit and of small diameter, it is, or may be, made a loose fit, and provided with a collar or valve to close against a seating in the casing, thus preventing the escape of fluid when the reactive pressure of the established jet moves it. This latter construction also permits the moving parts to work freely even when some deposit or dirt is allowed by neglect or otherwise to accumulate upon them.

The figure shows in longitudinal section an injector according to one modification of the invention, where all the internal parts are so arranged and combined together that all the [illegible]



of the combining cone or tube, and when the inner casing (e) is screwed out of the outer casing a and the part c^1 is removed, the compound combining and discharging cones c and d can also be removed. There is an annular space between the exterior of the combining cone c and the interior of the inner casing e, into which the steam or fluid from the escape space $c^\times$ when starting the injector and the steam and water from the overflow d^1 can enter, and the steam and water can pass through slits or holes e^3 from the interior of the casing e to the annular space e^4 between the exterior of the inner casing e and the interior of the outer casing a, and then out at the overflow outlet a^3. The combined steam and water discharged by the discharging cone d pass from the interior of the inner casing e through holes e^5 into the annular space e^6, between the exterior of the inner casing and interior of the outer casing, and then to the discharge branch a^4.

[illegible] PATENT C DENSER.

In [illegible] of the Society of Ch [illegible] at the Inventions (1467) [illegible] Lecturer at the [illegible] shows his patent apparatus f [illegible] in chemical pr [illegible] The apparatus, which is being made by [illegible] and Co., of Ashton [illegible] the annexed eng [illegible] with an elevation of [illegible] The vapour entering at the to [illegible] by means of the [illegible] condensing space, a [illegible] through a large nu [illegible] which, bein [illegible] the condensing space C, project [illegible] the circulating wate [illegible] the circular portio [illegible] the condensing space ([illegible] any air wh [illegible] any vapour which ma [illegible] passes out by the pipe [illegible] passing through the conden [illegible] the gauze, which co [illegible] the walls of the condensing s [illegible] the water, which is co [illegible] through it. By this mean [illegible] condensation is [illegible] the fact th [illegible] of vapour in passing thro [illegible] by a cooling [illegible] to pass through a [illegible] which is held in the m [illegible] can be condensed wi [illegible] Fahrenheit, which would [illegible] in an ordinary copper [illegible] Fahrenheit. The apparatus is appli [illegible] purposes for which worms or coils [illegible] more efficient and oc [illegible] it will be found in [illegible] chemical works. Among [illegible] it may be mentioned that it [illegible] with success to the following pu [illegible] the recovery of the volatile solve [illegible] the manufacture of indiarubber goo [illegible] in the form of vapour f spreading machine: the recovery of liquids, such as benzine, naphtha, &c. cleaning cloth; as an ordinary still in tillation of alcohol, light oils, benzine, for general heating and cooling purpo condensers are made of copper coated or any other metal needed to protect th the action of the gases passing throug are fitted in strong cast-iron cases, and good workmanship are not likely to be ranged. For ordinary distilling purp are sold in six sizes, the smallest, 9in. and the largest, 16in. by 60in. Though size, it will be seen from the principle construction they are powerful, and found useful for all purposes in which quired to condense volatile liquids with and rapidity.

THE length of the Swedish State railwa end of 1884 was 2,312k., and that of the railways 4,288k., or a total of 6,600k.

caused by the intellectual darkness which spread over Europe like a pall for many centuries. The mental results of Greek science, filtered through the Romans and Arabians, gradually fertilised the soil of Europe. Even in ages which are deemed to be dark and unprolific, substantial though slow progress was made. By the end of the 13th century, the mathematics of the Alexandrian school had become the possession of Western Europe. Arabic numerals, algebra, trigonometry, decimal reckoning and an improved calendar having been added to its stock of knowledge. The old discoveries of Democritus and Archimedes in physics, and of Hipparchus and Ptolemy in astronomy, were producing their natural developments, though with great slowness. Many manufactures, growing chiefly by experience and occasionally lightened up by glimmerings of science throughout the prevailing darkness, had arisen before the 16th century. A knowledge of the properties of bodies, though scarcely of their relations to each other, came through the labours of the alchemists, who had a mighty impulse to work, for by the philosopher's stone, often not larger than half a rapeseed, they hoped to attain the three sensuous conditions of human enjoyment, gold, health, and immortality. By the end of the 15th century many important manufactures were founded by empirical experiment, with only the uncertain guidance of science. Among these were the compass, printing, paper, gunpowder, guns, watches, locks, knitting needles, horseshoes, bells, wood-carving and copper engraving, wire-drawing, steel, table glass, spectacles, microscopes, glass mirrors backed by amalgams of tin and lead, windmills, crushing and saw mills. These important manufactures arose from an increased knowledge of facts, around which scientific conceptions were slowly concreting. Aristotle defines this as science when he says, "Art begins when, from a great number of experiences, one general conception is formed which will embrace all similar cases." Such conceptions are formed only when science develops the human mind and compels it to give a rational account of the world in which man lives and of the objects in and around it, as well as of the phenomena which govern their action and evolution. Though the accumulation of facts is indispensable to the growth of science, a thousand facts are of less value to human progress than is a single one when it is scientifically comprehended, for it then becomes generalised in all similar cases. Isolated facts may be viewed as the dust of science. The dust which floats in the atmosphere is to the common observer mere incoherent matter in a wrong place, while to the man of science it is all important when the rays of heat and light act upon its floating particles. It is by them that clouds and rains are influenced; it is by their selective influence on the solar waves that the blue of the heavens and the beauteous colours of the sky glorify all Nature. So, also, ascertained though isolated facts, forming the dust of science, become the reflecting media of the light of knowledge and cause all Nature to assume a new aspect. It is with the light of knowledge that we are enabled to question Nature through direct experiment. The hypothesis or theory which induces us to put the experimental question may be right or wrong; still, *prudens questio dimidium scientiæ* — it is half way to knowledge when you know what you have to inquire. Davy described hypothesis as the mere scaffolding of science, useful to build up true knowledge, but capable of being put up or taken down at pleasure. Undoubtedly a theory is only temporary, and the reason is, as Bacon has said, that the [illegible] of [illegible] loveth truth more than his [illegible]. The changing theories which the world despises are the leaves of the tree of science drawing nourishment to the parent stems, and enabling it to put forth new branches and to produce fruit; and though the leaves fall and decay, the very products of decay nourish the roots of the tree, and reappear in the new leaves or theories which succeed. When the questioning of Nature by intelligent experiment has raised a system of science, then those who want to apply it to industrial inventions proceed with the same methods to make further progress in the arts. They also must have [illegible] Nature to reveal her secrets.

Air and Micro-organisms.

[illegible] slowly at first and how rapidly afterwards science and its applications [illegible] thousands of examples [illegible] to my hand. One of the [illegible] is air, for that surely [illegible] unaided [illegible] weight. Air has been [illegible] the first man [illegible] at every turn; [illegible] and it [illegible] him [illegible] that this familiar [illegible] up [illegible] and [illegible] with [illegible] But [illegible] by a remarkable [illegible] important [illegible] discover [illegible] important practical application. [illegible] tion as to the composition of air [illegible] in 1774 repeated [illegible] empirical observation [illegible] made three hundred years before [illegible] mercury [illegible] produced [illegible] The experiment now proved [illegible] oxygen. From that date [illegible] from an intelligent questioning of air [illegible] experiments, has [illegible] The air, which mainly consists of nitrogen and oxygen, is now known to contain carbonic acid, ammonia, nitric acid, and, besides these, floating organisms which have a vast influence for good or evil in the economy of the world. These micro-organisms, the latest discoveries in our knowledge of air, perform great analytical functions in organic nature, and are the means of converting much of its potential energy into actual energy. Through their action on dead matter the mutual dependence of plants and animals is secured, so that the air becomes at once the grave of organic death and the cradle of organic life. Some of the ancients suspected this without being able to prove the dependence. The consequences of the progressive discoveries have added largely to our knowledge of life, and have given a marvellous development to the industrial arts. Combustion and respiration govern a wide range of processes. The economical use of fuel, the growth of plants, the food of animals, the processes of husbandry, the maintenance of public health, the origin and cure of disease, the production of alcoholic drinks, the processes of making vinegar and saltpetre—all these and many other kinds of knowledge have been brought under the dominion of law. No doubt animals respired, fuel burned, plants grew, sugar fermented, before we knew how they depended upon air. But as the knowledge was empirical, it could not be intelligently directed. Now all these processes are ranged in order under a wise economy of Nature, and can be directed to the utilities of life: for it is true, as Swedenborg says, that human "ends always ascend as Nature descends." There is scarcely a large industry in the world which has not received a mighty impulse by the better knowledge of air acquired within a hundred years. If I had time I could show still more strikingly the industrial advantages which have followed from Cavendish's discovery of the composition of water. I wish that I could have done this, because it was Addison who foolishly said, and Paley who as unwisely approved the remark, "that mankind required to know no more about water than the temperature at which it froze and boiled, and the mode of making steam." When we examine the order of progress in the arts, even before they are illumined by science, their improvements seem to be the resultants of three conditions. 1. The substitution of natural forces for brute animal power, as when Hercules used the waters of the Alpheus to cleanse the Augean stables; or when a Kamchadal of Eastern Asia, who has been three years hollowing out a canoe, finds that he can do it in a few hours by fire. 2. The economy of time, as when a calendering machine produces the same gloss to miles of calico that an African savage gives to a few inches by rubbing it with the shell of a snail; or the economy of production, as when steel pens, sold when first introduced at one shilling apiece, are now sold at a penny per dozen; or when steel rails, lately costing £45 per ton, can now be sold at £5. 3. Methods of utilising waste products, or of endowing them with properties which render them of increased value to industry, as when waste scrap iron and the galls on the oak are converted into ink; or the badly-smelling waste of gasworks is transformed into fragrant essences, brilliant dyes, and fertilising manure; or when the effete matter of animals or old bones is changed into lucifer-matches. All three results are often combined when a single end is obtained—at all events, economy of time and production invariably follows when natural forces substitute brute animal force. In industrial progress the sweat of the brow is lessened by the conceptions of the brain. How exultant is the old Greek poet, Antipater, when men are relieved of the drudgery o [illegible] for the daily supply [illegible] who have hitherto had t [illegible] arms rest for the future. I [illegible] that the birds announce t [illegible] the dawn of the morning. Ceres has [illegible] to move the heavy mi [illegible] labour." Penelope had slaves to grind corn for her small ho During the most prosperous time of At was estimated that there were twenty s and free citizens. Slaves are mere machin machines neither invent nor discover. Th men of the Jews, the helots of Sparta, the slaves of Rome, the serfs of Europe, a educated labourers of the present day who slaves of ignorance have added nothing to progress. But as natural forces substit become cheaper than slave labour, liberty advancing civilisation. Machines require superintendence. One shoe factory in Bo its machines does the work of 30,000 shoem Paris who have still to go through th drudgery of mechanical labour. The stea of the world during the last 20 years, h from 11½ million to 29 million h.-p., or men.

A Petty Manufacture and Scien

Let me take a single example of how petty manufacture improved by the teac science affects the comforts and enla resources of mankind. When I was a only way of obtaining a light was by the box, with its quadruple materials, flint a burnt rags or tinder, and a sulphur-ma everything went well, if the box could b and the air was dry, a light could be obt two minutes; but very often the time was much longer, and the process became trial to the serenity of temper. The cons of this was that a fire or a burning lamp w alight through the day. Old Gerard, in his tells us how certain fungi were used to c from one part of the country to the othe tinder-box long held its position as a g covery in the arts. The *Pyxidicula Igni* the Romans appears to have been much t implement, though a little ruder, than the f steel which Philip the Good put into the c the Golden Fleece in 1429 as a representa high knowledge in the progress of the a continued to prevail till 1833, when phos matches were introduced, though I hav amused to find that there are a few ve ancients in London who still stick to the box, and for whom a few shops keep a sma ply. Phosphorus was no new discovery, for been obtained by an Arabian called Bechel eighth century. However, it was forgotte was rediscovered by Brandt, who made it very stinking materials in 1669. Other dis had, however, to be made before it could b for lucifer-matches. The science of comb was only developed on the discovery of a century later. Time had to elapse chemical analysis showed the kind of which could be added to phosphorus so as to it ignite readily. So it was not till 18 matches became a partial success. Intolerab they then were, dangerously inflammable, bo poisonous to the makers, and injurious to the of the consumers. It required another disc by Schrötter in 1845 to change poisonous into innocuous red-brick phosphorus in order these defects might be remedied, and to gi the safety-match of the present day. Now, have these successive discoveries in science for the nation, in this single manufacture, economy of time? If before 1833 we had the same demands for light that we now do, we daily consume eight matches per head of population, the tinder-box could have supplie demand under the most favourable conditio an expenditure of one quarter of an hour. lucifer-match supplies a light in 15 second each occasion, or in two minutes for the day. Putting these differences into a year, venerable ancient who still sticks to his tinder would require to spend 90 hours yearly in the duction of light, while the user of lucifer-ma spends 12 hours; so that the latter has an econ of 78 hours yearly, or about ten working Measured by cost of production at one shi and sixpence daily, the economy of time re sented in money to our population is twenty millions of pounds annually. This is a curiou stance of the manner in which science lead economy of time and wealth even in a small ma facture. In larger industries the economy of t and labour produced by the application of scien discoveries is beyond all measurement. Thu discovery of latent heat by Black led to the in tions of Watt; while that of the mechani equivalent of heat by Joule has been the bas the progressive improvements in the steam-engi which enables power to be obtained by a consum tion of fuel less than one-fourth the amount us twenty years ago. It may be that the engines

Watt and Stephenson will yield in their turn to more economical motors; still they have already expanded the wealth, resources, and even the territories of England more than all the battles fought by her soldiers or all the treaties negotiated by her diplomatists.

The Waste of Coal.

The coal which has hitherto been the chief source of power probably represents the product of five or six million years during which the sun shone upon the plants of the carboniferous period, and stored up its energy in this convenient form. But we are using this conserved force wastefully and prodigally; for although horse power in steam-engines has so largely increased since 1864, two men only now produce what three men did at that date. It is only three hundred years since we became a manufacturing country. According to Professor Dewar, in less than two hundred years more the coal of this country will be wholly exhausted, and in half that time will be difficult to procure. Our not very distant descendants will have to face the problem—What will be the condition of England without coal? The answer to that question depends upon the intellectual development of the nation at that time. The value of the intellectual factor of production is continually increasing; while the values of raw material and fuel are lessening factors. It may be that when the dreaded time of exhausted fuel has arrived, its importation from other coal-fields, such as those of New South Wales, will be so easy and cheap that the increased technical education of our operatives may largely overbalance the disadvantages of increased cost in fuel. But this supposes that future Governments in England will have more enlightened views as to the value of science than past Governments have possessed. Industrial applications are but the overflowings of science welling over from the fulness of its measure. Few would ask now, as was constantly done a few years ago, "What is the use of an abstract discovery in science?" Faraday once answered this question by another, "What is the use of a baby?" Yet round that baby centre all the hopes and sentiments of its parents, and even the interests of the State, which interferes in its upbringing so as to insure it being a capable citizen. The processes of mind which produce a discovery or an invention are rarely associated in the same person, for while the discoverer seeks to explain causes and the relations of phenomena, the inventor aims at producing new effects, or at least of obtaining them in a novel and efficient way. In this the inventor may sometimes succeed without much knowledge of science, though his labours are infinitely more productive when he understands the causes of the effects which he desires to produce.

Industrial Progress a Necessity.

A nation in its industrial progress, when the competition of the world is keen, cannot stand still. Three conditions only are possible for it. It may go forward, retrograde, or perish. Its extinction as a great nation follows its neglect of higher education, for, as described in the proverb of Solomon, "They that hate instruction love death." In sociology, as in biology, there are three states. The first of balance, when things grow neither better nor worse; the second that of elaboration or evolution, as we see it when animals adapt themselves to their environments; and, third, that of degeneration, when they rapidly lose the ground they have made. For a nation, a state of balance is only possible in the early stage of its existence, but it is impossible when its environments are constantly changing. The possession of the raw materials of industry and the existence of a surplus population are important factors for the growth of manufactures in the early history of a nation, but afterwards they are bound up with another factor—the application of intellect to their development. England could not be called a manufacturing nation till the Elizabethan age. No doubt coal, iron, and wool were in abundance, though, in the reign of the Plantagenets, they produced little prosperity. Wool was sent to Flanders to be manufactured, for England then stood to Holland as Australia now does to Yorkshire. The political crimes of Spain from the reign of Ferdinand and Isabella to that of Philip III. destroyed it as a great manufacturing nation, and indirectly led to England taking its position. Spain, through the activity and science of the Arabian intellect, had acquired many important industries. The Moors and the Moriscoes, who had been in Spain for a period as long as from the Norman Conquest of this country to the present date, were banished, and with them departed the intellect of Spain. Then the invasion of the Low Countries by Philip II. drove the Flemish manufacturers to England, while the French persecution of the Huguenots added new manufacturing experience, and with them came the industries of cotton, wool, and silk. Cotton mixed with linen and wool became freely used, but it was only from 1738 to the end of the century that the inventions of Wyatt, Arkwright, Hargreaves, Crompton, and Cartwright started the wonderful modern development. The raw cotton was imported from India or America, but that fact as regards cost was a small factor in comparison with the intellect required to convert it into a utility. Science has in the last hundred years altered altogether the old conditions of industrial competition. She has taught the rigid metals to convey and record our thoughts even to the most distant lands, and, within less limits, to reproduce our speech. This marvellous application of electricity has diminished the cares and responsibilities of Governments, while it has at the same time altered the whole practice of commerce. To England steam and electricity have been of incalculable advantage. The ocean, which once made the country insular and isolated, is now the very life-blood of England and of the greater England beyond the seas. As in the human body the blood bathes all its parts, and through its travelling corpuscles carries force to all its members, so in the body politic of England and its pelasgic extensions, steam has become the circulatory and electricity the nervous system. The colonies, being young countries, value their raw materials as their chief sources of wealth. When they become older they will discover it is not in these, but in the culture of scientific intellect, that their future prosperity depends. Older nations recognise this as the law of progress more than we do; or, as Jules Simon tersely puts it—"That nation which most educates her people will become the greatest nation, if not to-day, certainly to-morrow." Higher education is the condition of higher prosperity, and the nation which neglects to develop the intellectual factor of production must degenerate, for it cannot stand still. If we felt compelled to adopt the test of science given by Comte, that its value must be measured by fecundity, it might be prudent to claim industrial inventions as the immediate fruit of the tree of science, though only fruit which the prolific tree has shed. But the test is untrue in the sense indicated, or rather the fruit, according to the simile of Bacon, is like the golden apples which Aphrodite gave to the suitor of Atalanta, who lagged in his course by stooping to pick them up, and so lost the race. The true cultivators of the tree of science must seek their own reward by seeing it flourish, and let others devote their attention to the possible practical advantages which may result from their labours.

The Importance of Research.

There is, however, one intimate connection between science and industry which I hope will be more intimate as scientific education becomes more prevalent in our schools and universities. Abstract science depends on the support of men of leisure, either themselves possessing or having provided for them the means of living without entering into the pursuits of active industry. The pursuit of science requires a superfluity of wealth in a community beyond the needs of ordinary life. Such superfluity is also necessary for art, though a picture or a statue is a saleable commodity, while an abstract discovery in science has no immediate or, as regards the discoverer, proximate commercial value. In Greece, when philosophical and scientific speculation was at its highest point, and when education was conducted in its own vernacular and not through dead languages, science, industry, and commerce were actively prosperous. Corinth carried on the manufactures of Birmingham and Sheffield, while Athens combined those of Leeds, Staffordshire, and London, for it had woollen manufactures, potteries, gold and silver work, as well as ship-building. Their philosophers were the sons of burghers, and sometimes carried on the trades of their fathers. Thales was a travelling oil merchant, who brought back science as well as oil from Egypt. Solon and his great descendant Plato, as well as Zeno, were men of commerce. Socrates was a stonemason; Thucydides a gold-miner; Aristotle kept a druggist's shop until Alexander endowed him with the wealth of Asia. All but Socrates had a superfluity of wealth, and he was supported by that of others. Now, if our universities and schools created that love of science which a broad education would surely inspire, our men of riches and leisure who advance the boundaries of scientific knowledge could not be counted on the fingers as they now are, when we think of Boyle, Cavendish, Napier, Lyell, Murchison, and Darwin, but would be as numerous as our statesmen and orators. Statesmen, without a following of the people who share their views and back their work, would be feeble indeed. But while England has never lacked leaders in science, they have too few followers to risk a rapid march. We might create an army to support our generals in science, as Germany has done, and France is now doing, if education in this country would only mould itself to the needs of a scientific age. It is with this feeling that Horace Mann wrote:—"The action of the mind is like the action of fire; one billet of wood will hardly burn alone, though as dry as the sun and north-west wind can make it, and though placed in a current of air; ten such billets will burn well together, but a hundred will create a heat fifty times as intense as ten—will make a current of air to fan their own flame, and consume even greenness itself."

Abstract Science the Condition for Progress.

The subject of my address has been the relations of science to the public weal. That is a very old subject to select for the year 1885. I began it by quoting the words of an illustrious Prince, the consort of our Queen, who addressed us on the same subject from this platform 26 years ago. But he was not the first prince who saw how closely science is bound up with the welfare of States. Ali, the son-in-law of Mahomet, the fourth successor to the Caliphate, urged upon his followers that men of science and their disciples give security to human progress. Ali loved to say, "Eminence in science is the highest of honours," and "He dies not who gives life to learning." In addressing you upon texts such as these, my purpose was to show how unwise it is for England to lag in the onward march of science when most other European Powers are using the resources of their States to promote higher education and to advance the boundaries of knowledge. English Governments alone fail to grasp the fact that the competition of the world has become a competition in intellect. Much of this indifference is due to our systems of education. I have ill-fulfilled my purpose if, in claiming for science a larger share in public education, I have in any way depreciated literature, art, or philosophy, for every subject which adds to culture aids in human development. I only contend that in public education there should be a free play to the scientific faculty, so that the youths who possess it should learn the richness of their possession during the educative process. The same faculties which make a man great in any walk of life—strong love of truth, high imagination tempered by judgment, a vivid memory which can co-ordinate other facts with those under immediate consideration—all these are qualties which the poet, the philosopher, the man of literature, and the man of science equally require and should cultivate through all parts of their education as well as in their future careers. My contention is that science should not be practically shut out from the view of a youth while his education is in progress, for the public weal requires that a large number of scientific men should belong to the community. This is necessary because science has impressed its character upon the age in which we live, and as science is not stationary but progressive, men are required to advance its boundaries, acting as pioneers in the onward march of States. Human progress is so identified with scientific thought, both in its conception and realisation, that it seems as if they were alternative terms in the history of civilisation. In literature, and even in art, a standard of excellence has been attained which we are content to imitate because we have been unable to surpass. But there is no such standard in science. Formerly, when the dark cloud was being dissipated which had obscured the learning of Greece and Rome, the diffusion of literature or the discovery of lost authors had a marked influence on advancing civilisation. Now, a Chrysoloras might teach Greek in the Italian universities without hastening sensibly the onward march of Italy; a Poggio might discover copies of Lucretius and Quintilian without exercising a tithe of the influence on modern life that an invention by Stephenson or Wheatstone would produce. Nevertheless, the divorce of culture and science, which the present state of education in this country tends to produce, is deeply to be deplored, because a cultured intelligence adds greatly to the development of the scientific faculty. My argument is that no amount of learning without science suffices in the present state of the world to put us in a position which will enable England to keep ahead of or even on a level with foreign nations as regards knowledge and its application to the utilities of life. Take the example of any man of learning, and see how soon the direct consequences resulting from it disappear in the life of a nation, while the discoveries of a man of science remain productive amid all the shocks of empire. As I am in Aberdeen I remember that the learned Dutchman Erasmus was introduced to England by the encouragement which he received from Hector Boece, the Principal of King's College in this University. Yet even in the case of Erasmus—who taught Greek at Cambridge and did so much for the revival of classical literature as well as in the promotion of spiritual freedom—how little has civilisation to ascribe to him in comparison with the discoveries of two other Cambridge men, Newton and Cavendish. The discoveries of Newton will influence the destinies of mankind to the end of the world. When he established the laws by which the motions of the great masses of matter in the universe are governed, he conferred an incalculable benefit upon the intellectual development of the human race. No doubt the road upon which he travelled had been long in preparation by other men. The exact observations of Tycho Brahe, coupled with the discoveries of Copernicus, Kepler, and Galileo, had already broken down the authority of Aristotle and weakened that of the Church. But though the conceptions of the universe were thus broadened, mankind had not yet rid themselves of the idea that the powers of the universe were still regulated by spirits or special providence. Even Kepler moved the planets by spirits, and it took some time to knock these celestial steersmen on the head. Descartes, who really did so much by his writings to force the conclusion that the planetary movements should be dealt with as an ordinary problem in mechanics, looked upon the universe as a machine, the wheels of which were kept in motion by the unceasing exercise of a divine power. Yet such theories were only an attempt to regulate the universe by celestial intelligences like our own, and by standards within our reach. It required the discovery of an all-pervading law, universal throughout all space, to enlarge the thoughts of men, and one which, while it widened the conceptions of the universe, reduced the earth and solar system to true dimensions. It is by the investigation of the limits on all sides that we obtain a higher conception of the infinite. Newton's discovery cast men's mind into an entirely new mould, and levelled many barriers to human progress. This intellectual result was vastly more important than the practical advantages of the discovery. It is true that navigation and commerce mightily benefited by our better knowledge of the motions of the heavenly bodies. Still these benefits to humanity are incomparably less in the history of progress than the expansion of the human intellect which followed the withdrawal of the cramps that confined it. Truth was now able to discard authority, and marched forward without hindrance. Before this point was reached Bruno had been burned, Galileo had abjured, and both Copernicus and Descartes had kept back their writings for fear of offending the Church. The recent acceptance of evolution in biology has had a like effect in producing a far profounder intellectual change in human thought than any mere impulse of industrial development. Already its application to sociology and education is recognised, but that is of less import to human progress than the broadening of our views of Nature. Abstract discovery in science is then the true foundation upon which the superstructure of modern civilisation is built; and the man who would take part in it should study science, and, if he can, advance it for its own sake, and not for its applications. Ignorance may walk in the path lighted by advancing knowledge, but she is unable to follow when science passes her, for, like the foolish virgin, she has no oil in her lamp. An established truth in science is like the constitution of an atom in matter—something so fixed in the order of things that it has become independent of further dangers in the struggle for existence. The sum of such truths forms the intellectual treasure which descends to each generation in hereditary succession. Though the discoverer of a new truth is a benefactor to humanity, he can give little to futurity in comparison with the wealth of knowledge which he inherited from the past. We, in our generation, should appreciate and use our great possessions—

[illegible] stores combine
[illegible] wealth, the world's name!

EVOLUTION IN THE VEGETABLE KINGDOM. IV.*

[illegible] page 7.)

THREE species of Rhizocarpeæ (Sporangites, Protosalvinia) have been described by Sir J. W. Dawson from spore cases detected in Devonian rocks of both Canada and Brazil. Heer had already announced, in 1871, what he regarded as the earliest known Rhizocarp from the Lower Carboniferous of Spitzbergen, and there can be little doubt that some of the spore-bearing plants [illegible] belonged to this order, although [illegible] been described from the Carboniferous [illegible]. This little group, which has been supposed in a manner to mark the transition from the cryptogams to the gymnosperms, reappears [illegible] Heer, in the Oölite of Siberia, the Urgonian of Kome, and the Cenomanian of Atane, Greenland, [illegible] in our Laramie and Green River [illegible] Oligocene of France, [illegible] Miocene of Switzerland and Central Europe [illegible] Carboniferous, as two new [illegible] the more [illegible] investigate the Mesozoic [illegible]

[illegible] Thus we see that all the leading groups of vegetation except the [illegible] made their appearance at the [illegible] of the Carboniferous age. Before passing to that important [illegible] of the vegetable kingdom, the Ligulatæ and the Gnetaceæ, though humble, may claim a word of notice because they have been regarded by some as transition forms connecting the great types. The Ligulatæ are allied to the Lycopodiaceæ, and the genus Selaginella has sometimes been placed in the one and sometimes in the other of these orders. It is claimed to have been found in the Carboniferous, but of this there is doubt. Its first certain appearance is in the Cenomanian beds of Atane, Greenland, but it also occurs in our Laramie group at Golden, Colorado, and at Point of Rocks Station in Wyoming Territory. The more typical ligulate genus, *Isoetes*, makes its first appearance in our Eocene at Florissant, Colorado, and is represented by two Miocene species in Europe. As regards the Gnetaceæ, by far the most ancient known representative is Heer's *Ephedrites antiquus*, from the Oölite of Siberia. Only two other fossil species of this order are known—viz., *Ephedra (Ephedrites) sotzkiana* (which not only occurs in the Oligocene of Sotzka, but in several of the principal Miocene beds of Switzerland, Germany, and Austria) and *Ephedra johniana* from the amber deposits of Samland, Prussia.

The immense interval of time that separates the first appearance of all other forms of plant life from that of the dicotyledons is one of the most striking facts revealed by palæontology. Heer's *Populus primæva*, from the Urgonian of Pattorfik, Greenland, described ten years ago, still remains the sole representative of this sub-class in any formation below the Cenomanian and the most ancient dicotyledon known.* Not less remarkable, however, has been the march of these plants since their earliest manifestation, as will presently be shown.

Having thus noted the time of first appearance of each principal type of vegetation, we may now hastily glance at the mode of subsequent development of each. This might be done from two distinct points of view, the absolute and the relative, but as the former would be powerfully affected by the defects in the geological record, no attempt will be here made to represent it graphically. The relative point of view, however, admits of such representation which in a certain respect eliminates these defects. Collectors of fossil plants do not seek specially for particular types. They take all they find, and hence if the chances of preservation are equal for all types, the chances of finding plants of a particular type would depend upon its abundance in the flora of the epoch to be studied, while, conversely, the degree to which any type of plants is represented in collections would be a fair measure of its abundance in the flora of the given epoch. The facts sustain in a striking manner the early generalisation of Brongniart, against which Dr. Lindley so strongly inveighed as late as 1836, that there has been a general upward tendency in structural development through the geological periods. The Silurian was the age of cellular cryptogams, consisting principally of marine Algæ. The reign of the vascular cryptogams began with the Devonian and closed with the Permian, the ferns constantly taking the lead but being strongly supported by the Calamariæ and Lepidophytes throughout the Carboniferous. The gymnosperms assumed supremacy in the Trias, the Cycadaceæ taking the lead in the Keuper and holding it through the Oölite, then surrendering it to the Coniferæ, which held it far up into the Lower Cretaceous. The monocotyledons never held a dominant position, but increased steadily throughout the Mesozoic, reaching their highest expression in the palms, and their greatest relative predominance in the Eocene, but probably attaining their highest absolute development in the Oligocene or Lower Miocene. The dicotyledons, which, as already shown, made their first observed appearance in the Urgonian, or Lower Cretaceous, progressed with such amazing rapidity as to become the ruling type in the Cenomanian, or Middle Cretaceous, furnishing in that formation over seventy-two per cent. of the total known flora of the globe, which is nearly as high a percentage as they attained at any subsequent period. Of the present flora they less than sixty per cent., and doubtless their re presentation in the fossil flora is exaggerated, ow the failure of the myriad fungoid forms, ex [illegible] to leave any traces in the rocks

The systematic value of the prevailing division of the dicotyledons into monochlamy and dialypetalous, and the latter agai polypetalous and gamopetalous, diminishes w progress of research. The first of these divis invalidated by the fact that the natural af are between apetalous and polypetalous a between apetalous and gamopetalous plan last-named division being the highest in p structural development. The apetalous d forms forty-five per cent. of the dicotyledon Cenomanian, thirty-seven per cent. in the M and only fourteen per cent. in the living flor Polypetalæ are fifty per cent. in the Ceno forty-eight per cent. in the Miocene, and fo cent. in the living flora. The Gamopetalæ per cent. in the Cenomanian, fifteen per cen Miocene, and forty-six per cent. in the livi Making all due allowance for the fact t Gamopetalæ of the living flora are more herbaceous than either of the other di which fact, properly viewed, constitutes a proof of their greater recency, this evidenc seem quite sufficient to establish the o development of the dicotyledons as here a As still further confirming the general development in vegetable life, we observe t decline of the cryptogamic types that predo throughout the Palæozoic. The same is t less extent of the gymnosperms, and notabl Cycadaceæ. The monocotyledons have also p declined, as have the lower or monochla dicotyledons. The only one of all the forms of life of which we can positively it still preserves an upward tendency gamopetalous division of the dicotyledons, unless arrested by human agency, seems des form the dominant type of vegetation for t geologic epoch.

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* [illegible]

THE DEVELOPMENT OF THE NECTING ROD.*

NATURALISTS, Darwin and other taught that there are many rudi organs in the anatomy of animals which l mained from generation to generation, g becoming smaller as the time of their us has passed. For example, the legs of a whose remote ancestors certainly had good them, but now only the rudimentary b found under a smooth exterior. The fing horse, the whole five series of rudimentar of which may be traced—the middle fing ever, having received its greatest devel nail and all, in the shape of the hoof. W similarity in many things of every-day lif mantel or chimney pieces in rooms whi neither fireplace nor chimney, being h steam-pipes, or by a current of dry air, d coal-gas, through a hole in the floor register. The buttons on the back of a m once had their use when gentlemen r horses and required a convenient attach their voluminous coat skirts on muddy da

The comparison holds good in regard necting-rods of steam-engines and other ma in which certain exterior forms, which o useful, are still retained, many engine d being led to preserve and reproduce the from an unquestioning belief in their m correctness, or from habit, which has ca ornamentation to appear the most sym loveliness. This I will endeavour to dem by reference to the accompanying cuts. three representing the ancient form, the n the mediæval, and the last two the moder departure; all are from measurements o actual use.

Fig. 1 is of cast iron, from a beam eng by Boulton and Watt 70 years ago, and use; a little extra weight was usually these rods for a counterbalance to the pi crosshead. Fig. 2 is the "umbrella" fo sisting of a bar of round rolled iron, and si bars disposed about it and welded at th form the stubs. The cast-iron blocking maintain the stiffness. About the only e of this rod now in use are on the old pum Schuylkill waterworks in Philadelphia, and on some old tow-boats on the Delaware riv impression is that it originated with Olive as there are none in England to my kn Fig. 3 represents the timber pitman of t river, at which the young men from the i on their first trip to the West are given much ridicule. On analysis and consider the circumstances attending its origin it found eminently fitted for its duty. It ing, the forgings are light and easy to ma

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* [illegible]

* By WILLIAM H. HARRISON, in the American J

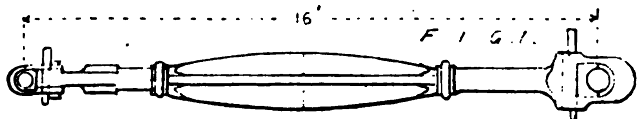
FIG. 1.

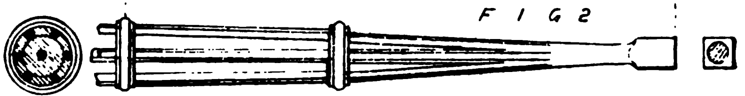
FIG 2

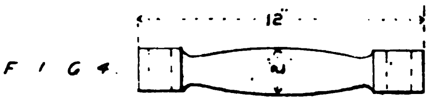
FIG 4.

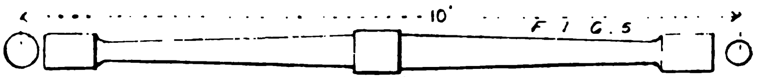
FIG. 5

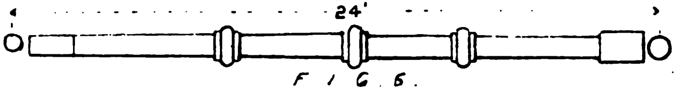

FIG. 6.

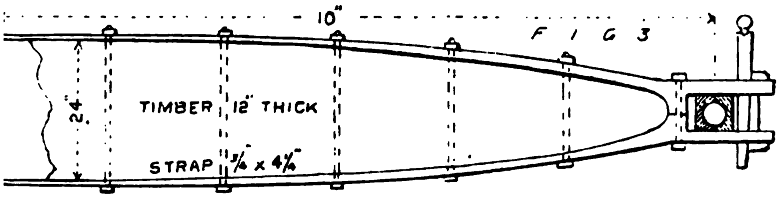
FIG 3

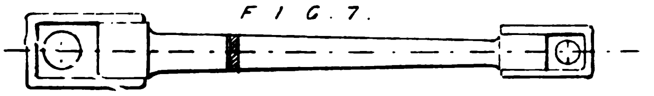
FIG. 7.

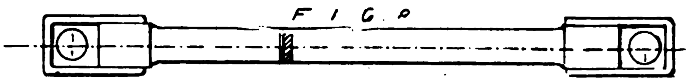
FIG. 8

fire, the stiffness under compression is ted by the adjoining forest, and the taste of the engineer is gratified by the he end of the key, which he sandpapers in re moments. This rod has its prototype rods of the Cornish mines, and so they are his day.

primeval forms had their influence on the later constructors after the use of solid had rendered them unnecessary or harm- we find on the Ohio river the greatest toward excessive bulging, as shown in hich is the front link of a "doctor" or engine, turned from the solid. In Fig. 5 favourite form of rod, the idea remain- the rod should be large in the middle, and there would be something wrong without al branch, which is sometimes used as a when holes are drilled for the support to ls when they are used. In Fig. 6, most l of all, we find three excrescences; this ntly a lineal descendant from Evans's la," and is taken from the pumping engines go, all the connecting-rods and links of e as shown. Whether these bunches were rom the solid, or whether they were stuck "soft sodder," I have no means of know- y are equally useful and ornamental made way. In later years, the speed of engines sures of steam having increased, it was at the small-necked rods were very un- ory to their owners, causing frequent s, until one day a notable thing occurred. ght man reasoned: "If these rods bend in ks we will make the necks bigger, regard- hat people say as to their looks;" so that worked out, and parallel rods of locomo- came truly parallel, easy to make, and well up to their work. Such a rod is Fig. 8.

ning in the same way: "If a connecting- retofore made is always breaking at the d, we will make that end the largest part," as in Fig. 7, was developed, which repre- e new departure in locomotives. Both ls are smooth-forged, with a coal-tar finish, as well adapted to modern facilities and ents as were the ancient constructions of d Evans to their times.

EW FACTS ABOUT TOBACCO SMOKING.

e of the opposition encountered by our est against cigarette-smoking, which, it emembered, first raised the question about of the use of tobacco, it is now generally admitted that we were right and our opponents wrong in the matter. The rapid consumption of the finely shredded leaves very close to the mouth has been proved to render the practice of smoking cigarettes peculiarly objectionable. Moreover, it has been shown, that although the use of a tube and the provision of a plug of cotton will lessen the evil, they do not wholly deprive the cigarette of its objectionable qualities. We are not, as is well known, advocates of the disuse of tobacco. If moderately and wisely employed, it is a valuable sedative to the nerves, and has an especially soothing influence in the majority of instances. There are, however, certain properties of the tobacco smoke which ought to be generally understood. It is unquestionably in some way a special sedative to the heart's action. We are not in the least surprised to find it stated that a considerable proportion of the boys medically examined for the United States Navy are rejected on the score of "weakness of the heart," and that this should be attributed to the habit of smoking cigarettes. As we pointed out when first directing attention to the subject, the sphygmograph shows a peculiar influence to be exerted by the smoking of tobacco, particularly in the form of cigarettes, on the pulse, partly due to depression of the heart's action, and partly to the loss of vaso-motor tone in the arteries. Those practitioners who do not habitually use the sphygmograph in their daily work, but content themselves with simply feeling the pulse with the finger, may not be aware of this fact. It is a fact nevertheless. To the sedative action of tobacco on the heart may possibly be due that agreeable sense of quietude and of "cooling" which is commonly experienced when smoking in the heat of summer. The points for which we are now specially anxious to call consideration are these:—(1) The influence of tobacco is *apparently* cumulative. A warning sense of excess in the use of tobacco generally comes too late. The pipe, cigar, or cigarette may be laid aside, but the depressing or nauseating effect increases for some time. Nevertheless there is no valid reason to suppose tobacco, or nicotine, does actually accumulate. (2) Excitation of the nerve centres, as by oxidation, seems to intensify the effects of tobacco when once taken into the system. On going out into the air and breathing quickly, the characteristic sensations are nearly always for a time aggravated. (3) A cigar or cigarette smoked through a fine tube is generally "stronger" in its influence than the same smoked without a tube. These three results of observation and experiment seem to suggest the conclusion that the action of tobacco is topical as regards the nerves, the afferent radicles being first acted upon, and when these are brought under its influence the centres being affected from the periphery. In short, we incline to think tobacco is not absorbed, or if it be its action is not due to absorption, but that it operates as a peripheral sedative like cocaine, and produces its general effects, as coca stops the sense of hunger, by numbing the nerves of the stomach, the central effects being secondary, and to some extent reflex. It is worth while to pursue this subject further. We incline to think that tobacco may be found to have an as yet unsuspected value therapeutically, if we can only arrive at a correct notion of the precise manner in which its effects are produced, and then determine how to use it. Great good would result from the recognition of tobacco as a drug, if only because then its abuse could be restrained. In the old days, before chloroform and the other anæsthetics were discovered, the use of tobacco as a potent sedative to relax the muscles in dislocations and to facilitate the reduction of herniæ was a clumsy expedient. It was speedily abandoned when better stupefying agents were provided. It would, however, have been wiser to investigate the action of the agent more closely, instead of throwing it wholly aside. —*Lancet.*

HOW TO MAKE A GLYCERINE BAROMETER.*

IN 1876 I improved Babinet's barometer by substituting glycerine for water. It is constructed in the following manner: A bottle about a quarter filled with glycerine, coloured red with magenta or crimson aniline, has a glass tube of about the diameter of a pencil passing airtight through the cork, which is inserted airtight into the bottle. The lower end of the tube dips beneath the surface of the glycerine. The bottle is made to contain compressed air by blowing into the upper end of the tube. On removing the mouth, part of the glycerine will rise in the tube until the weight of the liquid column in the tube and the atmosphere balance the internal air pressure on the surface of the glycerine. The column in the tube will tend to rise when the pressure of the atmosphere diminishes or the temperature of the compressed air rises, and to fall when the atmospheric pressure increases or the temperature of the compressed air diminishes. So far as the variation in the height of the column is due to changes in atmospheric pressure, the column moves in the opposite direction from that in a mercurial barometer.

It will now be seen that it is desirable to eliminate from the reading of the barometer scale the effect due to a change in temperature. I simultaneously observe the reading of my barometer and a thermometer at hand. I next find the difference between the readings, calling that of the thermometer the minuend. The difference is regarded as the relative pressure of the atmosphere at the time of observation. The divisions on my instrument are one-fourth of an inch apart, and the length of the tube above the bottle is 25in. It seems better to have 100 divisions than any other number. These divisions bear no relation to those on mercurial and aneroid barometers. Each instrument is intended to be compared with itself to indicate a relative pressure of the atmosphere. In my instrument the degrees are marked and numbered with a pen on a strip of paper obtained from a ribbon roll; this is pasted upon a neat wooden case behind the tube. The case has a recess into which the bottle is let. A neat piece of wood, of the proper shape, secures the bottle, while leaving it almost entirely in view. Two small wire staples secure the tube to the scale. If desirable, a paper scale may be pasted upon the tube, thus dispensing with a case. Of course, it is liable to be broken when thus constructed. The use of a thermometer is scarcely necessary if the barometer is kept in a cellar or any place where the temperature is nearly uniform. With a tube 3ft. or 4ft. long, the bottle may be buried in a large box of dry sawdust, or any other poor conductor of heat, in a finely divided state. The instrument will then give fair results without using either a thermometer or a cellar. The advantage of using glycerine instead of water, as used by the French scientist Babinet, is that glycerine scarcely evaporates; besides, it will not freeze except at a very low temperature, and if a minute quantity of water be present it never becomes solid. A thin glass tube, 4ft. long, can be bought for 10 cents at the drug stores in cities. The glycerine and magenta will cost less than 5 cents. By making an ornamental case one may, with a little ingenuity, produce a beautiful instrument. It will foretell fair, changeable, and stormy weather as well as a mercurial barometer costing thirty times as much. One evening I noticed that the column of glycerine had risen about 3in. within a few hours; not a cloud was to be seen, and the day had been very fine. Next morning there was a heavy rain. The upper end of the tube should be loosely filled with cotton to keep out the dust. After having forced air into the instrument, it should not be allowed to approach a horizontal position, for the compressed air may blow the column out of the tube; if this does not happen, a large air bubble may separate the column, and render the instrument useless. No particular dimensions are requisite for either the bottle or the tube. My bottle is about 4in. long and 1in. square. The magenta is used merely to render the column more readily visible. Other colours may be used, but this is the most beautiful. Were farmers provided with these simple and useful instruments, they would most likely be the means of saving grain in harvest, as storms could often be foretold.

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* By J. ASHER, in *Scientific American.*

THE WEIGHT OF AN AXE.

I WELL remember my first axe, and my early experience with it. It weighed 4¾lb., being the heaviest one I could find at the time. I was fresh from school—fresh from a class in natural philosophy, one of my favourite studies. I knew all about *inertia*, and had learned something of the force of gravity and the laws of falling bodies; had rightly guessed that chopping wood might be hard work, and determined that my knowledge of physics should help me out.

I would have a heavy axe, a long handle—would move slowly, and take strokes that would count when they fell. My axe handle was 34in. in length, the longest one in the store. I had hired a tough little French Canadian, weighing about 120lb., to help me in this work. When he came he brought an axe—a mere toy I called it. I think it weighed 2½lb., with a handle only 26in. long. I told him I had a fair-sized job for him, and thought it would pay him to buy a full-grown axe. He smiled and said he guessed his would do. I tried to explain to him the beauties of a heavy axe and the wonderful advantage of a long handle. But it was all in vain: I was only wasting time; he could not understand it.

"Poor fellow," I thought; "he knows nothing of the beautiful science of physics. It is too bad that he should thus waste his strength through ignorance, and be unwilling to listen to the voice of wisdom."

We went to the wood lot and began work. I had decided that we would work separately during the first day or two, in order that I might show him what I could do. As I began to swing my axe I felt proud of its ponderous blows that rang through the woods, and rather pitied the poor fellow who was drumming away with his little axe, taking about two blows to my one.

Presently I had to stop to rest, and then again, and still again: but Joe, my man, kept pecking away quietly, steadily, and easily. Every few minutes I would stop to take breath; but Joe seemed perfectly able to do all necessary breathing without stopping his work for the purpose.

When night came, we piled up our wood and measured it. Joe's pile measured 1½ cord; mine only three-quarters of a cord.

During the early part of the day I had planned giving Joe another lesson in the evening, to see if I could not make him understand the elementary principles of wood-cutting and the philosophical requirements of an axe. But when night came I decided that perhaps it would be as well to let him go on in ignorance; and thereafter remained silent on the subject.

The next day I felt lame, and stayed at home. Joe put in his cord and a half as usual.

When I went to the woods again, Joe and I worked together. Not many days passed before I found an excuse for buying a lighter axe and a shorter handle. And every axe and handle that I have bought since then has been lighter and shorter than its predecessor.

Whenever I use an axe now I select one very much like Joe's, both in weight and length of handle. I can use this without getting out of breath, and can hit twice in the same place. The result is, I can do more and better work, and save a vast amount of strength.

I write this as a word of caution to the inexperienced wood-chopper when about to purchase an axe.—*Albany Cultivator.*

Dyeing Straw, Willow, &c.—To give a black colour to the willow used for baskets and other woven ware, let the material remain from twelve to twenty hours in lukewarm water, and dipping it a sufficient length of time in a dye composed of five parts of ground fustic, three of sulphate of copper, five of sulphate of iron, and four of cream of tartar. The dye shouldbe kept at a boiling heat for half an hour, to extract the colour from the fustic and dissolve the other ingredients, after which it may be allowed to cool. A small quantity of logwood added will sometimes improve the colour. The same process may be used for colouring the various fabrics of which summer hats are made, such as straw, palm-leaf, grass, &c.

SCIENTIFIC NEWS.

◆◆◆

THE death is announced of Colonel William Yolland, C.B., F.R.S., the well-known inspector of railways, a post to which he was appointed in 1854. Col. Yolland obtained his commission in the Royal Engineers in 1828, and served in Canada and on the Ordnance Survey in England and Ireland, during which period of his life he superintended the publication of astronomical observations made with Ramsden's zenith sector, and afterwards with Airy's, the latter being for the purpose of determining the latitudes of various trigonometrical stations in the United Kingdom. The deceased was born in 1810.

Lieut. L. Brault, of the French navy, who had charge of the meteorological service at the dépôt des Cartes et Plans, Paris, and was the author of several useful meteorological works, died recently in harness, while engaged in the important labour of extracting and tabulating observations from ships' logs.

The most important news of the week in the astronomical world is the various observations of the new star in the Andromeda nebula, which will be found detailed at some length elsewhere.

Dun Echt Circular, No. 98, announces the discovery of a new comet on August 31, by Mr. Brooks, of Rochester, N.Y., and the code telegram from Prof. Krueger, of Kiel, states that it was observed by Prof. Pickering, at Cambridge, Mass., on Sept. 2·7 G.M.T., in R.A. 13h. 42m., N. Dec. 36° 37'. The daily motions are stated to be minus 3m. 12s., plus 19'; but there would appear to be some error, as Col. Tupman says that the place for Sept. 7, at 10 G.M.T., was R.A. 14h. 9m., N.P.D. 51° 17'. Mr. A. A. Common, of Ealing, discovered the comet independently on Friday, Sept. 4, and gives the approximate position then as R.A. 13h. 53m., N.P.D. 52° 20'. Mr. Common gives its diameter as 9'; but the telegram puts it at 2', and says that it is a circular comet, as bright as 9th mag., with some central condensation, but no tail. Col. Tupman, however, says it is a faint object, less than 9th mag., with neither nucleus nor tail.

Prof. C. H. F. Peters, Litchfield Observatory, Hamilton College, Clinton, N.Y., discovered his 43rd small planet on Aug. 16, raising the number to 249. The observation having been announced by telegraph, the planet was detected by M. Bigourdan, Paris, on the 18th ult.

That discovery was quickly followed by another, for on the evening of the 3rd inst. Herr Palisa, of Vienna, found a minor planet, thus bringing the number of these bodies to 250. The following are the particulars of the discovery:—Sept. 3, 9h. 53sec. (G. M. T.) R.A., 23h. 34m. 44s.; N.P.D., 106° 9' 35"; daily motion in right ascension, 48sec. decreasing, in polar distance 3' increasing; mag. 11th.

Tuttle's comet does not appear to have been noticed anywhere except at Nice. The perihelion passage occurs on the 11th inst. (today).

With reference to the lightning-struck trees in Richmond Park, Mr. G. J. Symons says that they stood on ground near to, but a little lower than, the White Lodge; that their respective girths at 3ft. were 11ft. and 12ft., the trunks being 23ft. apart. There are three other trees within 40ft. of them quite uninjured, except by the branches thrown upon them. The tree which presents the most interesting effects appears "to have been cut through horizontally at about 30ft. above the ground; the upper portion shows comparatively little injury, but the lower part is not merely stripped of its bark, but burst open in a very intense way. Spikes of the stem several inches thick, and 10ft. or 15ft. long, stand out from the trunk (somewhat like the ribs of an umbrella before it is fully opened), and grip, between themselves and the centre of the trunk, branches which fell from the upper part before they had time to reclose, while the ground for perhaps 200ft. around is strewn with bark and fragments of the trunk, from scraps like lucifer matches to pieces which some men could not lift." Mr. Symons asks what produces the disruptive force, and why are oaks and elms so especially liable to be struck.

At a meeting of the Boston (Mass.) Scientific Society, Mr. H. P. Curtis read a paper on "The Acoustics of Thunder," in which he stated, as the result of ten years' observation in Europe and America, that he had heard thunder at a distance of 100 miles from the flash. Other observers, by timing the interval between flash and sound, made the distance 150 miles! Perhaps they worked by the sound from a flash they omitted to observe.

Mr. W. Oldham Chambers, secretary of the National Fish Culture Association, says that from observations he has made at Delaford Park, he is convinced the catfish does not molest other species, neither does it subsist upon live food, but upon refuse—it being a bottom-feeder and a scavenger. The whitefish (*Coregonus albus*) is quite harmless, grows rapidly, is very prolific, and makes excellent food. Much success has been attained in rearing it at South Kensington and at Delaford Fishery; and next year it is hoped to hatch ova on the large scale with a view of distributing the fry among the Scotch lakes.

The National Fish Culture Association have forwarded by the *Republic* a large supply of young soles and brill as a present to the government of the United States, who are desirous of making further efforts to propagate the best of our flat fishes in their waters.

A series of meetings in connection with the East of Scotland Union of Naturalists was commenced at Kirkcaldy last week, when Prof. Geikie delivered an address, in which he said that they did not mean simply to obtain a complete census of all the rocks minerals fossils, and species of plants and animals in the East of Scotland, but to ascertain how their distribution was effected. The chief aim of the Union, then, is the careful and exhaustive collection of data which would render possible the elaboration of a complete natural history of the East of Scotland.

The Iron and Steel Institute held its autumn meeting last week at Glasgow, when several interesting and useful papers were read, and many pleasant excursions made. The iron trade of Scotland was dealt with by Mr. Rowan, and Mr. J. Riley gave an account of the Rise and Progress of the Scotch Steel Trade, and also described an experimental cupola furnace. A paper on "The Forth Bridge," by Mr. B. Baker, was intended as a preliminary to the visit paid by many of the members to the works.

The quarterly meeting of the Coalville Branch of the Amalgamated Society of Railway Servants was held recently, and after the transaction of routine business, Mr. C. E. Stretton delivered an address on railway matters, in which he touched on permanent way, ancient and modern; locomotives and rolling stock; continuous brakes, injectors, and valve-gear; breaking of crank axles, signals and block systems, accident returns, &c. Mr. Stretton urged that if proper appliances are not provided, it is unfair and unjust that servants should bear all the blame when disaster occurs.

The *Etruria* has accomplished the best voyage on record from Liverpool to New York and back again. As mentioned on p. 562, Aug. 28th, she made the trip to New York from Queenstown in 6 days 5 hours 31 minutes, and has now accomplished that voyage in 12 days 12 hours 32 minutes, giving 6 days 7 hours for the return trip. The *Etruria* embarked her passengers at New York one Saturday, and landed them in Liverpool on the afternoon of the next.

Mr. G. C. Bourne, B.A., of New College, Oxford, an ex-captain O.U.B.C., has taken a passage to the island of Diego Garcia, in the Indian Ocean, where he intends to remain some months, and make all the collections and investigations he can. Mr. Bourne has just taken a "first" in animal morphology, and the Royal Society have made a grant of £100 towards his expenses from the Government fund at their disposal.

The treasurer of the French Association, at the meeting held recently in Grenoble, announced that the association had a funded capital of £20,000, and an annual subscription of £2,250. The society is to be amalgamated with the Association Scientifique, founded by Leverrier. The next meeting will be held at Nancy.

M. Pasteur is at his country retreat in the Jura, perfecting a method for assuring to animals exemption from hydrophobia, which will also be efficacious in the case of man.

The Royal Victoria Hall, Waterloo-bridge-road, has now opened for the season with a highly attractive and diversified programme. Thursday, like Saturday and Monday, will at present be a variety night, but it is intended to recommence the Ballad Concerts in October. Among the variety articles will be recognised the names of many old favourites. The lectures, which will be as before on Tuesday evenings, begin with a series by Prof. Malden, for ten years lecturer at the late Royal Polytechnic, the subject of the first being "A Tour in Ireland," illustrated by 70 dioramic views. On Wednesday, there will be a series of Assaults at Arms, under the management of Prof. McCaffrey, together with performances on the flying trapeze. On Friday evenings there will be the usual Temperance Meetings, followed by short variety entertainments. The aim of the management has been to suit as many tastes as possible by rendering the entertainments given at this hall literally "variety" ones.

A New Explosive.—A new explosive, known as hellhoffite, which has been invented by Hellhoff and Gruson, has been subjected to comparative trials at St. Petersburg together with nitro-glycerine and ordinary gunpowder. It is a solution of a nitrated organic combination (naphthaline, phenol, benzene, &c.), in fuming nitric acid. In preparing the hellhoffite tried in the experiments, binitro-benzene, a solid, inexplosive, and badly burning body, was used. At the first trial glass bottles of 20 cubic centimètres contents each were filled with 20 grammes of the respective explosive substances, and corked down. A tube filled with fulminate of mercury was passed through the corks, a slow match being attached to the outer end of the tube for the purpose of ignition. Each of the bottles thus prepared was placed on a truncated cone of lead, the upper diameter of which was 3·5 centimètres, its lower 4·5, and its height 6. The cone itself stood on a cast-iron plate 2·5 centimètres thick. The deformation of the leaden cone by the action of the explosives could consequently be taken as a measure of their respective destructive power. The explosion of the gunpowder, as was anticipated, caused no changes. By the explosion of the nitro-glycerine the cone was compressed about a quarter of its height; its surface had assumed the appearance of a well worn hammer; the diameter of the surface had been increased to 6·5 centimètres. The explosion of the hellhoffite caused much greater changes. The surface of the cone was completely torn; pieces five centimètres long and two centimètres thick were torn off and thrown about for several paces; only half of the cone was still a compact but entirely defaced mass. At the second experiment bottles (of 25 grammes each) filled with the various explosive substances were let into corresponding cavities bored into the face of fir blocks of similar dimensions. In exploding the gunpowder the block was torn into four pieces as if split with a hatchet, the several pieces were thrown about for 18, 12, 11, and 10 paces. In exploding the nitro-glycerine the block was split into several pieces. The upper portion of the block, as far as the bottle was let into it, was torn off perpendicularly in the direction of the fibre in such a manner that a smooth cut was formed. The explosion of the hellhoffite likewise tore the portion of the block surrounding the bottle perpendicularly in the direction of the fibre, and splintered the remainder of the block into a large number of thin fibres. The following experiments were also made with hellhoffite alone:—A slow match was passed through the tube in the cork which was without fulminate of mercury, as far as the surface of the hellhoffite in the glass bottle. No explosion followed on igniting the slow match. A quantity of hellhoffite poured into a bowl could not be exploded by a lighted match. Finally, a few drops of hellhoffite were poured on an anvil, and exposed to heavy blows with a hammer, and no explosion followed. The hellhoffite, consequently, possesses the following advantages:—(1.) In igniting it with fulminate of mercury it acts more powerfully than nitro-glycerine. (2.) It may be stored and transported with perfect safety as regards concussion, as it cannot be exploded either by a blow or a shock, nor by an open flame. On the other hand, it has the following disadvantages:—(1.) Hellhoffite is a liquid. (2.) The fuming nitric acid contained in hellhoffite is of such a volatile nature that it can be stored only in perfectly closed vessels. (3.) Hellhoffite is rendered completely inexplosive by being mixed with water, and can consequently not be employed for works under water.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

LUNAR GLACIATION — DR. KLEIN'S NEW (?) DEPRESSION NEAR HYGINUS — PRISMATIC AND GRATING SPECTROSCOPES — THE STELLAR NUCLEUS OF 31 M. ANDROMEDÆ—PHOSPHORESCENCE OF THE SEA—WHAT IS "CREATION"?—FINDING THE PLACES OF STELLAR OBJECTS.

[24729.]—IN thanking Mr. Peal for his reply to my question in his letter (24669) on p. 563 of Vol. XLI., I may say that, merely as a matter of course, he has returned the only answer compatible with what is familiarly known of the condition and behaviour of gases. No decline of atmosphere could by any conceivable possibility occur in patches or zones. As long as any lunar atmosphere existed at all, *ex necessitate*, it must have been homogeneous at the same distance from the moon's centre. Having said which, I would proceed to add, though, that I scarcely see the force of his illustrations attempted to be drawn from Venus and Mars. As far as I can judge, from long experience as an observer, Venus has an atmosphere of such size and thickness that it is in the last degree doubtful if we ever catch sight of her actual solid body itself; while, with reference to Mars, everyone who is familiar with the telescopic aspect of that planet knows how capriciously moisture, or some other constituent of its atmosphere will obscure Areographical detail. Again, if your correspondent will study Fracastorius when very obliquely illuminated, preferably during the waning of the moon or at sunset, he will see that it has at some time been an unmistakably complete circle, and that the northern half has been so broken down as now only to appear as a series of isolated rocks. How much water, in tons, does Mr. Peal postulate as having been "flashed, steam-like, into the vacuum," in order to produce the stupendous system of white rays surrounding Tycho, Copernicus, &c.? Bear in mind that this must cover the moon's surface to a sufficient depth to appear to us here on earth as snow. Furthermore, I cannot understand what Mr. P. means by the "complete absence of colour in lunar detail." Every one who has ever studied the moon for three consecutive months must be familiar with the green of the Mare Serenitatis, the brown of the Palus Somnii, and other equally marked tints on the lunar surface. As for the "ominously level" character of the floors of such formations on the Mare Crisium: why the floor of that very Mare is ridged and branched in all directions! Finally, Professor Langley's theory proves too much; in fact, nothing less than that the moon can receive no heat from the sun, and that hence, since she cooled from her original incandescent condition down to a point at which water (if any) would become frozen, no action can have taken place on her surface at all.

Apropos of the moon, that well-known observer and occasional contributor to these columns, Mr. J. Rand Capron, F.R.A.S., has made the startling discovery that "Hyginus N," the strange dark depression to the N.W. of Hyginus, which was detected (?) by Dr. Klein in 1878 (vide ENGLISH MECHANIC, Vol. XXVIII.), is figured in the first edition of Beer and Mädler's map of the moon! (Ecclesiastes i. 9.)

In reply to "Rosicrucian" (query 87339, Vol. XLI., p. 573), the chief advantage of a diffraction grating for producing the solar spectrum is that such spectrum is normal: in other words, the distances of the dark lines correspond accurately with their differences of wave-length. In a prismatic spectroscope, the number of prisms employed, and the material of which they are composed, change the positions of these lines; so that drawings made with one spectroscope by no means necessarily correspond with those produced by the aid of another one. Hence, however valuable the measurements effected by the aid of any given spectroscope constructed with glass prisms may be, viewed as differential ones, we must refer to a grating spectrum to (directly) obtain absolute ones.

The Dun Echt Circular, No. 97 (quoted in your "Scientific News" on p. 10), prompted me to look last night (that of Sept. 3rd) at that most familiar object 31 M. Andromedæ; and there, sure enough, superposed on the very nucleus of the nebula was a bright stellar point! I observed at first with a power of 80; but on subsequently employing one of 260, the star-disc remained absolutely sharp, clear, and round, albeit uncommonly little was discernible of its nebulous background. I may add that I could see no trace whatever of diffraction rings. The suddenness of the apparition of this star-like nucleus in a body which has been constantly under observation for some 300 years, and which was even noticed and recorded as far back as the year 995, is as strange as, from a physical point of view, it is interesting and important. I shall look out anxiously for accounts of spectroscopic observations of this new visitor, made with adequate instrumental means.

In connection with the interesting letter of Mr. Shrubsole (24724) on p. 15, I may remark that I have seen large patches of the sea (say of an acre or two) brilliantly luminous during an absolutely dead calm. Doubtless, irritation though, does cause the minute protozoa in which it originates, to exhibit it; as, outside of such patches, the rising of big fish has caused small bright circular ones to appear temporarily.

As one of the interlocutors in the discussion as to what is "Creation," I will accept the invitation of "Nun. Dor." (letter 24727, p. 16) to define the sense in which I, at all events, employ that term. Creation, then, I take to be the production of anything *ex nihilo*. It is the merest solecism and abuse of language to talk of "creating" anything out of pre-existing material. When a man fashions brass, steel, glass, &c., into a watch, a slide-rest, or an object-glass, as the case may be, he *makes* such watch, slide-rest, or object-glass; but it is idle to talk of his creating them. Your correspondent "H. B. F." seems to me often to use the word "creation" in the sense in which the Quaker did, who said that he had created his coat; and, upon being asked what he meant, replied: "Friend, I said 'let it be made, and it was made.'"

Inasmuch as descriptions, co-ordinates, &c., of by very far the larger proportion of stellar objects referred to in these columns are to be found in the classical "Celestial Objects for Common Telescopes," by the late lamented Prebendary Webb, I think it a great pity that "Alphin" (query 57400, p. 20), does not procure that invaluable little book straightway.

A Fellow of the Royal Astronomical Society.

31 M. ANDROMEDÆ.

[24730.]—A MARVELLOUS change has taken place in this nebula! Seeing the notice given in the Dun Echt Circular, No. 97, that Dr. Hartwig, of Dorpat, had noticed variation in the nebula, I turned the 10in. to-night on the object; but I was not prepared for the extent of the change, and at first thought I had got the wrong object. In place of the hazy condensation in the centre of the nebula was a brilliant star of at least 6 mag., quite stellar and sharp. The night was not very good (but very clear); but I could see no departure from the star-like aspect with any power from 100 to 1,400, and even with this latter power it was clear and sharp.

To me the nebula *does not seem to brighten so suddenly to the centre now*; but with high powers I could make out that the brightest part of the nebulosity was a little (perhaps 10") following the new star, which may not really have any connection with the nebula itself, but perhaps be a new variable star.

The convenient position now of the nebula will insure the variations in the new object being closely watched. Anyhow, the phenomenon is one of intense interest. **Herbert Ingall.**

Champion Hill, S.E., Sept. 3.

[24731.]—SUPPLEMENTING my note on the above object, I have since made out certainly that the new star *is not in the old nucleus*, but about 10" preceding it. This is distinctly seen with powers of 300 and 600 in my refractor. With a lower power the brilliancy of the star deceives the eye, and appears in the centre of the nebula.

Is there any good map of the stars in the nebula accessible, as I have a faint recollection of seeing a star sometimes in the place of the new one, but very faint?

Sept. 7th. **Herbert Ingall.**

THE ANDROMEDA NEBULA.

[24732.]—THE variability of the Andromeda was observed here on Sept 3rd, about 10.20 p.m.

Before I had seen any account of Dr. Hartwig's discovery. I was doing a little star-gazing with a 2¼in. achromatic Lancaster (with Wray's object-glass), when I turned the telescope on the nebula. I was not a little startled to see a star shining right in the centre. It appeared to be about the sixth magnitude. As Webb says: "There is some deep mystery here." **G. W. Middleton.**

Mexboro' Common, Sept. [illegible]th.

NEW STAR IN 31 M. ANDROM.

[24738.]—I RECEIVED a notice of this discovery from Mr. W. S. Franks on the 4th inst., and was fortunate enough to obtain an excellent observation of it the same evening. It was rated at 7·5, orange red, and hazy with high powers. There is a curious "knot" of light immediately following, which may contain a minute star; but of this I could not be sure. The space between the Nova and this luminous patch appears very dark, and the nebulous matter seems to stream away in a following direction like a very faint ray. There are also one or two most minute star points suspected, s.p. the Nova, between it and the tolerably bright star to the south. I venture to think that a change of some sort has been taking place in the nebula itself; for on one exceptionally clear night at the beginning of July, I found, with my large reflector, the central portion apparently much more condensed than usual, and so bright as quite to suggest the idea that a bright star was shining through it, although at that time no absolute star-point was visible. The sketch made at the time shows the brightest portion to be about 12" [illegible] the brighter star, and therefore about the place where the new star has appeared.

Pinner, Sept. [illegible]th. **Kenneth J. Tarrant.**

THE GREAT NEBULA IN ANDROMEDA.

[24734.]—THIS object was observed with the 6⅓in. achromatic telescope of this observatory on 1885, Sept. [illegible], and it was at once apparent that some remarkable changes were taking place in this well-known nebula. In the dense centre of the great nebula there is now a well-defined orange-coloured star of about the 7th magnitude, which appears to shine with unusual steadiness, so much so that I applied a power of [illegible] to see if it exhibited any disc. Though I [illegible] no indication of this, there is a marked difference between it and the other stars in the field with me, so far as absence of scintillation is concerned. The part of the nebula in which the star is seen appears much more dense and brilliant than formerly; and the two well-known dark canals can be distinguished. [illegible]

The small [illegible] nebula M. [illegible] and the large faint nebula H. V. [illegible] were seen as usual.

Most of your readers will remember that a very similar [illegible] in the nebula M. [illegible] [illegible] F.R.A.S.

C. E. Peek, M.A., F.R.A.S.

[illegible], Sept. [illegible].

ERRATUM—DOUBLE STARS Σ 371 [illegible] 54.

[illegible]

[illegible]

[illegible] F.R.A.S.

[illegible]

last letter. Since then, in equally unsatisfactory air, I have been able to look two or three times at these objects, with no better results. β 167 was looked at first through the telescope, and, after a good deal of hesitation between 80° or 85°, I looked to other stars. It was only next day that I consulted β's catalogue. The knowledge of the position of a *comes* takes away sometimes more than half of the difficulty. Thus, Dawes's double star of δ Cygni I have seen with no very great difficulty. Will Mr. Sadler say with what instrument, and what aperture and power, he has seen these doubles?

I have, as it were, no experience in observing double stars with refractors; but, by what I have gathered in that rich mine of instruction, the ENGLISH MECHANIC, I feel convinced that, with such classes of stars, reflectors, however excellent their figure may be, will never compete successfully with refractors equally good. The scattered light produced by the "flat" around the minute central disc of a large star will always render difficult, if not impossible, the detection of minute stars within their limits. The refractor, on the contrary, gathers up, around the disc, nearly all the light of the star, and, with the exception of a few rings, leaves the environs of the star quite clear, and, therefore, any star within its reach can be seen. On the other hand, I think no refractor can beat a good reflector when the components are not too different in magnitude, and are very close. The reflector will show an elongation when the refractor will only show a round disc. If things are so, is it not unfair to judge of the value of a reflector by the work done by a refractor, and *vice-versâ*? I hope someone will answer the letter [illegible]. **C. M. Gaudibert.**

DOUBLE STARS — ERRATA.

[illegible]—IN my letter ([illegible]) in this week's issue there are three slight inaccuracies. The first occurs under the head of H.V. 75, where "Wallaston" is printed for "Wollaston" at the end of line three. The second is under H. 5112, where a comma has been omitted after the word "measured," causing it to read as though Mr. Gore had measured it at Cincinnati; and the third is under the same head, the small pair, p., being described as "H or unnumbered," instead of "Howe." **K. J. T.**

Sept. 4.

EQUATORIAL MOUNTING—ERRATUM.

[illegible]—IN reading over my communication on page 11, I find that in writing in a hurry I described the wheel as being driven by a pinion; it should have been by a worm-wheel with Hook's joint and long handle. The upper disc is as large as the wheel without the teeth, and I think this might almost as well be made of wood as of iron.

I am at present mounting a 8½in. tube in a simple manner, which I think will be much more firm than my present pillar-and-claw stand. I shall be glad to send details if of sufficient interest. **Ascalon.**

POWERS USED ON CERTAIN TELESCOPES.

[illegible]—JUST a few comments on Mr. Sadler's letter [illegible]. Your correspondent there states that in the first [illegible] pages of Lord Crawford's "Summary" he counts [illegible] objects where I [illegible] which a power of 848 (1,000) was used. My two are 14 Lyncis and ξ Leonis. I [illegible]

I have, since writing last, gone through the remaining half of the "Summary," and the number of objects on which 848 [illegible] is stated to have been used is [illegible]. These are Σ 1768, 1865, 1877, [illegible] and 2787, thus making for the whole work [illegible] objects; perhaps this is what Mr. S. [illegible] which the 848 power was used. Further, I may tell Mr. S. that I [illegible] the "Mensuræ Micrometricæ" [illegible] and consulted it in [illegible] the ponderous size of the [illegible] and its inconvenient classification [illegible] the "Summary," which [illegible] I wanted. As for [illegible] which was [illegible] I say nothing, only that [illegible] with the number [illegible]

[illegible] XLVII. of the [illegible] with [illegible] **W. S. Franks.**

THE CASSEGRAIN.

[24739.]—IN my letter (24704, page 11), " division 4·9," should read "the division by 4·9 and in the following line, $\frac{F}{f}$ should be $\frac{F}{5}$.

Since writing the letter, I find that Dr. Royst Pigott corrected the sentence referring to posit of convex in a subsequent letter—a correctio seem to have overlooked or forgotten.

As I have been written to privately on point, I had better add a word of explanation specting the second proposition in my letter August 21st (page 539 of last Vol.) I cannot better than refer to a refractor as illustrating meaning, and the telescope which Mr. Penny had constructed (see page 475 of same Vol.) i excellent example. I contend that in order obtain an image free from aberration, it is jus necessary to place the mirrors of a Gregorian Cassegrain at a certain definite distance apar it is to place at their correct distance apart component lenses of an achromatic refractor. O narily, this distance is practically nil: but in la instruments, and in the instrument described Mr. Perry, and still more so in a dialyte, the f correction is made by adjusting this distance. course, I assume that we are dealing with para rays.

I therefore maintain that as there is but proper distance apart of the mirrors, so there be but one position of the final focus where image will be free from aberration.

An immense amount of mathematical skill been devoted to the refractor: probably if equal amount had been devoted to the (compou reflector, the latter would be now in more dem on account of its convenience and power.

A. S. I

[24740.]—YOUR correspondent "A. S. L." (le 24632) is, no doubt, correct in saying that the mirrors of a reflector can only give the best def tion in one position. I should think that when optician was figuring the surfaces he would by t put them in that position which gave the l correction of error, and if they subsequently came altered in relation to each other the cha would make its effect visible in impairing the d nition.

With regard to the equivalent Newtonian fo I believe "A. S. L.'s" rule is correct when alteration he names on page 540 is made.

The two conjugate foci of the small mirror the final focus and the principal focus of the g speculum. I did not understand Dr. Royst Pigott to say that this condition was "non-es tial." What I understood him to mean was t the shorter conjugate focus of the small mi was not the same as its principal focal len This, of course, is unquestionable.

Orderic Vita

VENTILATION OF COAL-MINES

[24741.]—IF the views held by Colonel Sha pear on the ventilation of our coal-mines were a commensurate in point of accuracy with the sistency of his advocacy of them, then, ind would the non-adoption of his plans if his s what crude and incoherent descriptions can b designated by coal-owners and mining engineer little short of criminal. Such, however, is b means the case, for anything more stupendousl surd than the notions he holds of what he regar the perfect mode of ventilation could not poss be conceived by the most imaginative person ha a knowledge of coal-mining. Of course, one ca derstand any foolishness emanating from a pe unacquainted with mining. Now, this is no first, nor, possibly, the twenty-first occasio which the gallant Colonel has enunciated opinions, or, as he doubtless regards them, [illegible] on this subject in the public p Nearly five years ago he advanced the same v in your contemporary, the Colliery Guardian, a few correspondents of that journal, myself amo the number, took great pains to convince hi their fallacy with, it would seem, but small suc

Now let us inquire, in the first place, if the pression of sufficient air to ventilate a mi within the range of practicability. We will the case of a colliery requiring for its adeq ventilation [illegible] feet of air per minu atmospheric pressure, which would be r sented by a quantity of about [illegible] feet at a pressure of [illegible] per square above the atmosphere. Now I made a numb experiments a few years ago with the vie ascertaining the horse-power developed in comp ing air, and obtained the following results, w are closely in accord with the results [illegible] experimenters in the same field. The engine which the experiments were made was a horiz one, with a single steam cylinder, 27in. diam and having a [illegible]ft. stroke connected direct to an compressing cylinder, 28in. diameter, by a thr [illegible] to both air and steam pistons, gi the same length of stroke in both air and s cylinders. The air-compressing cylinder, I may add, was inclosed in a bath, through which a constant stream of water was maintained. Results: Number of double strokes per minute, 26; average horse-power developed in steam cylinder, 97·14; average pressure of air in the air-compressing cylinder, 25·35lb.; maximum pressure of air forced into the air-receiver, 41·5lb. per square inch above atmospheric pressure; quantity of air delivered per minute, 354 cubic feet; the temperature of air in the outlet-pipe near the air-compressing cylinder, 281° F.; and the temperature of the air in the air-receiver, 142° F. (I have given the results thus fully, thinking they may be of interest to others of your readers outside of the present discussion.) Here we see that to compress 354 cubic feet of air per minute to a pressure of 41·5lb. per square inch above the atmosphere requires the expenditure of 97·14 h.-p.; hence by a simple calculation we obtain the h.-p. needed to compress 80,000 cubic feet per minute $= \frac{80{,}000 \times 97{\cdot}14}{354} = 21{,}952$, or nearly 22,000. Now, these figures are not hypothetical. They are deduced from actual experiments with an air-compressing engine of fairly good construction, and I can vouch for their perfect accuracy. Having ascertained the power necessary for the compression of the air, we can now proceed to inquire into the quantity of fuel that would be required for the work. I think it will be conceded that 3lb. of coal per h.-p. per hour is not an excessive estimate; we have therefore the amount of fuel required per day of 24 hours

$$= \frac{22{,}000 \times 3 \times 24}{2{,}240} = 707 \text{ tons},$$

which is not a very small proportion of the output of an ordinary-sized colliery. So much for the power and cost of compressing this quantity of air for colliery ventilation. But this is by no means the heaviest portion of the task. According to our mining instructor, this air must be conveyed in pipes 10in. or 12in. diam. (these were the alternative sizes specified by Col. Shakespear five years ago) throughout the ramifications of the mine, amounting, probably, to miles, and there liberated; that is, at every point where air is wanted. Let us see what this means. We have 10,000 cubic feet of air per minute to be forced through a pipe 12in. diam. The area of 12in. is equal to seven-eighths of a square foot nearly; hence the velocity with which this quantity of air would have to travel through a pipe of that area would be $\frac{8 \times 80{,}000}{7} = 90{,}000$ft. per minute, or 1,500ft. per second. (This is what a less susceptible personage than a "Dominic Sampson" might truly term prodigious.) I forbear from entering into the question of the friction of air travelling at that velocity, or the amount of power that would be wanted to propel it at such a rate, even if it were practicable to do so. It would, I imagine, require the output of two or three collieries to accomplish the ventilation of one under such a system.

I think I have advanced sufficient to prove that the power which, in Col. Shakespear's opinion, is within reach of mining engineers to ventilate their pits efficiently is yet very far from their grasp, even granting that mines ventilated in that way would be an improvement on the present system, which the gallant colonel has not yet succeeded in proving. Indeed, Col. Shakespear's notions of ventilation generally are altogether fallacious, and are only calculated to mislead those who are as ill-informed on this subject as himself, and to bring down upon both coal-owners and mining engineers the reflections of ignorant but well-intentioned people thus led astray.

It will be noted that Col. Shakespear, in his reply to my letter, carefully avoided the question I put to him as to the power required to compress the given quantity of air; and, as to the cost of the necessary plant, he remarks with refreshing simplicity, "no doubt it would not be done for nothing," which, by the way, is the only portion of his letter I do not feel disposed to dispute.

If Colonel Shakespear's zeal for teaching were to take the direction of inaugurating some scheme under which instruction could be given to working miners as to the nature of the dangers they have daily to encounter, and the means of avoiding them or of dealing with them in the best and safest way when met, then I think he might possibly do good service in lessening somewhat the lamentable casualties which we all deplore. At any rate, mining engineers in general have a sufficient knowledge of their profession in all its details not to require instruction from one who manifestly needs instructing in this, one of the most important factors in the economy of mining.

September 2. **Lyons.**

WHAT IS "CREATION"?

[24742.]—I AGREE with "Nun. Dor." (letter 24727, page 16) that a clear definition of terms is absolutely essential in discussing a subject such as this, and with this view, in my first letter on the subject (letter 24256, page 257), I defined "creation" as "the coming into existence of qualities, either physical or mental, which previously were non-existent even in the latent state." I repeated this definition in letter 24408, page 367, where I further tried to elicit—as yet unsuccessfully—a definition of what is meant by the term "evolution." If "evolution" be neither more nor less than "natural selection," anyone who studies Darwin's works can tell what that is; but then, why not say so, or why alter the name? If, on the other hand, it be not identical with "natural selection," wherein, I ask, is it at variance with it, or wherein does it supplement it?

Now, let me explain to "F. W. H." that, while his reading of a portion of Darwin's works leads him to the conclusion, with which I concur, that "existing forms of life have sprung from previously existing, different, and simpler forms," yet he must remember that in the construction of the series "natural selection" postulates for the introduction, as required, of new forms, brought about apart from its agency, and without the occurrence of which it "can do nothing." Natural selection differs from the development hypothesis of Lamarck—which took no cognisance of these necessary introductions of absolutely new forms and characters—in making this admission, and in offering substantial evidence from organic nature of how these new forms and characters, appearing at first as single and isolated varieties, may, in the course of time, become dominant, ultimately at times supplanting the form or character of the original parent.

If, by introducing the term "evolution," "F. W. H." intends to revert in part to the Lamarckian hypothesis, ignoring the admissions required by natural selection, and, perhaps, accepting the confuted doctrine of "abiogenesis," I have no hesitation in saying that such a method of evading the difficulty is less scientific than the one I propose—of frankly admitting the insufficiency of natural selection to explain organic nature without the aid of an external, unknown factor.

By employing a meaningless term he hopes to slur over, without recognition, the acknowledged phenomena, which I have at once attributed to "creation."

I object to the term "evolution," if it be understood simply as synonymous with "natural selection," because, besides being unnecessary, it is misleading, and conveys the idea of "abiogenesis" or self-evolution—an hypothesis which natural selection in no way countenances.

"F. W. H." will thus see that, in sheltering himself beneath this metaphysical cloud, he is not explaining the problems of life in a "natural" way: and while, in assuming that a direct reference of these difficulties to "creation" is tantamount to their ascription to the "supernatural," he is arrogating to himself a knowledge of what the limits of the "natural" are. **H. B. F.**

AUTOMATIC MUSICAL INSTRUMENTS.

[24743.]—IT is an old and a very true saying that if you want a thing done well you should do it yourself.

Not having a piano where I wrote letter 24695, I got someone else to measure the depression of the keys for me, and some mistake seems to have been made.

Since reading Mr. Wenham's reply (for which I am much obliged), I have myself tried the keys, and find the difference about ⅛in. (the maximum was $\frac{3}{16}$), which does not much exceed Mr. Wenham's result, and is only half what I originally mentioned. This vastly reduces the objection that I made as to the probable irregularities in the musical effect. It still strikes me as singular that the lever does not often drop into a perforation just when the vibrating-bar has got below the top edge of the plungers, so that the plunger gets pushed against, instead of under, the bar, thus causing a note or notes to be missed. I have now succeeded in making a rough model of an alteration in the arrangement whereby the mechanism is rendered suitable for playing a harmonium or other wind instrument in which the keys have to be not merely depressed, but held down for a certain time. Though roughly put together, the working of the model is quite satisfactory, and shows the principle is a good one in practice. **A. S. L.**

THE AMMONIAPHONE AND THE DOCTRINE OF SIMILARS.

[24744.]—AN interesting point with regard to the now established success of Harness's and Carter Moffat's "Ammoniaphone" in the treatment of weak voice and hoarseness is the fact that the symptoms in which the vapour of ammonia is so useful are those caused by inhaling ammonia when in health, and especially does the symptom of a *weakened voice* appear in trials of the effect of large doses of inhaled ammonia, not applied so as to choke, but a diluted vapour.

Now and then the general public and the bulk of the medical profession "discover" the wonderful efficacy of some drug; and in a vast number of cases in which the benefit is reaped in a specially marked manner, on inquiry it is found that the drug used is capable in a state of health of producing the particular group of symptoms which it cures in disease. I write this to "Ours" because the general medical journals are closed to any notice of this great germ of medical truth; because it is advocated by a particular set of men who have been driven from the ranks of the profession, and compelled to take a sectarian position. The *public* must learn that this law of similars is probably the dawning of the long-missed light of truth and accuracy in medicine; then the great body of doctors and medical colleges will *have* to progress in the inquiry. **Gerard Smith, M.R.C.S.**

SOME QUERIES SOLVED BY THE SLIDE-RULE.

[24745.]—SHOULD mechanical solutions by slide-rule of "Whiskey Query" (57026), "Ladder Problem" (57122), "Trigonometrical Question" (57164), and other calculations by slide-rule be likely to interest and benefit readers of "E.M.," the following are submitted for publication. Thus:—

1st—

For (57026)—17·5 on slide set op. 12 on A.
Op. 51 „ is 35 gals. at 17s. 6d.
To mix with water 16 „ 0
—
And make mixture 51 „ 12s. per gallon.

2nd—(57122)—From scale projection of given dimensions, the angles of ladder to ground line level having been obtained about 69° 45′, 32° 45′; by Dixon's unique triple radius, double slide-rule, Sin. 69° 45′ being ·938, and sin. 32° 45′ = ·540.

1 on slide N or $\frac{B}{C}$ set op. 50 on line A
Op. ·938 „ „ is 47 „ A
and „ ·540 „ „ „ 27 „ A;

or 47ft., 27ft., being the heights to which ladder will reach.

3rd—Trigonometrical (57164).—By above stated instrument, sin. 30° being ·5, and sin. 60° = ·866.

·866 on slide N set op. 108 on line A
and ·866 „ $\frac{B}{C}$ op. ·5 on slide N
Op. ·5 „ $\frac{B}{C}$ is 36ft. on line A;

for difference between height of tower and column, and consequently 108 less, 36 giving 72ft. = height of column.

Or, to give a more complicated question for—

Ex. 4. To find the respective products, quotients, &c., &c., involved in obtaining the square root and cube root of, say $(4{\cdot}64^3 \div 73 \times 61) \div 89 \times 57$. Here simply by setting 73 on slide N. op. 4·64 on cu. rt. line; and 89 on slide $\frac{B}{C}$ op. 61 on slide N.

Then $4{\cdot}64^3$ being shown on line A nearly 100 (1)
100 ÷ 73 „ „ „ A „ 1·37 (2)
1·37 × 61 „ „ „ A „ 83·5 (3)
83·5 ÷ 89 „ „ „ A „ ·938 (4)
·938 × 57 „ „ „ A „ 53·5 (5)
Square root of 53·5 on square root line „ 7·32 (6)
And cube root of 53·5 on cube root line „ 3·77 (7)

Each and all intact at last, if necessity for revision should occur.

And, further, as instruments arranged with circular, &c., lines of figures and divisions on same principle as straight slide-rules are before the public, by which natural numbers and corresponding logarithmic decimals to four and estimate fifth place of figures are obtainable almost at a glance; and calculations of addition, subtraction, multiplication, division, single and double rule of three, simple and compound interest, mensuration, duodecimals, logarithms, trigonometry, navigation, &c., made with ease and facility; it, to me, does appear strange that while countless substitutions of machine for hand and other labour have been made with incalculable advantage in operations connected with engineering trades, &c., and manufactures since the days of the celebrated "Watt," yet exceedingly little progress has been made in extending the application of slide-rules (invented in principle more than 250 years ago), although their importance, value, and use to practical men are unquestionably beyond controversy or doubt.

Near Bradford, Sept. 4. **Buttershaw.**

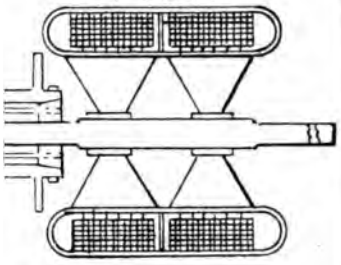
A METHOD OF CORRECTING GUIDE-SCREWS, INVENTED BY C. REICHEL, OF BERLIN.

[24746.]—I HEREWITH inclose you an abridged translation of description by the inventor of the method adopted by H. Walz, of Berlin, for correcting the screw-guides of his lathes. I tremble to so much as approach the awful subject of the endless screw; but having found something which appears to me of real value, I send it.

I received the translation from R. Schroeder, of is made of well-insulated iron wire, cing coils are of wire of a thickness to the work; there is no fear of power injurious heating, or in getting rid of tion.

describe a simple construction I have which I referred to above, in which ity and cheapness of a wire core is vith the advantages of a metallic It will be seen, on reference to Fig. 1,

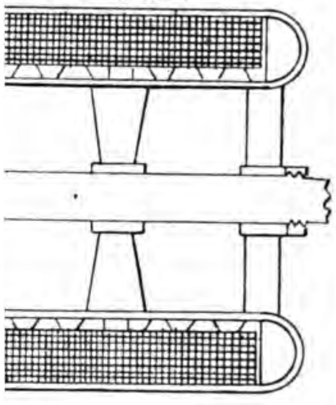
F I G. 1.



nature core is supported on hubs and the Maxim-Gramme armature; only long armature is required, I prefer to more complete cores side by side, and lucing coils right over both. This ar- as the advantage of breaking up the f the spokes, which otherwise are liable d by the circulation of "Foucault" to lines of force across the interior of he hubs and spokes or spiders are best sphor bronze or gun-metal. On the xed, by means of screws, pins, or keys, the space between the flanges being umber of rings about an inch in width, r the better; on the top of the rings in thus formed the wire core is wound. ting, one end flange is first fixed; the hen sheathed in insulating material, gs slid on alternately with rings of other end flange is then fixed, and the ound on. The rings and flanges may vell-annealed cast or wrought iron. Of rings and core may be carried right al sets of spokes, insulated from one ead of using separate cores.

ws another method of constructing a

F I G. 2.

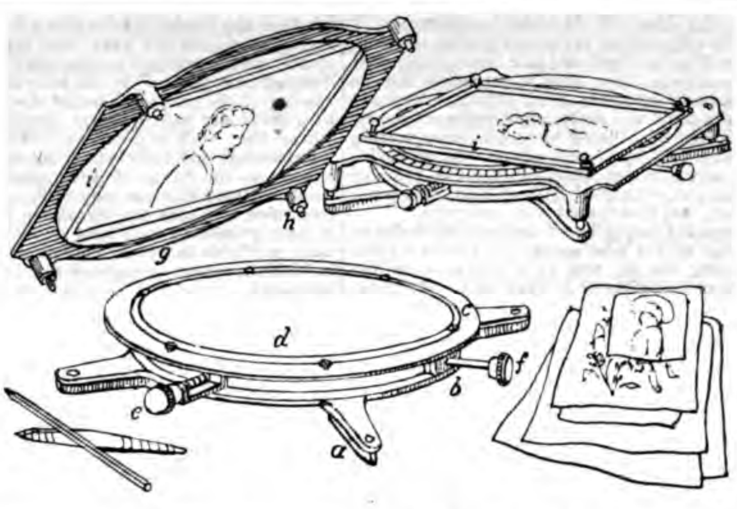


s or laminated mounting. A number iron rings are jointed or dovetailed her, and clamped up between sets of ore being wound as before on the top As far as I am aware, these con- e new.

G. E. Dorman.

THE SKIAGRAPH.

THE Skiagraph is a drawing apparatus en patented by Mr. E. H. Brown, of t, New York, for use in the prepara- type blocks. In the processes known imilar titles the pen takes the place , and the artist simply delineates his ades, whence the name skiagraph. In s *a* represents a bed plate having on face a central socket; *b* is a revolving on its lower surface a central pin e socket; *c* is the tint plate carrier, e revolving plate; *d* is the tint plate, the carrier; *e* is the tint screw, by arrier and tint plate can be moved d forward. By this movement tint thickened up to any desired shade. te and carrier can be locked at any ch they may be placed by means of



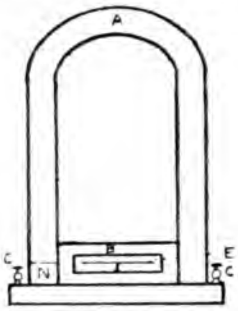
the locking screw, *f*; *g* is the surface plate, on which is screwed the hardwood sketch frame, *i*; *h h* are adjusting screws to regulate the distance of the surface of the pen and ink sketch from the surface of the tint plate.

The artist first makes a light pencil sketch on the upper surface of a sheet of drawing paper stretched on the frame *i*. Then with pen and ink he makes the outlines, and does all the other pen and ink work, except that to be done by the skiagraph. The next step is to screw the frame, with the face of the sketch down on to the surface plate, which can be lifted on or off the instrument as often as may be required. The drawing paper being semi-transparent, the artist then, on the back surface of his sketch, makes a pencil outline of the surface on which he wishes to produce a certain tint. The tint plate, having been inked over with printer's ink, is put in position, and that part of the drawing designed to receive the tint is pressed down to obtain the desired impression. By using the tint screw for thickening lines, the revolving plate for cross lines, and combining the shades produced by several tint plates, almost any desired effect can be attained. The sketch when finished is placed in the hands of the photo-engraver, and a plate ready to print from can be had in a very short time.

E. S. A.

THE ELECTRIC TOURNIQUET.

[24750.]—AN experiment similar to that described by Mr. J. Sutcliffe, in letter 24675, was given several years ago in *Design and Work*, and as I suppose a good many of the readers of the "E. M." have not heard of it, perhaps you will allow me space to describe it. It is there called the "electrical tourniquet." A magnet A is fixed in an upright position upon a board, and between its poles is inserted a galvanometer coil, B, the ends of which terminate in the binding screws, C C.



On a pivot in the centre of the coil a circular disc of sheet iron, E, is balanced, so that it can freely rotate. If the binding screws be now attached to the secondary wires of an induction coil in action, the disc will revolve rapidly. This I account for by supposing that the disc acts as a magnetic needle being magnetised by the presence of the magnet A, and this needle is deflected by the current. But the deflection of the needle, or, rather, the movement of the disc, brings a fresh portion of iron under the influence of the magnet, and the movement is repeated, each fresh portion of iron brought between the poles acting as a magnetic needle.

Shylock.

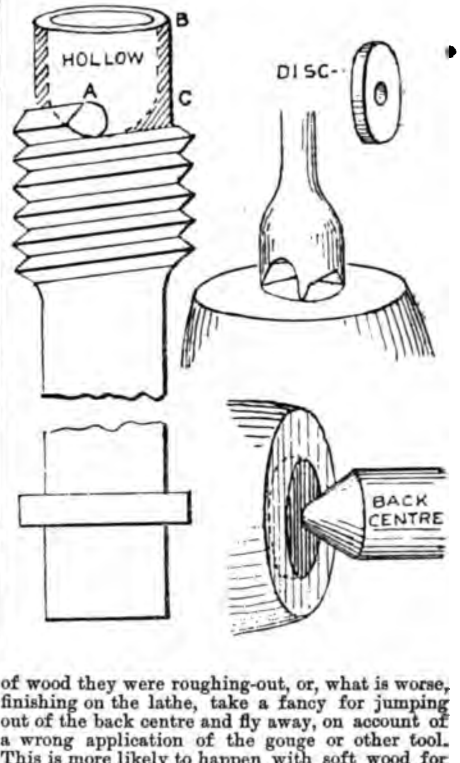
SCREW-CUTTING WITHOUT CHANGE WHEELS.

[24751.]—I CAN send an engraving that will give a good idea of lathe upon which any screw can be cut from 1mm. (say 25 to the inch) to 6·35mm., which is four threads to the inch. The range is, I suppose, ample enough for engineering purposes, and includes English, French, and no matter wh pitch. The possession of such a lathe wo gladden the heart of those makers who are anxi to cut their lathe noses and other screwed par their productions at such odd pitches as will their customers to apply to them only wh want some additions or repairs made at the I saw one of these lathes at work making its work appeared to be excellent. Screw cut both right and left-handed.

As far as I could judge, the principl machine is based upon the greater or slo of one end of a lever, according to the smaller distance of the fulcrum from the If more details are necessary, I will try a more fully what I have seen. The ferred to takes 20in. between centres. size is made also, taking 12in. only, and sizes can take up to 52in.

These lathes can be used, of course, f turning, either self-acting or by hand.

Wood-turning.—Beginners, like myself, often been annoyed, I am sure, by seeing the



of wood they were roughing-out, or, what is worse, finishing on the lathe, take a fancy for jumping out of the back centre and fly away, on account of a wrong application of the gouge or other tool. This is more likely to happen with soft wood for model making, for instance. I think I will try the following device as soon as I can get up: Take a round disc of iron $\frac{1}{2}$in. diameter, $\frac{1}{8}$in. thick; bore a small hole in centre, and give the hole a little conicity to suit back centre cone. Fit this little disc to the right-hand end of the wood to be turned, and put back centre in the hole and oil well. Fitting the disc will be an easy and quick job. Take a centre-bit making a hole a shade smaller than the size of the disc. With the bit bore a recess $\frac{1}{8}$in. deep in the end of the piece of wood, and with a slight tap of the hammer the disc will fit tight in the recess. I think this will prevent the centre getting spoiled.

[illegible] Christie Little Nose.—I inquired in back numbers about how to cut inside threads in wood, and got some kind replies. Inclosed sketch of a tap I will make might perhaps interest some of "Ours." Those having a screw-cutting lathe will easily make one: others will, no doubt, get the screw cut at little expense. A piece of round steel, or even good iron, will do, as it is not used often, and thus cannot wear out quick.

The part B C must be of the same diameter as the bottom of the nose screw, and acts as a guide for starting the tap true in a hole of same diameter first to be bored in the chuck. Bore that end hollow to allow the shavings to get through. At A the thread terminates, and a hole must be bored to communicate with the hollow part. With a small file sharpen the edges of the end of the thread inside only. It will cut a clean, beautiful inside thread in the wood in one operation, no taper required.

At the beginning, push the tap tight against the wood when the part B C is engaged in the hollow. After two turns the thread will guide itself. I got this from a tool I bought for making wooden presses used for cramping glued pieces together. I got at the same time, another tool for cutting the wooden screws to fit in the screwed holes. I only mention these tools because I never saw them in any tool catalogue.

For [illegible] I got the tap and dies [illegible], and can now make as many presses as I like; whilst these presses cost [illegible] each, and dozens are required when gluing work together.

Belgian.

THE FIFTH VOLUME OF HOLTZAPFFEL—A DUBIOUS WORD.

[illegible]—My attention has been drawn to the letter No. [illegible] in your last issue. My first and agreeable duty is to thank your correspondent for the high encomiums he has been good enough to pass upon Vol. V.—Turning and Mechanical Manipulation. In reply, the word "orine," which occurs twice upon page 387, should be "aurine." This error, for which, by the way, I do not happen to be responsible, has been kindly mentioned to me by one other reader, and, moreover, it is the only error that has been brought to my notice in response to the request in the preface. It is much to be regretted that the United States import duties should, as I learn from your correspondent, increase the cost of books by nearly [illegible] per cent., and I have reason to be all the more grateful to [illegible] American readers.

John J. Holtzapffel.

G.E.R. COMPOUND LOCOMOTIVES.

[illegible]—If "A Friend of the Bone-Shakers" [illegible] the opinions of the drivers on [illegible] I think he will find it very [illegible].

A few weeks ago compound No. [illegible] took the [illegible] from Cambridge to Bishop's Stortford, with [illegible] in [illegible] minutes, with a slacken to [illegible] miles an hour at Stansted. Average, 47½ miles an hour.

Three weeks ago No. [illegible] ran the [illegible] from Colchester to [illegible] with eighteen coaches in [illegible] minutes. Average, [illegible] miles an hour. Fastest speed [illegible] miles an hour down Brentwood Bank.

The distance from Colchester to Liverpool-street [illegible] miles; so I can scarcely accept the statement that [illegible] the singles, fine engines as they are, with eighteen coaches and a [illegible] in [illegible] minutes.

P. A. Ransom.

FAILURE OF BRAKE—TO "LOCO."

[illegible]—THE brake that caused seventy-two [illegible] Vol. XLI., was [illegible] valve [illegible] when wanted. [illegible] March [illegible] seventy-two [illegible]

Vacuum Brake.

THE BINEGAR ACCIDENT—CONTINUOUS BRAKES—MANSLAUGHTER.

[illegible]—[illegible] writing [illegible] from Binegar [illegible] Colonel Rich's report upon this [illegible] has been published and the details given in the Board of Trade report [illegible]

Colonel Rich reports that the accident was due to the signalman pulling over the wrong lever at a time when [illegible] with the locking-bar from the frame; but he states that "the locking gear should not have been taken out while trains were running"; also that if alterations "cannot be completed in the interval between the running of the trains, all trains should be brought to a stand and passed slowly through the station where the work is going on." The question of interlocking, and rules which relate thereto, are already in the hands of your readers; granting, therefore, that the company did not carry out its own rules, and that the signalman made an error in consequence, we have next to consider the distance available in which to stop the train, the speed at which it was running, and the brake power at command.

The up 11.45 a.m. passenger train from Bournemouth to Bath, at the time of the accident, consisted of a bogie tank-engine (No. 53), fitted with a steam brake and seven vehicles; the front van and three carriages were fitted with the chain brake under control of driver and guard; the rear van also had the brake under control of the guard riding therein.

According to the evidence of Mr. W. H. French, the locomotive superintendent, "the point of collision was 160 yards from the facing points" (this distance accords very nearly with my own measure). The speed of the train was not more than 27 miles an hour; the driver applied the brakes and did his utmost to stop, yet in a distance of 160 yards, with the inefficient appliances at his command, he could only reduce the speed of the train to 20 to 25 miles an hour when the collision took place. It is hardly necessary for me to tell the readers of the ENGLISH MECHANIC that if this train had been fitted with a quickly-acting automatic continuous brake the train could have been absolutely stopped in the distance between the facing-points and the point of collision. Under all the circumstances of the case, I ask, is it fair or just that the unfortunate signalman should be punished for manslaughter?

Clement E. Stretton, Hon. Mem. A.S.R.S.
Glen Magna, 5th September.

"ENGINE MAKING AT HOME," AND OTHER MATTERS.

[24756.]—WILL "our" kind friend, "J. H.," pardon me if I offer a suggestion relative to his admirable series of papers on the above subject? As I read through these excellent practical instructions, the thought occurred to me that perhaps some would like to make the engine a double-cylinder with reversing gear. Beyond doubling the width of the bed-plate and the necessary additional eccentric fittings, there does not seem to be need of much alteration, presuming that the second cylinder is put on the left side (above in figure) of that in Fig. 110, p. 534. But in this case, though it is the simplest way, there are two valve-boxes and the necessary pipe connections; whereas, if the second cylinder could be put on the right side of that in figure, with the slide-valve towards it, only one box would be needed. But in this case the eccentrics would come on the shaft between the double cranks, and would therefore have to be cast in pieces, which is, I presume, an insurmountable obstacle in a compact small engine.

Perhaps our friend will add a supplementary paper giving the details of double eccentric fittings?

Here I would also express the earnest hope that someone will take up the subject of brass-fitting for mathematical and optical instruments, as requested by a correspondent some few weeks ago. Mr. Wassell, Mr. Brashear, "Prismatique," myself, and others have at least done our part in the practical and theoretical treatment of glass-working; surely we have some friend who is able and willing to take up the "brassy" part. Recently, in looking through some back volumes, I came upon a few good articles of this character by "Expertus," but they were only three or four in number. Let us hope for another "Expertus" to appear.

Orderic Vital.

AN ELECTRICAL STORM.

[24757.]—A LETTER in the *Times* stated that a fine old oak in Richmond Park had been struck by lightning on 6th August last. I wish to call the attention of those of your readers who are interested in the surroundings of this occurrence that the date and time correspond with that given by Prof. Colladon of a remarkable atmospheric phenomenon which was then observed at Geneva, as reported in your last issue. This enables us to see how large an area is, at times, subject to electrical storms, and how intimately our atmospheric surroundings are connected and held in tension by laws at present but little understood.

I also wish to take this opportunity of again bringing forward the question whether this does not prove the possibility of the electric fluid passing upwards—i.e., from the earth. This oak is completely riven and burst from the core of the trunk without any indication of fire; but a topmost branch is evidently burnt. The bark is intact for about 5ft. from the ground; above that it is entirely torn away. It must be remembered that this took place after a long, dry summer, and the soil for some depth being exceedingly dry.

Sept. 1. **J. D. H.**

THE TELEPHONE PATENTS.

[24758.]—PATENT law in the United States has always been construed more rigidly than in this country; but it seems that at last it is becoming too rigid, and the following from the *Scientific American* will be read with interest by some of your readers. If I remember correctly, several articles which have appeared in your columns have taken the view that the English courts have given too much to the holders of the Bell and Edison patents, and the question, "What is a diaphragm?" is, I believe, not yet definitely settled.

In America, however, as your contemporary points out, it would be illegal to use a Reis telephone, although Bell acknowledges that he was acquainted with the discoveries of Reis. I make the following extract from your contemporary:—

"The courts, in their sweeping decisions in favour of the Bell patent, dispose very summarily of Reis's inventions. In one decision the judge rather gratuitously says that a century of Reis would not have produced an operative telephone. By all the decisions Bell's claims have become so broadly construed that the actual Reis telephone could not be used without infringing them, if it were so used as to transmit speech. In other words, if one of our readers were to place a Reis transmitter in one house and a Reis receiver in another, and connect them by wire, and were to talk over such a line, he would constitute himself an infringer of Bell's claims, though he was using an invention made by a man who died two years before the date of Bell's 1876 patent. If Reis himself, as is almost certain, spoke through his telephones, he ought to be considered an infringer in advance of his time. Seriously speaking, however, the bearing of the Reis invention upon the Bell claims depends on the following facts: Reis's telephones did transmit sound; they probably transmitted speech in the days of the inventor, as they are perfectly capable of doing so at the present time. This much should constitute them an anticipation of the broad claim to electrical transmission of speech. But their effectiveness as anticipations would be vastly increased if it could be definitely proved that speech had been transmitted by them during Reis's lifetime.

"Numerous passages from Reis's writings are cited to prove this. But they all are considered unsatisfactory to about such an extent as is the Bell patent of 1876, in its own claims to speech transmission. An appeal to Reis's contemporaries has been made with far more fruitful results. In Professor S. P. Thompson's work on the Reis telephone, a number of letters from friends of Reis are printed. Many of the writers are men in high standing in the scientific world. The letters are in some cases to the effect that articulate speech was received through the telephones as early as 1859-1864. Others are not so definite as to the facts. But the general unanimity of all on this subject is most striking. They effectually dispose of the 'century of Reis' theory, so firmly upheld by one of the circuit judges. The fact is that the scope of the Bell patents as determined by the courts is a monument to the ability of the lawyers engaged by the Bell Telephone Company. So thin a series of claims were in all probability never before made to protect a monopoly so securely."

I think that opinion will be indorsed by all who have looked into this question, and all inventors will be glad to hear that when the cases reach the U.S. Supreme Court, some restriction will probably be placed on the claims of the patents, which will be limited strictly to the invention described.

Nun. Dor.

PHOSPHORESCENCE OF THE SEA—TUNING FORKS.

[24759.]—I MUST say it is somewhat of a novelty to me to learn that the luminous appearance which is occasionally seen in the sea "is due to something in the nature of an electric discharge." I have always understood that it was actually phosphorescence, and I certainly think it highly probable, as there are very few inhabitants of the sea but what contain a much larger proportion of phosphorus than creatures whose habitat is dry land, and the phosphorus seems to be combined in such a manner that it is easily set free. For instance, a mackerel which has become tainted is brilliantly luminous in the dark, caused by the oxidation of the liberated phosphorus.

I thought at the time that the question of "F. R. A. S." had, to say the least, a strong flavour of irony, as I am quite sure he knows all about it; as a matter of fact, it is visible in smooth water, as I have seen the sea luminous for miles in perfectly calm weather. Probably these little creatures, or whatever they are, do not often

PLIES TO QUERIES.

◆◆◆

their answers, Correspondents are respectfully requested to mention, in each instance, the title of the query asked.

[illegible]—**Extra Currents and Testing by ed Currents.**—I am none the less obliged [illegible] for his answer because it does [illegible], being that frequently given. I do not [illegible] his illustration where the neutralisation [illegible]. Regarding the coils as magnet[illegible] of extra current when the current [illegible] them ceases: I see two generators in the first case, with the E.M.F. of two [illegible] in parallel in the second with the E.M.F. [illegible]. If the convolutions be alike in each [illegible] fact, if the same bobbins are used, the current in each being half in the second [illegible] it was in the first, and the [illegible] will [illegible] the E.M.F. This is [illegible]

[illegible]

—[illegible] **Engine.**—[illegible]

[illegible]

—**Ball Bearings.**—[illegible]

[illegible]

—**Ball Bearings.**—[illegible]

[illegible]

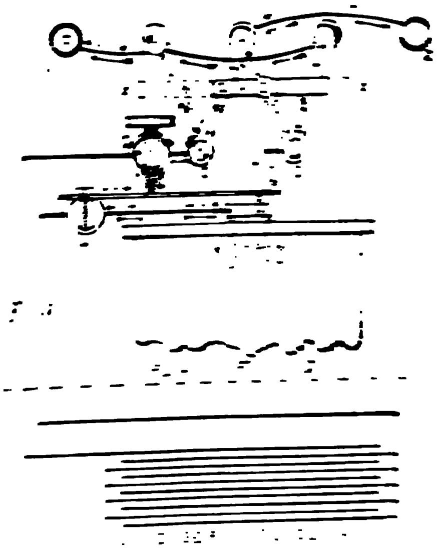
Ball Bearings.—[illegible]

shire and North Derbyshire. I wonder what condition the axle would be in had I used [illegible] bearings? I have a good guess. Where would be crowd 2½in. bearings so as not to interfere with comfortable pedalling? It is a pity intending cyclists should be misled by a single statement, when there are hundreds of thousands of riders who would designate such an assertion as "[illegible]" were they interrogated. My advice is: If you want to cover plenty of ground with a minimum of labour, most certainly have ball bearings, which have the additional advantage of wearing perfectly even. Take one precautionary measure—necessary in all this world's transactions—mind they are good ones.—G. D. G.

[illegible]—**Ball Bearings.**—Several replies in this question ought to have put Mr. H[illegible] in the right track in spite of his [illegible] experience [illegible]. He [illegible] questions which were calculated to test his knowledge, and all unwittingly shows that he does not understand his subject. [illegible] Mr. H[illegible] says, "[illegible] the bearings of a bicycle [illegible] and a half times the diameter of the axle." Why does Mr. H[illegible] [illegible] Mr. H[illegible] [illegible]

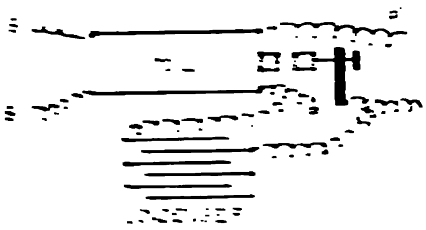
[illegible]

[illegible]—**Coil Connections.**—[illegible]



line represents the connections. In Fig. 1, *a* and *b* are the binding-screws, to which you connect the terminals of your battery: *e e* is the commutator; E is a handle for moving the commutator; e_1e_1 is an insulated bar to keep *e* and *e* at the right distance apart: *c* and *d* are stops to prevent e_1e_1 being moved too far either way: e_2e_2 is the other position of *e e*. If you prefer the cylindrical form, Fig. 2, connect *c* in Fig. 2 with *a* in Fig. 1, *c* with [illegible] and [illegible] with [illegible], and *b* with *b*. For the medical coil of course you do not need either the commutator or condenser, so join *b* and c_1, and *a* and *c*, and [illegible] have *g* and *h*. Then, lastly, for a medical coil with only a primary wire, join *b* and [illegible] and [illegible] as before, leaving out the commutator and fix the handles to the wires *g* and *h*, of course having no condenser.—C. L.

[illegible]—**Coil Connections.**—1. For medical coil with one kind of wire, connect the inner end to vibrating hammer, the outer end to one of the binding-screws in front of the hammer. The other binding-screw is connected to the pillar, which holds the set-screw of the vibrator by a short length of wire. Two more binding-screws are at the side of the coil. Connect one to the hammer by a short length of wire, and the other to the terminal to which the inner end of the coil is connected. The terminals in front of the vibrator are for the battery, and the side terminals are for the handles. 2. For medical coil with primary and secondary wires, connect the inner end of primary as above; and at the outer end, just where it leaves the coil, [illegible] the beginning of the secondary, and wind; remembering that sufficient length of primary is to be left loose for connection. This loose end of primary is connected to one of the terminals in front of the hammer. The other terminal is connected by a short wire to the pillar which holds the set-screw of the vibrator. The outer end of the secondary is connected to one of the terminals at the side of the coil, and a short length of wire connects the other to the hammer. Connect battery and handles as before. 3. For induction coil: the inner and outer ends of both primary and secondary are [illegible], and four ends have thus to be dealt with. Connect the inner end of primary to hammer, and the outer end to one of the pillars of the commutator, and by a short length of wire connect the pillar which holds the screw of the hammer to the other pillar of the commutator. The ends of the secondary are connected to the dischargers. A [illegible] is screwed through each spring of the commutator, and to these the battery is connected. The connection of condenser is shown by sketch.



[illegible] are ends of primary, SS are ends of secondary. The condenser is placed in the cavity of the base[illegible].—[illegible]

[illegible]—**[illegible] Varnish and Polishing.**—[illegible] instead of [illegible].—[illegible]

[illegible]—**Analyses of Copper Wires (U.Q.)**—[illegible] occupy space [illegible] analysis [illegible] not these things [illegible] analysis. I must [illegible] this query.—WM. JOHN [illegible], Newcastle-on-[illegible]

[illegible]—**[illegible] Beer.**—[illegible] "Old Soldier" [illegible] perhaps can [illegible] trade purposes or [illegible] quality, as [illegible] ambition to ex[illegible]

[illegible]—**[illegible]**—[illegible] state[illegible] imperceptible [illegible] done by B [illegible] gradually [illegible] &c. [illegible] done by the [illegible] incessantly [illegible] plane. [illegible] sense defined [illegible] does work, [illegible] motion, irre[illegible] shorten the stroke [illegible] succession of throbs [illegible] very gently, yet [illegible].—A. K. B.

[illegible]—**[illegible] Ornaments.**—[illegible] with a brush. I [illegible] to remove the

ing or brassing has worn off, the
'e-plated, and the polish brought
ch-brush.—NUN. DOR.

r **Monograms.**—This querist has
hair and arrange it in the form
;tle gum, or that advertised cos-
used for fixing the moustache.—

ıing **Machine.**—I think you
t subscriber, else you would be
.iled descriptions and views of a
precisely like that about which
:n appearing during seven months
; with January of this year. The
. dimensions lies between 1ft. 9in.
ıe length, so that by adding 5in.
u bring the machine up to your
t is also designed to work in the
tion only, though provision for
be illustrated in its proper place.

ıll **Shaping Machine.**—I under-
." would include this in his useful
—J. T.

ım **Pipe.**—Yes; galvanic action
the influence of heat. Interpose
r or asbestos.—ESSAR.

per **Balls.**—See reply 57157. The
his case is to have hard solder.—

lel **Well.**—The reason that the
; is obvious. When a siphon is
: of, say, wine, giving it a suck, it
cause the liquid has to be raised so
t vacuum is sufficient. Thus, when
to flow down the siphon it carries
›ng with it, out of the bend, to
uch a trifling height, although the
as you state, smaller than the
erpool.

lel **Well.**—I do not see where
difficulty. As the water rises in
es in the siphon pipe too, keeping
:l, and driving out the air as it
'r end of the siphon tube. When
.e bend, the residual air is carried
e water out by the other limb of
action of the siphon commences,
emptied to the level of the siphon
cistern, that is if the other end of
is below this level.—W. SCUDA-

mp **v. Cramp.**—I perceive, now
minds me of the fact, that there is
.tion to the former word besides
with brick-making. Cramp is
is clamp; but I do not think that
› words in English, however much
that mean exactly the same thing.
pointed out how easily the liquid
l, *n*, *r* get interchanged, and mis-
.nother, and one of the instances
ıs in point is how Seléné—Greek
he moon—became semele in the
ly and Jupiter, and how that the
ıns that the glare of the rising sun
feeble light of the moon. There
who cannot pronounce an R at all,
ıse when a boy; and the least lisp,
or caused only by a pimple on the
lamp" at once out of "cramp"; so
wrong word does get used pretty
as the right one. My own idea is
"cramp" is an instrument which
'emovable as soon as it has effected
that a "clamp" is a permanent
revent displacement or distortion
t parts of any structure. Thus, to
›p, several boards may be cramped
ıe whilst the glue is setting, and
d by battens fastened transversely,
then removed. A truss of hay is
the smallest compass in the hy-
ıd is "clamped" by iron hoops to
ınding again. So you "clamp"
with iron bands, or put corner
gun-case or a jewel-case. A theo-
y drawn round by a tangent-screw
›pe points to the object, and it is
›osition by its *clamping*-screw, not
ause the plates are constructed so
tact already. I think if the dic-
ted, it will be found generally that
ıencement of words of this class in-
ırce applied slowly, and that the
.ning of holding fast what you have
vhich "J. H." gives from Klampe
er significations given in the dic-
lamp, clinch, holdfast (marine),
dge (inserted to prevent things
m the rolling of the ship). Krampe
ıp-iron. I do not remember ever
ns called *clamps* by any workman,
;, to my recollection, in pr
book, in which I, inco

corrected it. I attach no importance to its appearance in catalogues. A few words from the dictionary indicate in, I think, all cases the use of considerable force slowly applied: crab, crawl, creep, crack, craft (primary sense stretch or strain), cram, cramp, crane, crib, crimp, crowd, crush. The dictionary signification of *clamp* is "something that fastens or binds." Nobody, very probably, would be "misled" by the use of clamp for cramp; but if clamp does not mean the same as cramp, it is wrong to use it in that sense, and forty wrongs do not make one right.—J. K. P.

[57209.]—**Case-hardened Iron.**—Has any reader ever succeeded in case-hardening iron by means of muriate of potash, as recommended by Mr. Bundy on p. 17? I have used the prussiate of potash; but never the muriate. Is it a slip of the pen, or will the muriate do as well?—C. O.

[57244.]—**Dentistry.**—In the whole of my twelve years' experience in this profession I have never known a vulcaniser to burst. I heard of one doing so once, and that is all. The machines of the present day are all fitted either with fusible plugs or safety-valves; the latter sometimes get stuck with burnt oil, but before the boiler burst the plug would be driven out by the pressure. Two years ago my vulcaniser was left on all night by accident, and with the exception that the rubber plate was burnt, no harm was done. I have always understood that a grain of practice is worth a pound of theory, and doubt if 50 years' study of the *Transactions* of the Odontological Society would make anyone competent in dental arts, especially as there are no two mouths alike.—DENTIST.

[57244.]—**Dentistry.**—Both "998" and "Dental Reform" have omitted to notice the force of the words "to become" in the reply which they criticise; but it is a matter of little moment, because I have no doubt we shall retain our own opinions. To the former I would point out that the "difficulty" of doing anything is simply a measure of the ability, or want of ability, of the operator; and if I may venture to say so, there is nothing in dentistry which lissom fingers, backed by subtle brains, may not hope to accomplish. "Dental Reform" makes a remark which he would probably withdraw on second thoughts, for the dentist can never stand on the same line with the physician, whose "business" it is to find out what is the matter with his patients without the possibility of seeing into them. I might be permitted to call his attention to the fact that if "amateur tooth-drawers" were at one time regarded as dentists, the new regulation goes to the opposite extreme, and has produced a close trade-union, which can be entered only by those who have sufficient money as well as brains. The "meanest capacity of mind" will readily appreciate the fact that "all this" is not necessary to make a dentist, and it will also appreciate the other fact that some who are "dentists" by examination delegate the most important portions of their work to those expert workmen who have the misfortune to be without the means to obtain a diploma, and are, therefore, compelled to remain behind the scenes. The attempt of "Dental Reform" to place the dentist on a level with the physician, assuming it to be something more than a mere notion for "cornering" a controversialist, is ridiculous in the extreme; and he, as well as "998," must be well aware that no one could be a dentist without practice in the art. It was a remark of one of the original repliers that brought out my rejoinder, and I would now ask that gentleman how he imagines a "dentist" can be made unless the latter has opportunities of experimenting in actual work. The replies on p. 550 remind me of nothing so much as the injunction, "Never go into the water unless you can swim." Sorry I have disturbed the professional vanity of your correspondents; but I can't help believing that there are as good fish in the sea as ever came out of it, and that a "diligent study of the *Transactions* of the Odontological Society will enable any one who is already a decent mechanic to become a superior sort of dentist." No one can ever become a useful physician without special training and clinical experience, and not then unless "brains" are added.—A. MALLARD.

[57251.]—**Agglomerate Blocks.**—To "F. E. M."—No; common salt will not destroy the blocks. And the people who told you that "the wrong acid" had been used could not have known much about the matter. If you have not thrown the blocks away, I should be glad if you could let me have them. If so, I will advertise my address. To "Silvertown."—If you are in any way connected with the company of that name, you will best be able to judge whether the first portion of your remarks is likely to be answered. Are you in a position to disprove my assertion with regard to the second portion? I may have something to say further on.—C. D. R.

[57255.]—**Storage Battery.**—To "BUNSEN."—Many thanks for answering my query No. 57255. The form of plate for my battery is that of Faure. [illegible] ring my last question, would you tell me whether they are 10 or 20 c.p. lamps that you mean? Is it an infringement of a patent to make a Faure battery?—W. LAURIE.

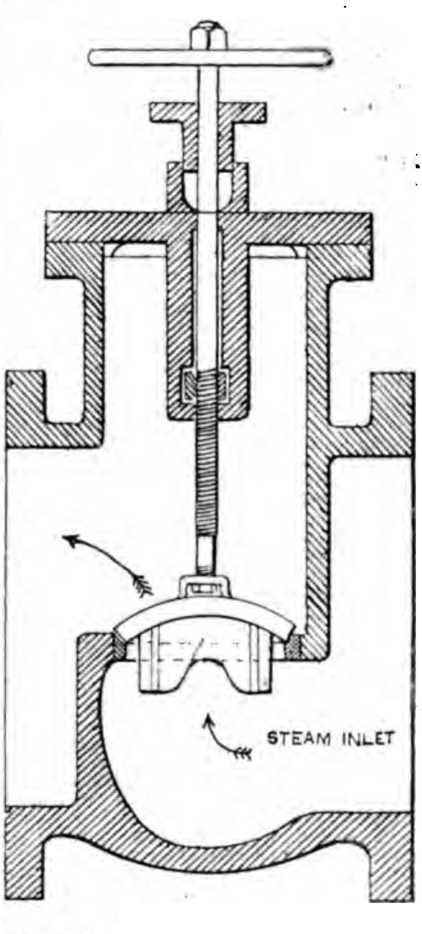
[57252.]—**Free Reeds.**—As Mr. Fryer, on p. 481, implied that he is acquainted with the "tuning bellows" used in organ factories, would he kindly give a description of it?—and oblige amongst others —ONE WHO WANTS TO LEARN TUNING.

[57289.]—**Electric Lighting in Mines.**—When the wires are coupled up to the lamps or uncoupled, sparks are produced, and these form the principal danger, although, of course, the accidental breaking of the conducting wires would produce sparks, which might inflame the fire-damp.—W. SCUDAMORE.

[57292.]—**Ebony.**—The best advice I can give "Vincent" is (he having rubbed down the bookcase with pumice powder) that he should give it two or three coats of ground drop-black mixed with French polish. When this is dry, which it will be in an hour, quite hard, he can rub it down with glass-paper; then give it a coat of white spirit varnish (10d. a pint); all the materials costing less than 1s. 6d. But why don't you polish it? You can, over the paint; first polishing with vegetable black till you get a good body on, finishing with gas black. Further advice if necessary.—NIGRUM.

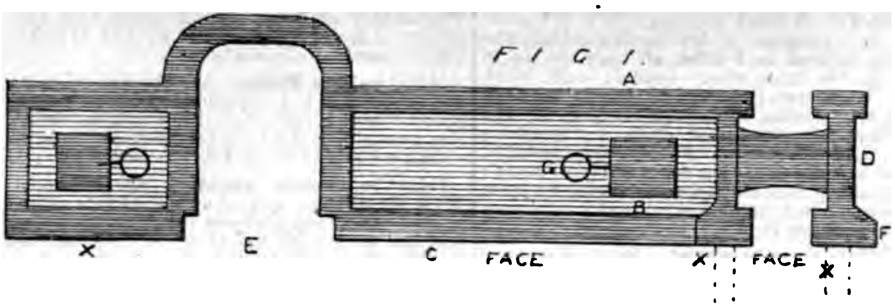
[57324.]—**Wire on F.M's.**—To MR. BOTTON
—You do not state whether the resistance 1·1
is the resistance of the entire length of wi
armature, or at the brushes. If the former,
4lb. of No. 16 c.c. will suffice; if the latter
will need nearly 8lb.—S. BOTTONE.

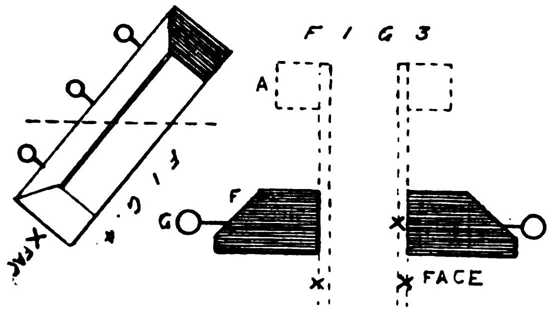
[57329.]—**Engine Stop-Valve.**—In
dinary steam stop-valve, the steam is ad
the under side of the valve, whereas if the st
mitted to the upper side of the valve there is a
certain amount of steam pressure always fo
valve upon its face, which would cause
very difficult to open, and, with the steam
the box from the under side of the valve,

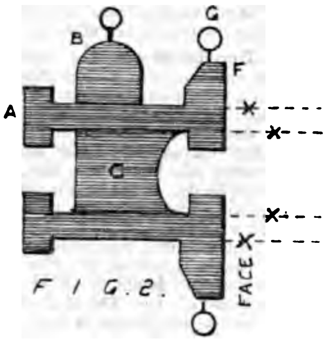


to liberate the valve if in any way stuck, which is sometimes the case. In a junction stop-valve the steam may be admitted to the top-side of the valve, if the box is put on the wrong road; but if put on the proper way, the steam will enter the box from the under side of the valve, which may be easily seen in the figure, the arrows pointing the proper route of the steam.—R. T. CLARKE.

[57326.]—**Pattern-Making.**—Make the pattern as Fig. 1. A is a side view, B is boss cast on for the leading-screw at each end, C is face of bed, D looking at the bed from the end, E is gap, with notches for loose slide-bars to rest on when the gap







—1; F is slide or end of v.'s; G is loose the boss while it is being moulded. The -id against the side of pattern, as -ted lines in Fig. 3. Cast face down, it a little taper in your pattern. . A is end of bed, B is boss on -ars in bed, F is the slide V.'s, -tted lines, both inside and outside, with the pins, G, to be drawn by the -ig. 3 is pattern and V.'s as moulded on A dotted lines, F slide-bars or V.'s, You can either black the pattern and sand cores, or make as the sketch. For -d be sure to make face down. Cut the -s as shown in Fig. 4, so that the pattern -w out of the sand.—Sand Rat.

]—**Tinman's Tools.**—"M. H." will find -wing some of the most useful tools for -. Crease iron with one end square, and for taking edges over, or squaring up flat -; the other end rounded, for taking up edges - circular pieces: it also has grooves in it of different sizes, which with a wire rod, is used for turning tubes round, &c. (i.e., in the grooves). Funnel stake used for bending conical shapes on, also extinguisher stake and beak iron used for similar purposes; a bright anvil and hammer for planishing; one or two block hammers and block for hollowing, such as the lid of a saucepan, &c.; a pair of rolls (technically called rollers) for bending or making round bodies, different sized groovers for making seams like that of saucepans; also a wheel machine called a jenny, and folding machine, both used for taking edges up on circular and straight work respectively. These are a few of the most commonly-used tools, and very briefly described. It would be impossible to expound them all here with their various uses; such can only be learnt by working in the trade. Any further special information on the subject I will gladly give.—Techna.

[57331.]—**Crystals of Gold.**—By dissolving gold in bromine water, or a mixture of nitric and hydrobromic acid, and crystallising out, crystals of bromide of gold are formed. By pouring bromine on pulverulent gold, and adding a quantity of strongest hydrobromic acid, equal in weight to the gold employed, and then as much bromine as is required to dissolve the gold completely, and allowing the solution to stand, crystals of hydroauric bromide are deposited. By adding strong hydrochloric acid to a very strong solution of chloride of gold, and crystallisine out, the acid chloride of gold comes down in long needles. By mixing a strong solution of perchloride of gold with strong solutions of the chlorides of potassium, ammonium, or sodium, crystalline chloro-aurates of these bodies are formed. By adding iodide of potassium drop by drop to a solution of perchloride of gold, aurous iodide is thrown down in small lemon-yellow crystals. Dissolve this aurous iodide in hydriodic acid saturated with iodine, and evaporate the solution at a gentle heat, and crystals of auric iodide will be thrown down. By mixing strong solutions of perchloride of gold and potassic iodide, in the proportion of one atom of the former to four of the latter, and leaving the liquid to stand, beautiful black crystals of iodo-aurate of potassium are formed. By evaporating a solution of auric oxide in a slight excess of pure potash, first over a flame, and afterwards *in vacuo*, crystals of aurate of potassium are deposited. By adding sulphite of potassium, drop by drop, to an alkaline solution of aurate of potassium, beautiful yellow needles of auro-sulphite of potassium are deposited. Dark-grey crystals of a double sulphide of silver and gold are produced by the action of melted sulphur on a fused mixture of gold and silver.—W. Scudamore.

[57332.]—**Manufacture of Aluminium.**—It is not necessary to use the double chloride of aluminium and sodium in the preparation of aluminium, as it may be prepared from the simple chloride of aluminium in many ways, as, for instance, in Deville's method, by passing its vapour over sodium in an iron or copper tube at a dull red heat, and removing the double chloride of aluminium and sodium, formed at the same time, with water. But the processes in which the double chloride is mixed with sodium, and usually fluor-spar or cryolite, and heated in crucibles, are preferable, as a much larger proportion of aluminium is separated out in a compact form, with, however, some globules, in proportion to the amount of chloride of aluminium in the double chloride used, than when the chloride of aluminium itself is used. The double chloride also requires much less heat in its manipulation than the simple chloride, as it fuses below 200° C. By the way, slight details of some of F. W. Gerhard's processes and patents for the manufacture of aluminium are given in Watts's Dictionary of Chemistry.—W. Scudamore.

[57335.]—**Battery.**—Totally useless for the purpose. See my reply to Qy. 57403 this week.—C. D. R.

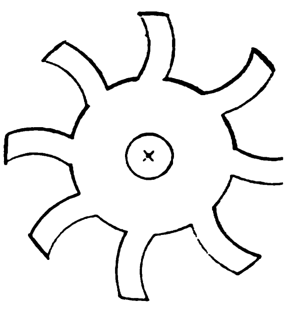
[57343.]—**Cupric Oxide.**—I think that the cheapest way of producing this oxide on a large scale would be by the continued ignition of copper in contact with a current of air.—W. Scudamore.

[57348.] — **Back-ache.** — Like "Hammer and Tongs," I have suffered from pains in the back for upwards of three or four years. My age is 44, stout, sedentary occupation, and much mental work; the pain is never acute, and better and worse alternately. Have tried to discover symptoms identical with the two conditions, but have never succeeded. Have consulted several physicians without result. Seat of pain shifts from kidneys to lumbar region. Have found change of scene and habits—a month in the Highlands or a trip to sea—has benefited me more than anything else; but cannot always be doing this.—Pen and Pencil.

[57349.]—**Gramme Dynamo.**—See reply 57221 for dimensions. Refer to No. 1001 of the English Mechanic for instructions as to engine — a ½ horse-power will do the work easily.—S. Bottone.

[57352.]—**Reducing Volts in Dynamo.**—To Mr. Bottone.—This depends on the build of the dynamo, whether series wound, shunt wound, or compound. Be quite sure that you mean volts and not ampères. You can easily reduce the ampères by putting resistance in circuit, whether the machine be series or shunt wound; not so the volts. For me to give a definite answer you must kindly inform me of the following points: 1, Speed of driving; 2, resistance of dynamo coils (armature and fields together); 3, build.—S. Bottone.

[57355.]—**Small Dynamo worked Water.**—The dynamo water wheel e Coxeter and Co., I believe, is the one, w simple in construction, and consists o wheels fixed on a shaft, as sketch, and



a drum 12in. by 5in. The water falls o from the same number of small pipes wheels, at a pressure of 60lb. to the dynamo is coupled direct to wheel, whi sufficient electricity to light five 5 c.p. I must remind you that the wheel is W. Habgood.

[57356.]—**Storage Battery.**—The given in No. 1016 apply to all storage battery shown is composed of two nominal E.M.F. of a single cell is 2 vo candle power lamp requires about 24, fore 12 to 14 cells must be joined supply the necessary E.M.F. If you a to go to the expense and trouble of c these you cannot do better than follow given. You will see that each cell is c eight plates. It is not absolutely ess they should contain this number. Yo struct a cell of two plates, but unless ficial area equalled the eight you wou able to charge it in proportion to its therefore the quantity of current availa charge would be in the same ratio. My to make the plates of the same pattern but to increase the size to 12 × 9, $\frac{3}{16}$ thi outer edge of ¼in. for stability. The in for joining up are not quite plain, perh pose after making the plates and putti red lead you number them in sets 1 to 8, p of course, you have arranged to put eig cell. Take the odd numbers, 1, 3, 5, a join them together by means of a brass ing through the tags A, placing a lead w tween each 1in. thick, and screw them up of a nut at each end. This will secure plates together with a space of 1in. betw Proceed in the same manner with the e bers. When placed in position the num run consecutively 1 to 8. The odd num be the positive plate, and the even the Now suspend them in the containing box and charge with dilute sulphuric acid, on to twelve of water. The cell is now formation. In giving instructions for m kind of apparatus, it is not always an ea to make oneself understood without diag you intend making the cells I will give yo tions for their formation, either by m dynamo or battery; but if not I do not take up the space of "Ours" unnece C. D. R.

[57363.]—**Lamp for Soldering.**—To Tone.—A spirit lamp, burning methylate with a good ¼in. wick, will give you plent for such a bit as described in my art Bottone.

[57377.]—**Dynamo.**—To Mr. Botto dynamo will light from four to five 20-can The machine (Siemens) will not run very motor, as the resistances are high for su machine. The principal alteration that make is to get it to run easily in its bea alter the "lead" of the bushes as req Bottone.

[57379.]—**Horse-power of Engine** steam pressure full on to the end of t your engine would develop ·47h.p. n J. H.

[57379.]—**Horse-power of Engi** should "W. P. B." expect anyone to w "sum" for him which he might easily do The h.p. of an engine is found by t formula, 2 A P R S, divided by 33,000, i is area of piston in square inches; P ave sure of steam in lb. per sq. in.; R revolutions per minute; and S length of feet. As the 2 will apply to any term in he can stick it on to S, and call his stroke 5¾in.—Jimmy.

[57380.]—**Cracked Boiler.**—Finely iron (procured at a druggist's) made in ite with water-glass. The hotter the fire the re the cement melts and combines, and the more npletely does the crack become closed.—R. ALKER, Stanley R.S.O.

[57381.] — **Stretching Trousers.**—The best y to stretch your trousers is to shrink them. onge the knees and creases, beat them with the lm of your hand to send the wet through, pull m out nice and straight; button the top button, l hang them up on a hook. Put them to the before wearing, to insure their being dry.— RAX.

[57384.)—**Noise in Flushing Pipe.**—Put a all air-pipe just under the valve, and carry it up ove the level of water in the cistern, and this ll effectually remedy the nuisance.—A., Liverol.

[57390.]—**Silver Goods.**—The blackening is ised by the sulphur in the gas, if you burn it, ich forms sulphide of silver. Of course, the re silver, the more black sulphide is formed; so non-hall-marked goods, having less silver in ir composition, get black less readily than those ich are purer silver. I don't see how it could prevented, except by burning the gas outside, as ny silversmiths do.—R. A. R. BENNETT.

[57394.]—**A Fishy Question.**—"Sou'-Wester" uld try the soap boilers. Except on a large le, I fear the extraction of oil would not pay.— M. ROGERS, 21, Finsbury-pavement.

[57396.]—**Leclanche Battery Management.** The cells are too heavily charged. You must pty them, wash thoroughly with hot-water both rous and outers, clean the connections bright, ape the zincs, mount the battery afresh, and arge with a half-saturated solution of salmoniac, made by dissolving the salt in cold water til it will take up no more, and then diluting th an equal volume of water. Charge the cells o-thirds full. In the course of a day or so this ll sink, probably because the porous pots take a rtion of it. If this is the case, add a quantity to ake up. Leclanché cells always are liable to eeping salts, especially when too heavily charged. saturated solution adds nothing to the E.M.F. eep the battery in a dry, cool place, and visit it casionally.—C. D. R.

[57399.]—**Hot-Air Engine.**—You can make a rling hot-air engine without much difficulty to rk with two Bunsen gas burners. I made one ne years ago from a drawing given in one of the ly numbers of the ENGLISH MECHANIC, and ich has since been published in "Axon's chanic's Friend." For a sewing machine the king cylinder should be about 2in. diameter, the expanding cylinder 3½in. or 4in. There is a d form of the engine shown in Deschanel's atural Philosophy."—J. SUTCLIFFE.

57403.]—**Battery.**—No battery of six cells will at one 10 candle-power lamp, much less four. is has been reiterated again and again. The d of cells you require have yet to be invented. no known cell will give more than two volts— the majority a great deal less than that—it lows that six can only give twelve. A 10 dle-power lamp requires 24 volts at least. Dale's nule gives about 1·60 volt; you can, therefore, culate how many you require. Notwithstanding the puffing, this granule arrangement is no better n a Fuller, and in constant work will not last r four hours.—C. D. R.

57409.]—**Dry Plates.**—1. You will find in- actions in making gelatine bromide dry plates in ughes's "Practice of Photography," price 1s. 2. at albumenised paper on the following solution three minutes:—Silver nitrate 40gr., water 1oz. ow the paper to drain, then lay it face downrds on a pad of blotting-paper, and with a broad nel-hair brush damp the back with a solution of ric acid 30gr., water 1oz. Suspend to dry, and serve under pressure, as the less air admitted longer it will keep.—C. F. S. R.

[57409.]—**Gelatine Bromide Dry Plates.**— is impossible to give a proper description of the ocess of making gelatine dry plates in this column, it would take up so much space. If "Amateur hotographer" will refer to the article taken from e *Photographic News* that appeared in the E. M." for the 14th November, 1884, he will find ll he needs. It is much better for you to buy our albumenised paper than to make it, as it requires a deal of practice in coating it properly. It made by coating paper with a solution of albumen and ammonium chloride, after which it is ated on a bath of silver nitrate.—A. TREYER VANS, Monmouthshire.

[57412.]—**Electro-plating.**—Has been written bout no end of times. Look up back numbers, r purchase a book on the subject.—C. D. R.

[57416.]—**New Brake.**—To "BRAKE."—There another new vacuum brake on the Midland; it is e invention of Mr. Haigh, of the carriage department; it is fitted to only four bogie coaches, and has been run about Derby, Trent, &c., and has run London to Bradford and back a few times. The Vacuum Company, you know, have got a ball-valve brake on the South-Western, &c., but it sticks, and Mr. Haigh has a ball-valve with a kind of spring that puts an end to this sticking. I would advise those who wish for a more full account to refer to Haigh's patent, 16,887, 24th December, 1884. He claims it to be an improved form of valve for a brake stated, line 8, to be "now commonly called or known as the Clayton two minute leak-off brake."—LOCO.

[57423.—**Lamp for Blowpipe.**—You can buy a lamp on purpose for soldering for about 1s. 6d. I have not tried the lamp you inquire about, but do not see much advantage in it.—C. A. W.

[57423.]—**Blowpipe for Soldering.**—I have not a blowpipe and lamp combined myself, but having made an intimate acquaintance with one belonging to a friend, I believe they work extremely well. I fancy a good many gasfitters use them now; some do that I know of myself. The only thing I was warned about them is, take care to get one with a safety-valve at the top; they are not safe without one, as the spirit is apt to blow up. With one, of course, there is no danger, unless screwed on too lightly.—R. A. R. BENNETT.

[57425.]—**Argentic Nitrate.**—Dissolve the whole of the three precipitates in a solution of potassic hydrate, which should form a clear solution. Add to this a saturated solution of hydrogen sulphide until no more precipitate is formed: $2KHO + 2AgCl + H_2S = Ag_2S + 2KCl + 2HO$. Sodium hyposulphite may be used instead of the potassic hydrate, as it dissolves a greater quantity of the silver salts; the precipitate is, theoretically speaking, pure argentic sulphide, which has to be washed on a filter and dissolved by boiling in nitric acid:

$$Ag_2S + 2HNO_3 = 2AgNO_3 + H_2S,$$

which gives a solution of argentic nitrate, and hydrogen sulphide is set free. Finally, filter and evaporate until it crystallises, which will be the argentic nitrate sought.—A. TREYER EVANS, Monmouthshire.

[57425.]—**Nitrate of Silver.**—Carbonate of silver may be treated with nitric acid, when it dissolves with effervescence, evolving carbonic anhydride, and forming nitrate of silver, which may be evaporated to dryness thus:—$COAgO_2 + 2NO_2HO = 2NO_2AgO + CO_2 + OH_2$. Citrate of silver may be dissolved in a sufficiently large quantity of hot water, and solution of potassic chloride added, when potassic citrate will be produced, and chloride of silver thrown down, and may be dried and treated as in the next case, thus:—$C_6H_5Ag_3O_7 + 3KCl = C_6H_5K_3O_7 + 3AgCl$. Chloride of silver must be heated before the blowpipe in a crucible, with carbonate of soda, when metallic silver and sodic chloride are formed, and a mixture of oxygen and carbonic anhydride evolved. Fusion mixture and a little borax make the reduction easier still. $4AgCl + 2CONaO_2 = 4NaCl + 2CO_2 + O_2 + 2Ag_2$. Wash the residue with water to dissolve it in nitric acid, and evaporate the solution to dryness. $2Ag_2 + 6NO_2HO = 4NO_2AgO + N_2O_3 + 3OH_2$.—W. SCUDAMORE.

[57430.]—**Tricycle Chain.**—By far the best are Morgan's roller-chains; they are very strong, and do not weigh much more than half the ordinary. They have no rivets to get loose, and do not stretch, and if "G. D. G." will get one I am sure he will find it satisfactory.—C. A. W.

[57431.]—**Tuning Fork.**—You may either solder or screw the stem, but forging is bad, for the steel will certainly crack. Tuning forks are best cut from a solid piece of shear steel. I had three made by different smiths, and only one stood, the others all broke.—J. SUTCLIFFE.

[57437.]—**Bleaching Micro. Objects.**—If the "chloride of lime" is really pure calcium chloride, and the "soda" is sodium carbonate, the clear fluid will be nothing in the world but solution of common salt—

$$CaCl_2 + Na_2CO_3 = CaCO_3 + 2NaCl.$$

But as "chloride of lime" is sometimes thought to contain hypochlorite as well, there might be a certain amount of sod. hypochlorite present in the clear liquid.—R. A. R. BENNETT.

[57438.] — **Cricket under Cover.** — I believe that where good turf cannot be had for cricket, cocoanut matting makes a good substitute. The ground must be levelled and rolled, and the matting laid on it. English regiments in foreign countries adopt this plan, and so carry their pitch about with them. A roof without sides would probably keep this dry enough.—T. K. W.

[57441.]—**Replacing Pivot.**—There are two kinds of tools for centring pivots. The first is simply a chamfering tool, on which is fitted a small steel cup; there is also a spring, which keeps the chamfering point back. All you have to do is to place the arbor you wish to drill in this cup (taking care it is quite upright) and press down the chamfering point, moving it round. This will make a mark in the centre, which you can drill in the turns by drilling a hole up a brass runner exactly opposite the centre of the left-hand runner. Put a drill in this hole and a ferrule on the arbor to be drilled, and then put it in the turns, so that it is centred between the drill and the runner. It will then be drilled true. The price of this tool is 1s. The other kind is much more expensive (about 10s.). It is like a pair of turns in shape, except on side there is a circular piece of steel with a number of cup-shaped holes. You have to put a ferrule on the arbor and fit it in one of the holes with the runner. Then put a drill through the cup (for which there is a hole), and drill, pressing the drill through and working the arbor with a bow.—C. A. W.

[57441.]—**Replacing Pivots.**—I am afraid I was not quite plain in my last reply. First, the gravers. What I meant was, that if the surface be not ground down perfectly flat, the cutting edge will not be straight. The beginner almost always gets a round edge on his tools, which will never do. The work depends on the shape of the tools. With reference to the pivoting, practice has a deal to do with it. First, take the centre true with a tool for the purpose. There are several kinds—some expensive. I am using one which only cost 2s. 8d., and which answers the purpose. Next, the drilling. This will be, indeed, difficult if already begun and out of centre. But, supposing it is not, instead of drilling in the ordinary way, put a screw ferrule on the pinion, fit the drill to a stock which will slide easily into the turns, and turn the pinion; the drill to remain stationary. This must be done carefully and rather slowly, using plenty of oil. There is no particular trouble in polishing pinions; but this is a job which I am by no means expert in. I always do it with a lead polisher, cut so as to fit down in the leaves, and use redstuff and oil. But first clean the job with stone dust.—ESCAPEMENT.

[57445.]—**Hoist.**—Before the cost can be stated "Forward" should supply the following particulars:—Is there available steam or water-power at hand? if so, how much? A sketch of position is also needed.—F. M. ROGERS, 21, Finsbury-pavement.

[57446.]—**Nitrous Fumes.**—There are no effectual means of suppressing the fumes. Bichromate of potash dissolved in the acid was said to do so, but experience shows that after an hour's work the stench is as bad as ever. A patent was taken out for this, and a company started to supply batteries, but all to no purpose. If you must use a Bunsen, the best arrangement you can have is a stink chamber to carry off the fumes into a chimney or flue.—C. D. R.

[57446.]—**Nitrous Fumes.**—"Voltaire" can get rid of the nitrous fumes by covering the cell over with a cover made to contain quicklime, in passing through which the gas is absorbed. The better plan would be to use a solution of four parts pot. bichromate, four parts sulphuric acid, and eighteen parts of water; but the electromotive force is thereby diminished, which could, however, be compensated for by using more cells.—R. A. R. BENNETT.

[57446.]—**Nitrous Fumes.**—You cannot substitute any other body for the nitric acid in your Bunsen's battery without decreasing the electromotive force. You should keep your battery in an outhouse and lead the wires up or keep the cells in an air-tight box. Water dissolves a great quantity of nitrous fumes, so if you could arrange some contrivance so as to lead the fumes into the water you might get rid of them in that way.—A. TREYER EVANS, Monmouthshire.

[57449.]—**Sanitary.**—Like "R. B. W.," I use gas only for heating and cooking, and the vegetable refuse goes into the ash-tub, which is regularly emptied without the slightest difficulty. It appears to be, in the case of "R. B. W.," simply an attempt to extort beer money, and if he lays the matter before the nuisance inspector, he will have no difficulty. The objection of the men is absurd; they might, with equal reason, refuse to remove cinders and clinkers because they were not dust. A note to the nuisance inspector or scavenging department will settle the matter at once.—998.

[57450.]—**Induction Coil.**—Guttapercha tissue cut in strips ½in. or 1in. wide lengthways of the grain is the best insulating material. It will stand for 20 years, and then, perhaps, be brittle in some places. Tissue paper of the best quality varnished on one side with two coats of lac dissolved in methylated spirit, and thoroughly dry, is the next best, and must also be cut into strips like the guttapercha. Tissue paper soaked in paraffin is very good at first, but gets damp in a year or two, and then does not insulate so well. Wrap the strips or ribbons one to two layers for small coils up to 1in. spark, and three for 1in. to 2in. spark. The thickness in layers is obtained by rolling the ribbons round the coil to overlap each other to the required depth.—J. SUTCLIFFE.

[illegible] **Induction Coil.** Shellac varnish forms a good insulator, but is not quite so effective a mixture as the ordinary black resin and beeswax. The method to be adopted is this: The resin is to be melted in an earthen vessel, and one fifth, by weight, of wax added to it. The resin and wax, when fully melted and heated almost to boiling, are to be carefully poured over the wire by means of a spoon, turning the coils round until the mixture has completely filled up all the interstices between the wires. H. H. B.

[57461.] **Lightning Paper.** The so-called lightning paper is made by saturating a paper with a solution of phosphorus in carbon bisulphide; the latter (carbon bisulphide) being volatile, evaporates, leaving the phosphorus in a finely divided state, which catches fire by the heat of the atmosphere. In a warm room the phosphorus ignites almost immediately the carbon bisulphide evaporates. A. TREVER EVANS, Monmouthshire.

[57461.] **Lightning Paper.** Whether it is the right way to do it or not, I don't know; but you can easily make the "lightning paper" by soaking soft paper in strong sulphuric and nitric acids (equal portions); it will get perfectly hard and unlike paper (it is, in fact, "gun paper," if there is such a material), and when washed and dried, will go off with a flash on applying a match, without leaving any residue. Cotton wool is still more effective; this makes the real gun cotton.—E. A. R. BENNETT.

[57461.]—**Lightning Paper.** The solution is composed of four parts, by measure, of oil of vitriol (sulphuric acid), and five parts of strong fuming nitric acid. Mix the two acids well by stirring with a glass rod. Let the paper remain in the solution for ten minutes; remove it, by the aid of the glass rod, into a panful of warm soft water; let them remain for an hour, and then pour off all the water, and replace with clean. Keep repeating this operation till every trace of acid is removed, then dry. H. H. B.

UNANSWERED QUERIES.

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The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, W. J. Grey has replied to 57108.

[illegible] Solubility of Carbonic Acid, p. 396.
[illegible] Clock Springs, 396.
[illegible] Rotary Hair Brush, 396.
[illegible] [illegible], 397.
[illegible] Ball-room Floor, 397.

[illegible] Hand Fire Extinguishers, p. 488.
[illegible] Bidwell System, 488.
[illegible] Instantaneous Shutter, 488.
[illegible] Incandescent Lighting, 488.
[illegible] Microscopes, 488.
[illegible] Wooden Houses, 488.

Scraper Chasers.—One of the many odd callings which the production and pipe line transportation of petroleum have made necessary is one known as "chasing the scraper." Crude petroleum is run from the oil regions to the refineries at the sea board, a distance of 300 miles, in iron pipes. It is forced over the high hills that intervene by powerful pumps. Much of the way it runs by its own gravity. The pipes are constantly becoming clogged by sediment and paraffin. To clean them out an iron stem 2ft. long, to which are attached circular steel scrapers fitting loosely in the pipes, is placed in the line at regular intervals. This is forced along the line by the pressure of the oil behind it. It is necessary to keep track of this scraper, in order that its exact location may be constantly known, so that if it is arrested by any obstacle it may be readily discovered and the obstacle removed. The men [illegible]

QUERIES.

[57452.] **Water Power.** I have a tank holding about 700 gallons, with a 3ft. fall, and constant supply, and I wish to know what driving-power I ought to get through a pipe 4in. in diameter at, say, 30lb. pressure. If I made this pipe conical, with a graduated fall reducing it to 3½in., 3in., 2½in., to 1½in. outlet, would the power be greater by this arrangement, and should I obtain better results for driving a small rotary engine? Will any of "Ours" versed in these matters fully explain?—AN OLD SUBSCRIBER.

[57453.] **Lathe Overhead.** Can any of our lathe hands favour me with a description of light-running overhead gear for ornamental lathe of 5in. or 6in. centres? Would like to see outline sketch of the Kennan arrangement, which, I believe, is detached from the lathe. What are the respective merits of a continuous parallel drum and a sliding (adjustable) V-grooved pulley? I fancy the latter myself, as I think it would run lighter, besides having a better grip on the cord. I have not back numbers of the "E. M." further than Vol. XXXI., and I think it was before that time that an overhead gear, alluded to as the "D. H. G.," was described. Was this an efficient gear? and, if so, what is its principle? A. F. H.

[57454.] **Wimshurst Electric Machine.**—I wish to know the best size Leyden jars to use with a 17in. machine, 12 or 16 sectors, and to obtain the maximum length of spark? Should like information as to the area of tinfoil surfaces exposed and proportion of uncovered jar above the foil. Has the thickness of the dielectric any important connection with the capacity of a jar? With regard to the machine itself, am I right in supposing that the nearer the two plates are together, the more efficiency one may obtain from the machine? Should much esteem a reply from Mr. Wimshurst, if he has the time to spare. A. F. H.

[57455.] **Killing Rats by Electricity.**—As I have suffered very much this year from rats amongst my fowls, and have tried trapping, and poisoning, and every known way without much effect, I have determined to try electricity, and for this purpose propose surrounding the ground, about 20 acres, with two wires, about 1½in. apart, supported on insulators. Would "Electrical Engineer," or any other reader, kindly let me know if this is practical, and, if so, what sized coil and what sized battery I should have? Would the wires have to be kept bright? The battery would be put in gear at night and out of gear in the daytime. I shall be very grateful for any information.—GLADIATOR.

[57456.] **Australian Duties on Watchmaker's Materials.** Will some of "Ours" kindly let me know if there is any duty on watchmaker's materials going into Melbourne, such as mainsprings, hands, pinions, jewels, endstones, and the like; all the above ready for fitting? EMIGRANT.

[57457.] **Japanning.** Will any correspondent give fullest particulars for japanning small articles; if any recent improvement in the process? Please state, for information of AN AMATEUR.

[57458.] **Surveying and Measuring.**—Will any of the readers of your valuable paper kindly inform me if there be an examination held in London, or elsewhere, to enable one to become qualified or certified as a quantity surveyor? If so, would he be good enough to state when and where it is held, and also give the nature of the examination, with amount of entrance fees, and all the subjects embraced? Perhaps one of your Scotch readers could let me know of an examination held in Scotland for qualification as an ordained surveyor and measurer. If so, he might give some particulars about it.—J. C. H.

[57459.] **Intermedial Engine.**—Would some kind reader of the "E. M." give a description of intermedial engine and rotary valve for same? I have seen one in Byers' book on the steam engine, but it is very indefinite. I would be very glad of sketch, if possible. It is an engine with crank-shaft inside of piston.—RAZOR.

[57460.] **Preparing Hard Woods.** Could any of your readers inform me of the best way to season pearwood? I propose to cut a pear tree down in November, and wish to make use of the wood for turning, &c. I want to season it so that it will not crack or warp.—AMATEUR.

[57461.] **Universities.** Will some reader kindly give me names of university towns in Canada and United States?—TRAVELLER.

[57462.] **Papier Mache.** I require to make articles of papier maché like the inside of railway waggon wheels made in America. Will someone kindly say how the paper pulp is made, and what plant it would be necessary to get? [illegible] I can command a pressure of about three hundred tons: would this be sufficient to make the paper of the required hardness? Is there any book published on the subject? Any information will much oblige. [illegible]

[illegible] **Electrically-worked Clock Dials.** [illegible]

[illegible] **Storage Battery.** [illegible]

[illegible] **Dynamo.** [illegible]

[illegible] **Bright Silver-plating.** [illegible] Gore's "Electro Deposition," but fail to get [illegible] required. Should I use more or less battery [illegible] for the ordinary plating process, which I can [illegible] small way very well? I use a bath containing [illegible] gallons, and have a good 12-cell Smee's battery.-

[57467.]—**Boiler Query.**—Could anyone e[illegible] appears to me a rather singular affair? A bo[illegible] until it raises 60lb. of pressure. All outlets are [illegible] the fire is drawn, and the boiler allowed to cool [illegible] day the water is an inch lower in the glass t[illegible] before steam was raised, although all outle[illegible] closed. What is the explanation for this?—So[illegible]

[57468.]—**Recovering Gold from Ol[illegible] Plates.**—Will any reader kindly tell me the [illegible] of getting the gilt from old verge movement p[illegible] the plates to be dissolved in nitric acid, leaving [illegible] is there a better method? Any information wi[illegible] fully received.—EXTRACT.

[57469.]—**Lime.**—TO BRICK AND TIL[illegible] CHEMISTS, &C.—I am much troubled with [illegible] manufacture of bricks. Would some kind r[illegible] there is any process, patent or other, besid[illegible] crushing, or screening, by which I could extra[illegible] stones, and gravel from the clay in a complete[illegible] LIMESTONE.

[57470.]—**Brush Dynamo.**—Will any r[illegible] inform me how I can alter my machine to [illegible] results than at present? The following are a [illegible] lars:—F.M., cast iron, wound with No. 14 wir[illegible] 1·48; Arm. 8½ dia. by 1¾ by 1¾ wound with [illegible] resistance ·350 ohm. The machine, when r[illegible] 1,500 revolutions per minute, will only light [illegible] lamps, and absorbs 1 h.-power to do this. Will [illegible] in diameter of wire on "A." be of any use? I [illegible] and 16 d.c.c. Would this be of any use?—Wi[illegible]

[57471.]—**Stove.**—Will any kind reader ad[illegible] kind of stove will be best to heat and keep a[illegible] temperature as possible a room at the back o[illegible] which is built on two brick tiers and is ex[illegible] weather on three sides and the floor and roof, [illegible] it almost impossible to live in it last winter? [illegible] fitted with an asbestos fireplace, but the [illegible] sufficient, and it is so expensive. I have bee[illegible] buy a stove to stand on the hearth in front of [illegible] with chimney running into the flue, as I am t[illegible] bring the heat more into the room; but I sh[illegible] have the advice of some of the readers of "O[illegible] purchasing.—CHILLY ONE.

[57472.]—**Dynamo.**—Many thanks to Mr. [illegible] the promptitude and clearness with which he [illegible] query as to winding of laminated armature. T[illegible] which I propose to change belongs to a m[illegible] field magnet is wound with 25lb. c.c. copper [illegible] In view of this, would Mr. Bottone kindly say [illegible] be the proper quantity and gauge of wire wi[illegible] wind the laminated armature for arc lightin[illegible] the proper quantity and gauge to use for [illegible] lighting? And would he kindly further say [illegible] of winding is best for each system of lighting[illegible] ticulars to these queries would excite my war[illegible] —PERPLEXED.

[57473.]—**Legal.**—A father wills house pr[illegible] two daughters and their heirs for ever. [illegible] daughters is dead, leaving a husband and a [illegible] being 23 years of age. Does the son take the [illegible] once, or does the husband have the property [illegible] lives?—JAME SPOONNER.

[57474.]—**Engine and Boiler.**—I hav[illegible] engine, 5in. stroke, 2in. bore. Can I use it fo[illegible] lathe? If so, wish to know particulars of bo[illegible] pressure, &c. What ought to be the cost of [illegible] supplying the plates? In how much time [illegible] pressure be right, using coal for fuel? Flywhe[illegible] 24in. diam. What diam. must be the flat p[illegible] shaft; flat pulley because the lathe has flat [illegible] want to put a new shaft and new crank. Wha[illegible] good size for same? Also a feed-pump fo[illegible] Would anyone send sketch of a plain pump? [illegible] the castings ready for a pair of eccentrics to [illegible] ing motion. How must I make the link, rad[illegible] and length of same? I would use it for regul[illegible] also. BELGIAN.

[57475.]—**Family Clothes-washing [illegible]** Will any reader kindly send working dr[illegible] thoroughly-efficient family clothes-washing [illegible] publication in this journal? The writer of t[illegible] an Eastern county, and where domestic [illegible] machines are almost unknown; he would [illegible] grateful, and has no doubt that hundreds [illegible] the information that would enable him to con[illegible] washing machine. The drawing must sho[illegible] efficient washing-machine, not one that w[illegible] [illegible]

[illegible] **Patent [illegible] Ring.**—[illegible]

[illegible] **Refracting Telescopes**—[illegible]

[illegible] **Bright Work** [illegible]

).]—**Clay Pipe Making.**—Is there any sub- other than clay used in making the above? Also, he clay tempered previous to moulding? Is there ans of making them tougher by using various clays? S.

).]—**Kilns.**—What kind of kilns are used in firing ware, such as small dishes, cheese plates, &c.?—

1.]—**Water Motor.**—Being desirous of making water motor to drive a sewing machine, I will feel bliged if some kind reader would furnish me with ars as to what materials to use, and the simplest st make of castings, &c.? I want to make one to a ¾in. pipe, where there is a good pressure. I am "duffer" on the subject, so any information will ach oblige—J. M. L.

2.]—**Warm Water for Bath.**—Would any of be kind enough to help me with some simple way n water for wash-bath? I have zinc bath fitted . I can run the cold water into bath from scullery t have to carry the warm water from boiler in cellar which is rather too much trouble after doing a 's work. Some suggestion to heat water by gas, or er simple way, would greatly oblige—A FIREMAN.

.]—**Sinking Sphere.**—To what depth will a ink in a liquid whose specific gravity is three times he sphere?—C. N. P.

.]—**Electro-Gilding.**—Will any reader describe hod of gilding silver filigree articles? I can gild anything, but silver filigree beats me. Tried a cross the other day: the points alone took on the ile the centre obstinately refused to be gilt. What eason of this, as the solution was good and the rge? A detailed method of gilding filigree will stable.—FILIGREE.

.] — **Gillet's Telephone.** — Will some kind ell me how to make the above, and all connections, ribed in advertisement page (9) of "E. M.," for use in our house, which would be allowed, I think? will you please state?—A CONSTANT READER.

.]—**Mechanics.**—Two equal weights, M_1, M_2, g over a pulley by a cord. A third weight, M_3 o M_1 or M_2), is now attached to M_1, causing it to . Friction and weight of cord being neglected, eckoned = 0; what is the tension of the cord during ent?—X. Y. Z.

.]—**Silver Stains in Negative.**—Can any llow readers tell me how to remove these stains? ative, of which I am not able to get another, got et between it and the sensitized paper, and the as eaten through the varnish and film. I have weak solution of cyanide. The stains are on a part egative, which is an engine, which will be black in are.—BERTRAM S. SMITH.

3.]—**Grinding a 6in. O.G.**—As I am about g a 6in. o.g., will one of our astronomical corre- its kindly inform me what curvatures are required crown and flint glasses respectively, and also what esponding focal length would be?—RETINA.

0.]—**Clock Cords.**—By what process can I get nts water-tight, after they are spun, in clock cords? .

0.]—**Softening Brass Wire.**—Would some ader kindly inform me how to soften brass wire to n metallic paper? Want it to mark very soft. I ried to soften it with fire, but cannot get it soft .—CHOR.

1.]—**Bisschop Gas Engine.**—Can any of our help me out of my trouble, regarding my 4 man-power p gas engine? When I start it to work it makes a ing noise in the eccentric; can hardly turn, or, revolve, it by hand. It will only go for about ten s, and then gradually stop to a standstill. The pins ach the slide valve and eccentric to rocking lever little play; would they make all that difference? had new piston rings and slide valve rings and new gs, but makes no impression; also new gas and air . The only work it has to do is to drive a small mineral machine. Can you kindly advise me what to do to t go, and greatly oblige?—A. H. A.

2.]—**Locomotive Queries.**—Can any of our furnish me with the height, from the rail to centre ler, of the following locomotives, viz.:—G. E. R., ., single; G. N. R., 8ft., single; L. and N. W. R., 6ft. ouble-coupled; G. W. R., 7ft., single; and L. and R., 7ft., double-coupled? Also can anyone say which s are considered the best on the G. E. R., the 7ft. 6in. or the 7ft. double-coupled? From observations I ade from time, I fancy the single engines bear away m, not only for speed and general efficiency, but range to say, for starting and climbing. At any hey are employed on most of the heavy seaside es, and they apparently take the steep gradients on st Suffolk line at least as well, if not better, than the l engines. With reference to the letter that red in your last issue respecting the compound otives on the G. E. R., I understand they have not entire satisfaction, slow starting being one of their d defects. In addition to this, they seem deficient in which, perhaps, is partly accounted for by their great —upwards of 46 tons when in steam. Perhaps some pondent can inform us whether any more compounds be built, or whether the new loco. superintendent s striking out a line for himself?—X. Y. X.

3.]—**Screw-driver.**—It is well known to all ters, &c., that a screw can be driven into wood much easily with a long screw-driver than with a short Can any of our readers explain this clearly, as I don't anyone has explained it satisfactorily as yet?— US.

4.]—**Whitworth Scholarship.**—Would any kindly tell me what course to adopt in order to e myself for competing for a Whitworth scholar- —MECHANIC.

5.]—**Stern Tube for Launch.**—Will any favour me (by sketch, if possible) with a simple of making water-tight the screw shaft of a small h at the stern post? The shaft is 1in. diam.; st is of wood. Also with the best method of screwing a vertical boiler in the boat, the water here being often very rough?—C. B.

[57496.]—**Insoluble Gum.**—Can any reader of "Ours" tell me how to make a gum, or how to prepare the paper, that when two pieces of paper have once been fastened together the gum, or other adhesive, shall not again yield to water? I want to use it without heat or other special preparation. I have seen somewhere a notice of such a preparation for envelopes, but do not know how to prepare it.—INSOLUBLE.

[57497.]—**Aluminium Binoculars.**—Will some reader of "Ours" tell me how to remove from a pair of aluminium binoculars a sort of film? It comes on the tubes after the binoculars have been used near the sea.—OPTIC.

[57498.]—**Electro Depositions.**—Will anyone help me in my copper solution? It is the double cyanide of copper; the quantity is half a gallon. There are 2oz. of nitrate of copper, and about 4oz. of cyanide in the solution; but it gives bad results—it deposits very feebly, and the colour is bad. I use a Daniell battery; but no matter what alterations I make in the battery, the results are the same. My gold and silver sol., made up on the same scale, work first-rate, but my copper sol. will not work. An answer to this will greatly help—ONE THAT TRIES.

[57499.]—**Charging Porous Cells.**—Will anyone please give me the proportion of carbon to manganese in charging a porous cell of the Leclanché battery?—ONE THAT TRIES.

[57500.]—**Gear Wheels.**—To "GLATTON."—I am much obliged for your practical reply respecting gear wheels. I might say that the size of drum is not a particular object; but I contemplated having it rather smaller than 10in., and I presume that would be less pressure on the teeth; but I should like to know if there is any objection to having the wheels shrouded, as you say it would not be required? I suppose it must necessarily make them stronger, whereby I could make the teeth narrower.—C. B.

[57501.]—**Adulterated Honey.**—Could "J. I. S." (who, in the last issue of "Ours," criticises the article on "Artificial American Honey") give us a simple test for adulteration in honey? Will he also give us, as promised, the number of the *British Bee Journal* in which appears the report of the cases in which different samples had been analysed? Also would "J. I. S.," or any other correspondent, give us the true origin of the term "wooden nutmegs"? I should think it would cost as much to get up the wooden imitations as to procure the genuine article.—ANTI-HUMBUG.

[57502.]—**Quick Match.**—Will any correspondent inform me of a good, reliable quick match for firing a large set piece (other than that made with cotton and meal powder)? I have heard they use one for experiments with explosives, but cannot get to know how made.—H. H. B.

[57503.]—**Backlash in Gearing.**—I have two pinions, A and B, which are 1in. pitch, have twelve teeth each, and are about 3in. wide, working together at about 150 revolutions per min. A drives B for half a revolution, and for the remainder of the revolution B drives A. I am very much troubled with the noise made at the two points in each revolution where the change in the transfer of motion takes place, owing to the backlash in the gearing. I should like to know if there is any means of avoiding this, either by altering the shape of the teeth, or by running the teeth in some lubricant?—GEARING.

[57504.]—**Pottery Glazes.**—Would someone oblige me with recipes for pottery glazes, and mention how the ingredients may be obtained?—H. S.

[57505.]—**Engine Query.**—Will "Invicta" kindly answer the following? I wish to know the size of slide-valve and throw of eccentric required to cut off when piston has travelled three-quarters of the length of the cylinder? Size of ports: steam, ¼; exhaust, ½; bars between ports, ¼in.; depth, 1⅛; length of stroke, 3¼; dia. of cylinder, 2 1-16. Say if ports are large enough?—PERPLEXED.

57506.]—**Wimshurst Machine.**—To MR. WIMSHURST.—I am trying to make a machine like the one shown by you at the Inventions. I have plates 18in. diameter, but have not been able to get any glass jars longer than 8in. Will thank you to tell me if those you have used are lengthened by any attachment at the end the tinfoil is put on, as they appear to be about 11in. in length. In No. 1,054 I see you promise to give full instructions, &c. For one, I shall be greatly pleased to see them in an early number of "Ours" if convenient for you to give them.—W. D.

[57507.]—**Chaplets.**—I would feel very grateful to any reader who would explain how chaplets are made, as made by the Manchester firms; also the quantity a man will make a day?—S. P.

[57508.]—**To Mr. Eaves.**—I have a Siemens H armature machine finished all but winding the F.M.'s. They are 12 by 11 by 1in. thick; the armature is 12 by 2, and wound with about 23 yards of No. 18 B.G. I wish to finish machine as a shunt, and should consider it a great favour if Mr. Eaves would give me size and length of wire for F.M.'s. What would be the number of 20 c.p. lamps such a machine would light, and about what number of revolutions per minute must it be driven? I am sure Mr. E. has the thanks of our electrical readers for his valuable instructions on the 30 lighter, and I shall commence one as soon as I have time.—H. H. B.

[57509.]—**Altering Lathe.**—I have a back-geared 4½in. lathe, bed 5½in. wide on top, 4¼in. deep, with both both edges V'd. I want to make it into a screw-cutting lathe. I want to know what size and pitch of the wheels best suited; also pitch of leading screw, and how far the centre of it should be from the centre of the mandrel. I also should like an illustration of the swinging plate that takes the intermediate wheels behind the headstock, or a complete illustration of the back of headstock would be better, as I have no means of getting the sizes but through the "E. M." Which would be the easiest to fit up, the split nut and rack and pinion arrangement, or the rotary nut on the leading screw? Any other information on the above subject will be gladly received by—E. J. LLEWELLIN.

[57510.]—**Coupler to Harmonium.**—I am the father of [illegible] erous family, mostly musically inclined, and [illegible] small harmonium with only one set of reeds. Its tone is good, and I think the instrument might be greatly improved for family use by the addition of an octave coupler being attached. Would Mr. G. Fryer or any of the readers of the "E. M." kindly inform me how to proceed, as I find it difficult to manage myself without opening all the upper octaves at once, and this I do not want? A simple diagram would greatly assist—J. H. H.

[57511.]—**Slide Valves, &c.**—Can any of our readers help me in the following:—How to ascertain the size of slide-valve and throw of eccentrics to cut steam off at various points of the stroke when you have only the size of ports given and length of stroke? Also, a book recommended on the same would oblige.—GREENHORN.

[57512.]—**Hydraulics.**—A hydraulic engine does a certain amount of work when supplied with water by a 1½in. lead pipe 80ft. long, with a 40ft. fall, the water in the pipe flowing at a velocity of 64ft. per minute. Would I gain sufficiently by using a 2in. pipe to get the same amount of power out of the engine with only 32ft. fall and 72ft. of pipe? If not, what amount of fall with a 2in. pipe would be required to give equal power approximately? The engine gives twelve strokes per minute.—LINDEN.

[57513.]—**Adjusting Mirrors of Newtonian Reflector.**—Will one of our readers give me information as to the mode of adjustment of the mirrors of a Newtonian reflector?—W. W.

[57514.]—**Valve Query.**—Will "Invicta" or any other reader kindly inform me how to calculate my safety-valve? It is a 5in. valve, 5in. fulcrum, 3ft. 5½in. lever, weight 92lb., weight of lever 19lb., and weight of valve 4½lb. What will the steam blow off at?—YOUNG FIRER.

[57515.]—**Chemical.**—I have often to braze complicated machine parts of thin iron, which aft[illegible] have to be filed and polished. The borax glass over and soaks into the iron, and is very hard to I cannot twist, buckle, or hammer the things to [illegible] glass off, so have to rub it away with a file, which out directly. I have tried fluoric acid. Now, if I in a glass bottle, it displays great fondness for [illegible] but if I put my combined iron and glass into loses all love for the glass and goes for the iron parts protecting the iron very nicely. Will so[illegible] friend help me by pointing out a solvent for glass that will not destroy the iron or brass, and —A MUCH-WORN FILE.

[57516.]—**Tube Well.**—I shall have to ma[illegible] between 60ft. and 70ft. deep, at Fleet, near Far[illegible] Hants. The soil I believe to be sand and [illegible] some clay. Could a tube be driven that there a probability of its answering the pu[illegible] much would it cost, and how to go about it?

[57517.]—**Applied Mechanics.**—Will [illegible] or any others of "Ours," kindly say which is t[illegible] on applied mechanics for the Science and Ar[illegible] ELDHIN.

[57518.]—**Swings.**—Can anyone tell me dimensions and how to make a set of swings for use at fairs?—A. HAWKER.

USEFUL AND SCIENTIFIC NOTES.

MR. E. OXBORROW, of the Æolus B.C., recently accomplished a remarkable bicycle ride. Starting from Hitchin at midnight on August 25th, he rode viâ Peterboro', Long Sutton, and Lynn to Norwich, and back as far as Biggleswade, having thus covered about 263 miles, or within 3½ miles of the present "record" made last year by J. H. Adams on a "Facile." Mr. Oxborrow also rode a "Facile," and it is a great testimony to the capabilities of this machine (whose merits we were almost the first to recognise) that the two longest rides ever accomplished should have been made upon it.

Chinchona Cultivation in Bengal.—The report for 1883-4 of the progress of the Government chinchona plantation in Bengal is highly satisfactory. During the year no fewer than 174,000 of the chinchonas known as *Calisaya verde* and *Calisaya morada* were added to the plantations. These are the best varieties yet discovered suitable to the climate of Sikkim. About forty seedlings of a hitherto untried variety, known as *Cuprea*, produced from a kind of *Remija*, have also, after much trouble in procuring the seed from South Africa, viâ the Kew Gardens, been added to the plantation.

Paste.—A paste that will not draw engravings when pasted down on paper must be thin. A mixture of gum-tragacanth and gum-arabic forms with water, a thinner mucilage than either of these two gums alone. Rice flour is said to make an excellent paste for fine paper-work. A solution of two ounces and a half gum-arabic in two quarts of warm water is thickened to a paste with wheat flour; to this is added a solution of alum and sugar of lead, one ounce and a half each, in water. The mixture is heated and stirred until about to boil, and then cooled. It may be thinned with a gum solution.

THE Dutch State Railway authorities have been conducting experiments on the behaviour of different paints for ironwork. They have shown that red lead best resists the action of the atmosphere. It was found, also, that the coat holds better on iron plates cleaned by pickling than when the plates have been scraped or brushed. The trial sheets were pickled with hydrochloric acid, washed with warm water, dried, and oiled while still warm.

ANSWERS TO CORRESPONDENTS.

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*** All communications should be addressed to the EDITOR of the ENGLISH MECHANIC, 332, Strand, W.C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 9, and unacknowledged elsewhere:—

A. F. [illegible]. A. Stanley Williams. British Gas Engineer. N. F. Alexander. A. W. Hirst. Archytas. W. Johnson. J. J. S. J. W. L. Constant Reader. Sons. A. S. Chesterfield. J. R. Young Mechanic. R. L. Kirk. Cast Metal. Kappa. E. Smith. Amateur.—Forte Verre. C. E. Mechanic. Potash. W. Taylor.—Bengawer. J. Kean. Fiddler. Dens. S. Bottone.—Rebeldi. W. S. R. George.

A YOUNG ELECTRICIAN. (Wimshurst's machine has been fully described. See p. 542, No. 1,035, and the indices.)—ERNEST BAYNER, South Boston, U.S.A. (We know of nothing that will do what you want. You should cut out the parts and fit in pieces of ebonite.)—A. J. R. (We can only advise the study of the subjects you name, and any others (physics) you may have time to take up. As to establishing science classes, full directions are given in the Science and Art Directory, which you can obtain from the secretary of the department, South Kensington.)—R. M. (We answered your question as soon as possible, and if you look through all the back volumes you will find nothing more satisfactory; but see the series of articles on the Indiarubber and Guttapercha Industries in Vol. XXXI. pp. [illegible]; Vol. XXXII. pp. 3, 54, 81. If you have taken in the paper "for many years" you should know that it is impossible to do what you require without proper appliances.)—P. T. (If you cannot search the back volumes, procure the "Calendar" of the London University. C. E. is nothing.) [illegible] There are several associations of the kind, and we should imagine one in Glasgow.) [illegible]

[illegible]

Agent-General for the Colony, 7, Albert-mansions, Victoria-street, S.W.) S. S. (See answer to "E. F. N." last week. It was described in No. 1024, p. 226.)—CARINO. (All such statements must be taken for what they are worth. See remarks about lanterns in back volumes. Mr. Wright's work on "Light" is published by Macmillan and Co., Bedford-street, Covent-garden, W.C.) A. HAWKER. (Use the pulverised flour of Pyrethrum roseum, many tons of which are ground weekly in London.) BAROMETER. (The tube is held so that the mercury does not run out. A spirit lamp is the best source of heat.) ECONOMY. (Camera bellows described in Vol. XXXII. pp. 18, 356; Vol. XXXV. p. 224; see also Nos. 946, 953.) INSTRUCTOR. (You will find a list of such books in the catalogue published by Mr. Calvert, Great Jackson-street, Manchester. 2. We do not know.) VULCAN. (Apply to any of our advertisers who sell such apparatus, and procure one of the cheap handbooks of the art.)

CHESS.

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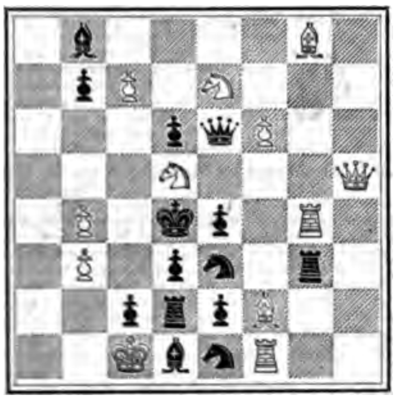
ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLVI.—MEASURE-FOR-MEASURE.

Black.



White. [12 + 14

White to play and mate in three moves.

SOLUTION TO 954.

White.	*Black.*
1. R-Q R 3	1. Q takes B (a)
2. Q takes Q B P (ch)	2. K moves
3. P takes Q, mate.	
2. Kt-Q 6 (ch) &c.	(a) 1. Kt takes B, or K moves (b)
2. R-R 5 (ch) &c.	(b) 1. K-Kt 4 (c)
2. Kt takes Q, &c.	(c) 1. Q-Q 2 (d)
2. Q takes Q B P (ch) &c.	(d) 1. Q-K B 7, &c. (e)
2. Kt-Q 6 (ch) &c.	(e) 1. Q-K Kt 7, or K B 6

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 954 by A. A. E. Leclaise, F. C. N. [illegible] simple and pretty; and V. S. Pochin.

[illegible] by V. S. Pochin, R. A. Bennett, J. A. Miles [illegible] A. S. Oliver (one good variation, rest very [illegible]), A. A. E. Leclaise (weak), and H. Culmer.

[illegible] by A. S. Oliver (very good), R. S., J. A. Miles [illegible] H. Culmer, Stevengate, and F. A. Vincent.

[illegible]

K takes P.

[illegible] Thanks for game.

[illegible] We have entered your name for new [illegible]

USEFUL AND SCIENTIFIC NOTES.

◆

FOR turning and drilling wrought iron and steel [illegible]

COCAINE IN SEA-SICKNESS.—In a preliminary [illegible] Dr. Manassein, of St. Petersburg, gives an interesting account of the employment of the drug in sea-sickness [illegible] August [illegible]

That it had a prophylactic effect seemed [illegible] spite of very rough weather for a period o[illegible] hours both the individuals were, for t[illegible] in their lives, free from sickness, [illegible] a very good appetite the whole t[illegible] child six years old, who began to [illegible] with sea-sickness on rising in the m[illegible] treatment was so effectual that it was [illegible] about during the day in spite of the [illegible] child took one teaspoonful in two dose[illegible] first half-hour, and then half-a-tea-[illegible] three hours. Another case was th[illegible] 18 years of age, who had been sick f[illegible] before the drug was given. The [illegible] severe one, she had a double dose eve[illegible] with "truly magical effect;" for afte[illegible] dose the patient was able to assume a [illegible] posture, and after the sixth dose she [illegible] began to complain of hunger. During the voyage she remained well, althou[illegible] much rolling of the vessel. Similar [illegible] attended the use of the drug in three [illegible] and had it not been that his supply [illegible] Manassein would have been abl[illegible] more extended observations. Still, [illegible] experience of these few cases, [illegible] it justifiable to infer that in [illegible] we have a certain and harmless rem[illegible] sea-sickness. In the same communicat[illegible]tions that he had found "cocainum mur[illegible] great service in arresting the collapse [illegible] cases of simple cholera, and thinks it [illegible] try its action in cases of Asiatic cholera.

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Holloway's Pills [illegible]

The English Mechanic
ND WORLD OF SCIENCE AND ART.
FRIDAY, SEPTEMBER 18, 1885.

ARES AND PITFALLS IN AMATEUR CARPENTRY.—II.

A VERY common fault with amateurs is working without a definite plan; the ult being that when the job is half done ɜ arrangement of some detail has to be tirely altered, to the detriment of good id work. A drawing should always be ıde, even of comparatively unimportant rk, although in many cases it may be aply a rough affair in pencil doomed to mediate destruction after it shall have ved its purpose. Such drawing will call tention to difficulties of construction that uld otherwise not have been foreseen, or ll suggest possible modifications of the sign that will improve its stability or aparance, or will show where material may economised or made to correspond better th available stock in hand. No one who s not had experience in handicraft would lieve what help is to be obtained from us deliberately planning and sketching out e proposed work, and well considering this an before proceeding to cut out the aterial. Such drawing, moreover, will enle an amateur to discover at once the antity of stuff required, which, I may add, generally greater than he would have agined; and there is nothing more tirene than to run short of material when rk is three-parts finished. The result of h miscalculation often is that a bit of unsoned board, thus obtained at a moment's tice, spoils the job, which up to that int had been constructed of dry, well-soned wood, and as I am address- country amateurs especially, who this respect are subject to the disadvantage dealing with the local carpenter, who uses ood deal of unseasoned timber in his own rk, and has not often a large stock to select m, I would suggest his purchasing wood all his better work direct from some ber merchant in London or other large n. I can assure the reader that it pays do so, both in actual cost and superiority the material. Living twelve miles from a tion, and having, therefore to pay the rier and railway company, I still find the n economical. Moreover, you can get at imber merchant's exactly what you rere, instead of being compelled to use just at you can get. When about to fabricate h an article as a set of shelves in deal, to subsequently stained and varnished, it is well to consider well beforehand, whether will not be more advisable to expend a le more, and make them at once of oak. ey will, as property, be of more intrinsic ue to keep or to sell. There will be no m, no pretence of being oak or mahogany, ich they are not, and which, moreover, y never do really represent. They will pleasanter, and in some respects easier to ke, and more solid and satisfactory when shed, and even unvarnished, which is en preferable, will always have a better earance.

Where oak cannot be had, either owing to t or otherwise, pitch-pine will be the best rth using for the above and similar pures, and will look exceedingly well if rely varnished. For my own part m prejudiced against stains, unless it to produce what is known as ebonised rk, but even this requires very skilful atment to render it effective. A mere ok stain varnished has not at all the desired earance, but is instantly recognised as a n. It has no doubt often occurred to the ateur to wonder at the sullied appearance of what was for a while a smoothly-planed surface of deal. This frequently arises from the presence of small chips and shavings left on the bench top, forming a trap for the unwary. One side of the board is perhaps nicely and evenly faced, and it is then turned over upon an unswept bench. Then, when the pressure of the plane comes upon the second face the first is indented by small chips, and is otherwise sullied and dirtied. A bench should be kept as level and clean as possible, or there is little hope of good work. If it is not a dead level, the board upon which the workman is operating will oscillate, and he will never know when it is levelled truly. If, therefore, of sheer necessity an indifferent bench must needs be used, a 2in. plank accurately planed on one side should be kept as a planing board, and laid upon the bench, resting at one end against the planing stop, a second stop being fixed at one end of the supplementary board against which to set the work that is under treatment. This board must be rigidly kept for its own appointed purpose, and removed when done with. It is not meant for supporting work upon which mallet and chisel are to be used, as in cutting mortises and dovetails. But if, on the other hand, you have a really good bench fit for best work with the plane, then keep also such a supplementary board to support wood that is to undergo the above mortising operation, and do not spoil the bench, as so many amateurs are wont to do. A frequent pitfall is concealed in the amateur's impatience to see his work put together, which he does, therefore, piece by piece as it advances. The consequence is, that as each joint has probably to be again and again taken apart, the tenons and mortises become loose, and the edges of the pieces, especially if of deal, are very apt to become bruised and defaced. A workman will, as a rule, begin by cutting out all his stuff in the rough. If he has a set of six shelves to make, he will not make one complete and then fit it to the sides already prepared; but will plane up the entire set. Very probably he will plane a board 6ft. in length, and then cut it into two shelves 3ft. long, or four 1½ft. long, which will thus be of exactly the same thickness and width; or he may prefer to cut each to length first, and then plane them one after the other. This will depend probably upon the material at hand; but he will assuredly get out his six shelves and the two sides first of all, and then mark accurately upon the clean surface with pencil or scriber the grooves or mortises or dovetails, and will not begin to get the parts together till all are ready to go each into its appointed place. Another pitfall may be avoided by carefully lettering or numbering parts intended to be adjacent, else after fitting a tenon to a mortise, it may easily happen that they each belong elsewhere—that, in fact, you have turned the shelf upside down, and so mismatched the joints. Nothing, perhaps, is more characteristic of amateur work as compared with professional than the want of sharp, well-defined outlines. The edges of boards, instead of being flat, are rounded, and even that not evenly, but in an uncertain sort of manner, evidencing the fact that it was unintentional. By all means chamfer the edges of soft wood where it can be effectively done, as it is certain that they will get bruised and the angles obliterated by wear; or such edges may be rounded decisively and thoroughly if preferred to chamfering. But let there be no doubt as to the workman's intention; and where an edge ought to be sharp and even, take care to keep it so. For the same reason do not let partly-finished work be tossed aside in the workshop into any odd corner, nor left on the bench to come in contact with hammers and pincers and other en[illegible]ies. Lay it carefully aside till wanted, and [illegible] tance protect it also from dust. [illegible] r the general defects seen in amateur work, of which, perhaps, the worst are comprised in the words "unsubstantial" and "out of square," I have taken some pains to discover the origin of the cause of the first, as a mortise and tenon cut to line, should be equally strong whether made by amateur or professional. I am convinced that blunt and badly-set tools have much to do with the defect in question, because, unless the chisel is very sharp, the inside of a mortise cannot be made so smooth and even as to embrace at all points the tenon that is fitted into it. In rough, outdoor carpentry, a tenon may be so tight that when driven into its mortise it will compress the fibres, and practically smooth and level the surfaces in contact, and thus make a firm joint; but here we have a mortise cut in a stout beam that is not likely to give way under the strain, and it is a very different matter to make a mortise and tenon that will hold securely when the former can be readily split by driving in a tenon that is too large to enter without undue force. In this class of work nothing will avail but an accurate sliding fit, which cannot possibly be accomplished with blunt tools. The labour of grinding a plane iron or chisel being by no means light or agreeable, an amateur is sure to postpone it as long as possible, and the bevelled face of the tool gets gradually shorter and the angle of the edge larger and, therefore, blunter, until, though it may be forcibly made to enter the wood, it rather bruises and tears apart the fibres than cuts them.

Then, again, I may repeat the caution not to cut out marked lines, to which I may add that such lines should be thin and clear, accurately defining the position at which a cut is to be made. Very generally a mortise is marked by a gauge which traces the line with its steel scribing point; but in white wood it is often as well to run over these with a hard and fine pencil, as the line is then more clearly visible. Cut accurately to lines accurately marked, and there can be no possible misfit or looseness about the joint. Nearly all the mortise and tenon, and all dovetail joints of light work, will be held by glue instead of by pins and trenails, such as are used for the framework of buildings. Here amateurs are specially in danger of pitfalls which are of a fatal character to the victims. Glue, when good, is a splendid cement if discreetly used, and not otherwise. In its dry state, the best is transparent and thin and brittle (unless damp). A small portion should be placed in the inner receptacle of the glue-pot, and just covered with cold, soft water, and left to stand 12 hours, by which time it will have swollen and absorbed all the water. The outer vessel is now to be three parts filled with water, and made slowly to boil, when the glue will be melted, and will generally be thin enough for use. If not, add a little water and boil again. It must be tolerably thin, so as to flow readily. Warm the parts to be united, that they may not chill the glue. Brush it on quickly and evenly; both on mortise and tenon; drive close home. Wipe off superfluous glue with a sponge, and hot water, and set the work aside to dry, and you will have a union at least as secure as modern matrimony.

O. J. L.

ELECTRICAL INSTRUMENT-MAKING FOR AMATEURS.—III.*

By S. R. BOTTONE.

§ 7. GLASS THREADS.—These are extremely useful as insulators in small work, such as electroscopes, carriers, torsion balances, &c. They are easily made from rather thin glass rod, by heating it carefully over a clear flame (spirit-lamp, or Bunsen burner) until soft, and then pulling asunder rapidly if a very fine thread be desired; more slowly, if a coarser filament be required. Similar threads may be made from shellac; and these, though more brittle, are even better, in [illegible]

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* All rights reserved.

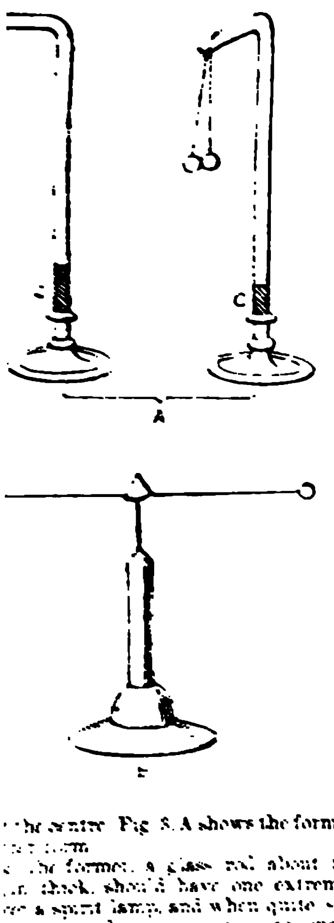
The straws of various grasses, [illegible]pecially the fine, straight, hairlike [illegible] of such grasses as *Agrostis spica-* [illegible] *pratensis*, *Phalaris arundi-* [illegible] *cristata*, if gathered soon after [illegible] are fully matured, cut to the [illegible] about 6in., dried, and then boiled in [illegible]ffin wax, make excellent insulating [illegible] far stronger than the glass or shellac [illegible]tioned above. The same straws, *not* [illegible] are, from their lightness, well [illegible] pointers for such galvanometers as [illegible] and others, which require a separate

[illegible]*-balls*. These are much used in ex[illegible] with frictional electricity. The best [illegible] ordinary purposes are those of the [illegible] *nigra*, and of the Jerusalem [illegible] *Helianthus tuberosus*. Before being [illegible] into balls or other figures, the pith [illegible] thoroughly dried. With a penknife, [illegible] a razor-like sharpness, the pith can [illegible] any desired figure, and is easily [illegible] an approximate sphere. When a [illegible] of equal size have been made, the final [illegible] may be given by *lightly* rolling them [illegible] smooth, flat board, on a level table. Care [illegible] taken not to press too heavily, otherwise [illegible] will be flattened. Having now got [illegible] the few things necessary for starting [illegible] may try our constructive abilities on [illegible] forms of electroscopes.

[illegible]scopes are instruments employed for [illegible] of the presence (and sometimes of [illegible]) of electricity; not for its measure-[illegible]

[illegible]*-ball Electroscopes*.—These are of [illegible]—viz., those in which the balls are [illegible] by a filament, and those in which [illegible] consists of a horizontal rod.

FIG. 3.



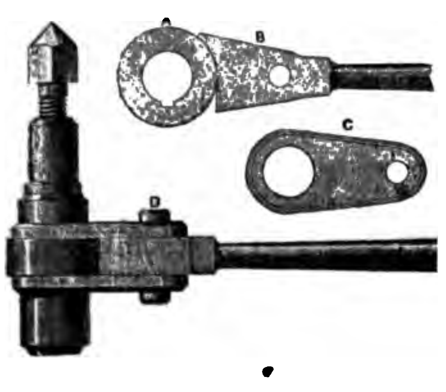
[illegible] the centre Fig. 3 A shows the former; [illegible] form.

[illegible] the former, a glass rod about 8in. [illegible] thick, should have one extremity [illegible] a spirit lamp, and when quite soft, [illegible] another piece, so as to enable [illegible] to draw out a filament. [illegible] be bent into the shape of a [illegible] The rod must then be heated at [illegible] from this end, and when [illegible] [illegible] The bent rod must be [illegible] without touching [illegible] be liable to fly to [illegible] quite cold it may be fastened to the foot of a broken wineglass by means of a turn or two of stout brown paper, previously brushed over with good Russian glue as shown at c. When this is quite dry it should receive (at this joint only) a coating of red varnish, made by mixing a few grains of red lead with a tea-spoonful of white hard varnish. (The white hard varnish may be procured at any oilman's.) A single filament of cocoon silk is now to be procured, and a fine needle threaded with it. The needle is passed through the centre of a pith-ball, the end of silk fibre moistened with a drop of glue, and the needle pulled until the ball reaches the glued portion of the silk. This will serve to fasten it to the ball. The other end of the fibre may be tied or glued to the little hook of the bent glass arm. Two balls may be thus suspended, if it is required to show the repulsive effects of similarly charged bodies. To construct the horizontally-pivoted form, it is only necessary to split a straight paraffined straw (§8) at its centre, with a sharp penknife, insert a small glass pivot in the split, and fasten it thereto by means of a single drop of hot glue. When quite cold, a pith ball must be attached to each end of the straw, a small hole being made in each ball with a pin, and the end of the straw (previously touched with glue) inserted in the hole. Care must be taken at this point that the balls balance one another. They may be made to do this by sliding along the straw, until when placed on a needle-point the arms of the electroscope remain perfectly level. Half of an ordinary sewing-cotton reel may be used as the foot of this electroscope. After sawing in half, the upper portion should be filed, rounded, and smoothed, a short length (say 4in.) of cane, glued, and thrust in the central hole; a needle (point upwards) forced into the upper extremity of the cane; and, lastly, the whole wooden portion neatly varnished with the red varnish described above.

POSTLETHWAITE'S RATCHETLESS DRILL BRACE.

IN the annexed engraving we illustrate a drill brace which is stated to have solved for "all time" the difficult problem of superseding the old-fashioned pawl and ratchet motion in drill braces, and which has been patented by Mr. G. R. Postlethwaite, of 124, Park-road, Aston, Birmingham.

The plain wheel or disc A is of highly



tempered steel, and grooved out to fit on to a feather let into the drill spindle or stock. The compound lever or handle B is steel-faced along the line of contact with the wheel, and is also highly tempered; a portion of this steel face is circled out to fit the wheel A, and the remaining part of the face forms a tangent line to the periphery of the wheel. The coupling straps C are placed above and below the wheel A, and connect the compound lever B with the drill spindle by means of a fulcrum pin D, passing through both straps and handle as shown. A forward pull of the lever occasions the grip on the disc or wheel A, by reason of the shape given to the face of the handle in contact with the wheel. The difference between the tangent line before mentioned and a radial line taken from the centre of fulcrum pin (as shown by dots in the illustration) forms a wedge of such a nature as to overcome any amount of resistance the drill may offer; in fact, the grip has already been tested up to several tons, and any extreme test would result i the fulcrum pin rather than overcon This grip is attained when the brace with less than ⅛in. loss at the end 1⅞in. long, and the release again fo ward motion, just as sudden and im is perfectly silent in action, and nei grease weakens the grip. but essential to the wear of the brace.

CEREBOTANI'S TELETOPO

A NEW instrument, which wi useful by surveyors and oth hibited the other day on the Tham ment, and can be seen in simple offices of Messrs. A. Wreschner London Wall. The instrument, wh a teletopometer, is the invention of Cerebotani, of Verona, and enables t altitudes, &c., of inaccessible p measured without trigonometrical and without a base-line in the or of that term, for the base-line is in ment itself. The latter consists o scopes carried on a frame, which is a tripod. The object, the distance to be measured, is observed throug scope and brought into the centre The observer then looks through telescope, and turns a milled-he until he gets the object in the centre of the second telescope, the latter b through an arc of a circle by the m screw. When the object is seen in scopes a pointer on the scale indic figures, and comparing these with distance of the object can be read of yards, feet, &c. Similarly, with t simple appliances, the height of an object can be ascertained with a accuracy, while a drawing board b to the tripod, a sketch of the groun can be pricked off as the work pr measuring the distance of a moving observers would probably be necess required with accuracy for any give but for fixed objects one operator ca the observations necessary. The pr the instrument is, in fact, "triangula by ingenious devices. Prof. Cereb brought all the essentials into one The instrument has earned the com of Herr Foerster, director of the Berl vatory, and is at present undergoin mental trials by the War Office auth this country. In trigonometry ever based upon the alterability of the functions; in Prof. Cerebotani's meth thing is based upon the alterabili radius. As the base-line is in the ins obviously each is limited to a certain —800, 2,000, 6,000 yards, &c.

CHEMISTRY OF PIGMENTS

By J. M. THOMSON, F.R.S.E., F

Demonstrator of Chemistry at King's London.

IT would be impossible, in the time posal, to treat of every colouring present employed, even were I to de solely to the consideration of such pigm used by artists in the finer departmen ing. I propose, therefore, in the two le about to give to take into considera some points with regard to the relatio to the composition of the substances these different colours; and, secondly, to review some of the properties of the m pigments, arranging them in the followi namely, (1) Whites, (2) Reds, (3 (4) Greens, and (5) Blues.

With regard to the first question— relation of colour to composition—it w that, on examining the majority of which evince the property of colour, roughly be divided into two large cl substances which change their colour application of heat or other circum retain still the same chemical compo this change of colour has taken pl originally possessed; and those substan changing their colours also change position. Instances of the first class are

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* The substance of the Cantor Lectures de the Society of Arts.

BRITISH ASSOCIATION.

THE ADDRESS IN MATHEMATICS AND PHYSICS.

THE address in Section A was delivered by Prof. G. Chrystal, M.A., F.R.S.E., president of the section, who, in his opening remarks, said he should follow the lead of one his forerunners (Prof. Henrici), and take for his subject the Diffusion of Scientific Knowledge. The following is an abstract of the address:—The British Association, by its title, exists for the advancement of science. Now, I hold that one of the essential conditions for that advancement is the existence of a scientific public—a public, like the Athenians of old, eager to hear and tell of some new truth; eager to discuss and eager to criticise; ready to appreciate what is novel; to receive it if sound, to reject it if unsound. It is to such a public that the British Association appeals, and certainly in the past it has not found its public wanting in generosity. What I should wish to see is less of mere friendly onlooking and more participation in the dance. I am not speaking now merely of a professional public, such as is so prominent in Germany for instance, made up of teachers and others professionally concerned with science. I refer mainly to that amateur but truly expert public which has always been so honourable a feature of English science, as examples of which I may mention Boyle and Cavendish in former days, and Joule and Spottiswoode in our own. It is quite true that much of that scientific public came in days of yore from the leisured class, whose ratio to the rest of the nation will not improbably decrease in the course of our social development. I think, however, that the loss we may thus sustain will be more than compensated by the continual increase of those who have received higher education of some kind or other, and whose daily occupations give them an interest, direct or indirect, in one or more branches of science. I know of no greater advantage for science than the existence of an army of independent workers sufficiently enlightened for self-criticism, who shall test the results and theories of their day. Great and indispensable as are the uses of professional schools of scientific workmen, they are open to one great and insidious danger. The temptation there to swear by the word of the master is often irresistible. Not to speak of its being often the readiest avenue to fame and profit, it is the perfectly natural consequence of the contact of smaller mind with greater. There are few things where the want of an enlightened scientific public strikes an expert more than the matter of scientific textbooks. If the British public were educated as it ought to be, publishers would not be able to palm off upon them in this guise the ill-paid work of fifth-rate workmen so often as they do; nor would the scientific articles and reviews in popular journals and magazines so often be written by men so palpably ignorant of their subject. I will not take up your time in insisting upon the necessity of the diffusion of science among that large portion of the public who are, or ought to be, appliers of scientific knowledge to practical life. That part of my theme is so obvious, and has been of late so much dwelt upon, that I may pass it by, and draw your attention to another place in which the shoe pinches. All of you who have taken any practical interest in the organisation of our educational institutions must be aware of the great difficulty in securing the services of non-professional men of sufficient scientific knowledge to act on school boards, and undertake the direction of our higher schools. It is no secret among those who carefully watch the course of the times in these matters, that our present organisation is utterly insufficient; that it has not solved, and shows every day less likelihood of solving, the problems of higher education. This arises, to a great extent, from the fact that a scientifically-educated public of the extent presupposed by the organisation really does not at present exist. If the existence of a great scientific public be as important as I think I have shown it to be, it must be worth while to devote a few moments to the consideration of the means we adopt to produce it both in the rising and in the risen generation. It would naturally be expected that we should look carefully to the scientific education of our youth, to see that the best men and the best means that could be had were devoted to it; that we should endeavour to make for them a broad straight road to the newest and best of our scientific ideas; that we should exercise them when young on the best work of the greatest masters; familiarise them early with the great men and the great feats of science, both of the past and of the present; that we should avoid retarding their progress by making the details and illustrations or particular rules and methods end in themselves. Granting that it is impossible to bring every learner within reach of the fullest scientific knowledge of his time, it would surely be reasonable to take care that the little way we lead him should not be along some devious by-path, but towards some eminence from which he might at least *see* the promised land. The end of all scientific training of the great public I take to be, to enable each member of it to look reason and nature in the face, and judge for himself what, considering the circumstances of his day, may be known, and not be deceived regarding what must to him remain unknown. If this be so, surely the ideal of scientific education which I have sketched is the right one; yet it is most certainly not the ideal of our present system of instruction. To attain conviction on that head it is sufficient to examine the textbooks and examination papers of the day. Let us confine ourselves for the present to the most elementary of all the exact sciences—viz., geometry and algebra. These two, although among the oldest, are, as Professor Cayley very justly reminded the Association, perhaps the most progressive and promising of all the sciences. Great names of antiquity are associated with them, and in modern times an army of men of genius have aided their advance. Moreover, it cannot be said that this advance concerns the higher parts of these sciences alone. On the contrary, the discoveries of Gauss, Lobatschewsky, and Riemann, and of Poncelet, Möbius, Steiner, Chasles, and Von Standt, in geometry, and the labours of De Morgan, Hamilton, and Grassman, not to mention many others, in algebra, have thrown a flood of light on the elements of both these subjects. What traces of all this do we find in our schoolbooks? To be sure *antiquity* is stamped upon our geometry, for we use the text-book of Euclid, which is some two thousand years old; but where can we point to the influence of *modern* progress in our geometrical teaching? For our teaching of algebra, I am afraid, we can claim neither the sanction of antiquity nor the light of modern times. Whether we look at the elementary, or at what is called the higher teaching of this subject, the result is unsatisfactory. All men practically engaged in teaching who have learned enough, in spite of the defects of their own early training, to enable them to take a broad view of the matter, are agreed as to the canker which turns everything that is good in our educational practice to evil. It is the absurd prominence of written competitive examinations that works all this mischief. The end of all education nowadays is to fit the pupil to be examined; the end of every examination not to be an educational instrument, but to be an *examination* which a creditable number of men, however badly taught, shall pass. We reap, but we omit to sow. Consequently our examinations, to be what is called fair—that is, beyond criticism in the newspapers—must contain nothing that is not to be found in the most miserable text-book that any one can cite bearing on the subject. The cure for all this evil is simply to give effect to a higher ideal of education in general, and of scientific education in particular. Science cannot live among the people, and scientific education cannot be more than a wordy rehearsal of dead text-books, unless we have living contact with the working minds of living men. It takes the hand of God to make a great mind, but contact with a great mind will make a little mind greater. The most valuable instruction in any art or science is to sit at the feet of a master, and the next best to have contact with another who has himself been so instructed. No agency that I have ever seen at work can compare for efficiency with an intelligent teacher, who has thoroughly made his subject his own. It is by providing such, and not by sowing the dragon's teeth of examinations, that we can hope to raise up an intelligent generation of scientifically educated men, who shall help our race to keep its place in the struggle of nations. How glad we, the teachers of science in Edinburgh for example, would be to have a course of lectures once every three or four years from Professors Cayley, Sylvester, Stokes, Adams, Lord Rayleigh. In this way effect would be given to the principle, which cannot be too much insisted upon, that the power of the spoken word far exceeds that of the written letter. Not only should we learn from the mouths of the prophets themselves the highest truths of science, but the present generation would thus come to know face to face, as living men, those whose work will be the glory of their time and a light for future ages. From the want of a proper circulating medium, the influence of great scientific men very often does not develop until they and the secrets of their insight have gone from among us. The object of what I propose is to make these men more of a living power in their own lifetime.

THE ADDRESS IN CHEMISTRY.

The address in Section B was delivered by Prof. H. E. Armstrong, F.R.S., president of the section, who, following Sir L. Playfair and Prof. Chrystal, also dealt with the question of science teaching. The following is an abstract of the address:—The neglect of chemical research in our British schools has often been forcibly commented upon—of late, especially, by an eminent past-President of this section, Dr. Perkin, v
is of peculiar value, as he is not
renowned as a chemist, but also as a m
indeed, as the founder of two distin
chemical industries. There can be
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of such neglect. We maintain that
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original investigation, and which i
possible—many would say, perhaps w
is impossible—to sufficiently cultivate
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quired as long as all goes well. Th
the materials used or produced can be
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analyst, or by well-trained laboratory
things never do go well for any lo
time: difficulties are always arising; o
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taking place. Investigation is therefo
at every step. No amount of instruct
is ordinarily given, in the mere theory
of chemical science will confer th
mind, the acuteness of vision, and
ness required of an efficient chemist
any more than the mere placing of th
in a workman's hands will make h
operator. Such being our position,
that it is essential to make research
portion of the student's course in e
which pretends to educate chemists.
suffice occasionally to set a promisin
investigate, but a number of students
the staff, must always be engaged in o
—in fact, an atmosphere of research m
the college. It cannot be too clearly
that it is this which characterises and d
the German schools at the present ti
realise the state which I have picture
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in order that it may be possible for ou
obtain complete training in chemis
things are required. In the first plac
necessary that the students come to the
pared than they are at preient; as a rul
ill-prepared that it is very difficult, if no
in the time at disposal to give such pre
struction as is indispensable before high
be attempted. Their mathematical kn
ill-digested that it is more often tha
sary to begin by teaching simple pro
they look aghast at a logarithm t
cannot draw; so far have we advan
civilisation that the subject is more
not an "extra" in our schools. They
a little French; but German, which
be called the language of modern sc
deed an unknown tongue to them. I
plain of their want of knowledge of
jects, but of the unscientific manne
they have been trained at school, and
the manner in which their intellect
have become deadened from want of
stead of developed and sharpened. To
never acquired the habit of working
seriously; they have not learnt to ap
holiness of work, so that they rende
of teacher akin to that of slave-dri
of to that of friend. What is pe
is their marked inability, often
to downright refusal, either to
notice of what happens in an experimen
any logical conclusion from an observ
is said to be a reasoning being, but m
as an examiner and teacher would le
lieve that this fact is altogether lost
the average schoolmaster, who appear
himself almost exclusively to the teac
dry facts, and makes no attempt to cul
very faculties which are supposed to cha
human race; or he is so ill-prepared f
that he fails to understand his duty. Th
words, but the evil is of such magni
cannot be too plainly stated; those who,
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dents who come to me may already have gained
ne knowledge of science; under existing cir-
mstances I prefer that they shall not; but I
sire its introduction because the faculty of ob-
ving and of reasoning from observation,
d also from experiment, is most readily
veloped by the study of experimental science;
is faculty, which is of such enormous practical
lue throughout life, being, I believe—as I have
id elsewhere—left uncultivated after the most
reful mathematical and literary training. While
aming the schoolmaster for his neglect, it must
t be forgotten that the teaching of science in
ools meet with comparatively little encourage-
nt at the hands of our examining bodies and the
iversities. Again, examinations are too often
trusted to those who have no educational experi-
ce, and with most unfortunate results: in no
se, probably, is inexperience so inexcusable as in
examiner. Too often, also, the examinations are
the hands of pure specialists, who take too formal
view of their duty, and expect from boys and
rls at school as much as from their own students,
ho are older and devote more time to the work.
ch examiners are prone to discourage science by
arking too severely; and as their questions
vern the teaching, instruction is given in
hools without due reference to educational
quirements, and in a purely technical style: this,
fear, is the effect of some of the universities' local
aminations. We must carefully guard against
ing satified with the mere introduction of one or
ore science subjects into the school curriculum;
me of those who strenuously advocate the intro-
ction of science teaching perhaps do not suffi-
ntly bear this in mind. Chemistry, physics, &c.,
ay be—and I fear are, more often than not—taught
such a way that it were better had no attempt
hatever been made to teach them. I hold that it
of no use merely to set lads to prepare oxygen, &c.,
to make experiments which please them in pro-
rtion as they more nearly resemble fireworks;
d it is not the duty of the schoolmaster to train
boys as though they were to become chemists,
y more than it is his duty to fit them to enter any
ner particular profession or trade; the whole of
science teaching in a school should be subser-
nt to the one object of developing certain
ulties. Unfortunately, two great difficulties
nd in the way at present—viz., the want of
table books and of a rational system of teaching
ence from the point of view here advocated; and
requirements of the universities and other
amining bodies. Both books and examinations
of too special a character: they may suit the
cialist, but do not meet educational requirements.
e reform most urgently needed, in which, as
mbers of the community, not merely as chemists,
are all most interested, is the introduction of
ne system which will insure a proper training for
chers. Engineers, lawyers, medical men,
armacists, have severally associated themselves
found institutions which require those who
ire to join the profession to obtain a certain
alification; even chemists are seeking to do this
rough the Institute of Chemistry. But school-
sters, although members of what is probably the
st responsible, onerous, useful, and honourable of
y of the professions, have as yet neither made,
r shown any inclination to make, a united effort
insure that all those who join their profession
all be properly qualifed. Surely the time has
me when the subject must receive full public
ention; the country cannot much longer remain
ntent that the education of all but those of its
s and daughters who come within the province of
School Board should be carried on without any
arantee that it is being properly conducted. I
ow it is rank heresy to say so; but I maintain
t in future far less time must be devoted to the
ching of ordinary qualitative and quantitative
alysis, and that *technical instruction* as now given
these subjects must find its place later in the
rse. Our main object in the first instance must
to fully develop the intellectual faculties of our
dents; to encourage their aspirations by incul-
ing broad and liberal views of our science, not
infinite number of petty details.

Passing to a subject of special interest in this
tion, which required the immediate earnest
ention of chemists and physicists combined—that
hemical action—Prof. Armstrong called atten-
to the address of Lord Rayleigh last year, in
he said:—"From the further study of
[illegible] we may expect to gain improved views
[illegible] reactions, and of
[illegible] them about."
[illegible] being any
[illegible] alteration
[illegible] tion; the
[illegible] ly of
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between AB and CD, producing AC and BD, for example. That, at all events, was the impression which the ordinary average student gained. In studying the chemistry of carbon compounds, they became acquainted with a large number of instances in which a more or less minute quantity of a substance was capable of inducing change in the body or bodies with which it was associated without apparently itself being altered. The polymerisation of a number of cyanogen compounds and of aldehydes, the "condensation" of ketonic compounds and the hydrolysis of carbohydrates, were cases in point; but so little had been done to ascertain the nature of the influence of the contact-substance, or catalyst, as he would term it, the main object in view being the study of the product of the reaction, that the importance of the catalyst was not duly appreciated. Recent discoveries, however—more particularly Mr. H. B. Dixon's invaluable investigation on conditions of chemical change in gases, and the experiments of Mr. Cowper with chlorine and various metals, and of Mr. Baker on the combustion of carbon and phosphorus—must have given a rude shock, from which it could never recover' to the belief in the assumed simplicity of chemical change. The inference which might fairly be drawn from Mr. Baker's observations—that pure carbon and phosphorus were incombustible in pure oxygen—was indeed startling, and his experiments must do much to favour that "more minute study of the simpler chemical phenomena" so pertinently advocated by Lord Rayleigh. But if it were a logical conclusion from the cases now known to us that chemical action was not possible between any two substances other than elementary atoms, and that the presence of a third was necessary, what was the function of the third body—the catalyst, and what must be its character with reference to one or both of the two primary agents? In the discussion which took place at the Chemical Society after the reading of Mr. Baker's paper, I ventured to define chemical action as reverse electrolysis, stating that in any case in which chemical action was to take place it was essential that the system operated upon should contain a material of the nature of an electrolyte. In short, I believe that the conditions which obtain in any voltaic element are those which must be fulfilled in every case of chemical action. There is nothing new in this; in fact, it practically was stated by Faraday in 1834, and had due heed been given to Faraday's teachings we should scarcely now be so ignorant as we are of the conditions of chemical change. The interpretation of Faraday's law of electrolysis, which Helmholtz had brought under the notice of chemists, was of the most definite and far-reaching character. Did it, however, at all events in the form in which he had put it forward, accord sufficiently with the facts as these presented themselves to the chemist's mind? All would recognise that the chemical changes effected by a current in a series of electrolytic cells were equivalent to those which took place within the voltaic cells wherein the current was generated; but in neither case was the action of a simple character; in both a variety of chemical changes took place, the precise character of which was but imperfectly understood, and they were unable to assign numerical values, either in terms of heat or electrical units, to most of the separate changes. Moreover, many compounds were not electrolytes, while others which were regarded by the chemist as their analogues were very readily decomposed by a current of low E.M.F., although no great difference was to be observed in their "heats of formation"; liquid hydrogen chloride on the one hand, and fused silver chloride on the other, might be cited as examples. Our knowledge of the binary metallic compounds, which were generally admitted to be electrolytes *per se*, afforded evidence of an intimate relation between chemical constitution and "electrolysability." Although opinions differ widely as to the definition to be given of a typical or atomic compound, and of a molecular compound or aggregate, the majority of chemists appear to agree that they must recognise the existence of two distinct classes of compounds. I have long been of opinion that the experimental investigation of this question is of great importance, and that it must ere long attract the attention it deserves. The problem would be solved, not by discussions on the fertile theme of valency, but by determining the structure—the constitution—of bodies such as were referred to by Prof. Williamson. So far as the mere definition of valency is concerned, I entirely agree with Lossen; and as I hold with Prof. Williamson that in compounds the constituents are held together by atomic affinities, and atomic affinities only, but I believe that the formation of so-called molecular compounds is mainly due to peculiarities inherent more especially in the negative elements—*i.e.*, the non-metals and metalloids, and not in the positive elements—the metals; in other words, to the fact that, as was first pointed out by Lothar Meyer, the negative elements tended to exhibit a higher [illegible] towards each other than towards positive [illegible]. I much regret that it is impossible for [illegible] attempt any review of recent work in [illegible]ry. Not [illegible]ally important discoveries might be chronicled, and the patient industry of many who have toiled long to win results apparently insignificant should have been mentioned with high approval. A few remarks I will crave permission for, as regarding the general character of the work being done by chemists, and regarding that which has to be done. Complaints are not unfrequently made in this country that a large proportion of the published work is of little value, and that chemists are devoting themselves too exclusively to the study of carbon compounds, and especially of synthetical chemistry. We are told that investigation is running too much in a few grooves, and it is said that we are gross worshippers of formulæ. Most of these outbursts are attributable to that pardonable selfishhess which consists in assigning a higher value to the particular class of work with which one happens to be engaged or interested in than to any other line of investigation; too frequently they result from want of sympathy with, if not absolute ignorance of, the scope and character of the work complained of. It must not be forgotten that chemical investigation, like other investigation, is to a large extent the work of genius; the rank and file must necessarily follow in the order of their abilities and opportunities; hence it is that we work in grooves. The attention paid to the study of carbon compounds may be more than jnstified, both by reference to the results obtained and to the nature of the work before us; the inorganic kingdom refuses any longer to yield up her secrets—new elements—except after severe compulsion; the organic kingdom, both animal and vegetable, stands ever ready before us; little wonder, then, if problems directly bearing upon life prove the more attractive to the living. The physiologist complains that probably 95 per cent. of the solid matters of living structures are pure unknowns to us, and that the fundamental chemical changes which occur during life are entirely enshrouded in mystery. It is in order that this may no longer be the case that the study of carbon compounds is being so vigorously prosecuted; our weapons—the knowledge of synthetical processes and of chemical functions—are now rapidly being sharpened, but we are yet far from ready for the attack.

THE ADDRESS IN GEOLOGY.

The address in Section C was delivered by Prof. J. W. Judd, F.R.S., president of the section, who took for his subject "The Age of the Crystalline Rocks of the Highlands and the Geological Position of the Reptiliferous Sandstone of Elgin." It was, said Prof. Judd, at a former meeting of the Association that James Nicol submitted to the scientific world that splendid solution of a difficult problem which is now universally admitted to have been the correct one. This University was, during the last 27 years of his active, useful, and honoured life, the scene and centre of the labours of that profound but modest thinker to whom we owe so much. Lest it should seem presumption on his part to speak on the question, he might add that for some years before his death it was his good fortune to enjoy the friendship and confidence of the late Prof. Nicol, with whom he had several opportunities of discussing the great questions at issue between himself and Murchison. Seeing, as he did, Nicol's own great claims too often forgotten or ignored, he felt that, should he on this occasion hold his peace, "the very stones would cry out." It would, indeed, be an unfortunate day for our republic of science when the palm of recognition—withheld from him whom modesty and self-respect restrain from clamorous self-assertion—is permitted to be snatched away by bold and noisy advertiser of his own claims. Murchison took up the position that the limestone of Durness, which had yielded fossils to Mr. Peach, was of Silurian—that was, as he employed the term, of Lower Palæozoic age. But, at the same time, he maintained that the red sandstones of Applecross and Garcloch are in reality nothing but Old Red Sandstone, and in this latter contention he received the warm support of Sedgwick. Subsequently, however, he somewhat modified his views. Nicol laid before the meeting of the Association in Aberdeen a paper which must be admitted to have really established the main facts concerning the geology of the Highlands, as accepted by all geologists of the present day. Nicol's conclusions, briefly stated, were:—(1) He maintained with Macculloch and Hay Cunningham, and in opposition to the views originally propounded by Sedgwick and Murchison, that there exists in the Western Highlands an enormously thick series of red sandstones, quartzites, and limestones, which rest unconformably upon the ancient gneisses and schists, and belong to a far older geological period than the Old Red Sandstone. (2) He showed that this series of strata really constitutes *two* distinct formations, and that the older of these, the Torridon Sandstone, consists of red sandstones and conglomerates, in which no organic remains could be detected. (3) The younger of these formations was shown by him to lie unconformably upon the Torridon Sandstone, and to consist of three members, which Nicol named the Quartzite, the Fucoid Beds, and the Limestone. It is this formation which has yielded the interesting fossils of Lower Palæozoic age. (4) The apparent repetition of beds of quartzite and limestone, which was insisted upon by Murchison, was shown to be due to faulting and overthrow, and thus the "Upper Quartzite" and the "Upper Limestone" of that author were proved to have no real existence. (5) What so many authors had taken for a comfortable upward succession of this old Palæozoic formation into overlying schist and gneiss, was asserted by Nicol to be an altogether fallacious appearance, due to the thrusting of the crystalline rocks over the sedimentary ones by great overthrow-faults. (6) The relations between these crystalline and sedimentary strata in the Scottish Highlands were shown to be precisely similar to those which are constantly produced by lateral pressure in all great mountain-chains, and consist of sharp foldings, inversions, and faulting on the very grandest scale. During the last seven years many of the sections of the Western Highlands have been visited by different geologists, and while new methods of study had enabled them to improve or correct Nicol's petrological nomenclature, the principal conclusions of nearly all these writers concerning the relations of the several rock-masses entirely supported his views on the subject. Prof. Judd next alluded to Prof. Lapworth's work at Eriboll, and the detailed mapping of the Durness-Eriboll district by a detachment of the Geological Survey of Scotland, and said the conclusions arrived at by Nicol, by Prof. Lapworth, and by the officers of the Geological Survey were, in all their main features, absolutely identical, and the Murchisonian theory of Highland succession was now, by universal consent, abandoned. Referring next to the second of the great controversies which had occupied the attention of this Geological Section in 1859—that concerning the age and relations of the Reptiliferous Sandstone of Elgin—Prof. Judd said the combatants were found ranged in quite a different order. Nicol was seen battling shoulder to shoulder with Murchison, Ramsay, and Harkness in favour of the Palæozoic age of the beds in question; while Lyell, supported by Symonds of Pendock and Moore of Bath, was as stoutly maintaining their Secondary age. Up to the finding by Mr. Patrick Duff, in the year 1852, of the little fossil lizard called Telerpeton, and the determination of its true nature by Mantell and Owen, no doubt had ever been entertained as to the "Old Red" age of the yellow sandstone of Elgin. For bringing together the remarkable fossils of these rocks, geologists are indebted to the untiring labours of Dr. Gordon, of Birnie. Studying Dr. Gordon's important collections, Professor Huxley was able, shortly before the previous meeting of the Association in this city, to announce that a crocodilian (Stagonolepis), and a second lizard of Triassic affinities (Hyperodapedon), existed at the period when these beds were deposited, so that even in 1859 the palæontological evidence in favour of the Mesozoic age of these rocks was admitted to be almost overwhelming. But this evidence has been very greatly strengthened since that date; for Professor Huxley has shown that the genus Hyperodapedon is represented in the Trias of Warwickshire, of Devonshire, and of India. In the same reptiliferous sandstone, with its abundant footprints, the teeth of Ceradotus, a fish unknown in the Palæozoic rocks, have been found, together with the remains of a reptile which Prof. Huxley permits me to state is, in his opinion, probably Dinosaurian. I am sure that you will all join with me in the hope that the health of the President of the Royal Society may soon be so far restored that he may be able to return to the examination of these fossil reptiles of Elgin, in the study of which some of the earliest of his great palæontological discoveries were achieved. The manner in which the yellow sandstones, which have yielded these reptilian remains, are at many different points found associated with beds containing Holoptychius and other Old Red Sandstone fish appeared to many geologists altogether inexplicable on any other hypothesis than that the strata are all of the same geological age. In spite, however, of these appearances, and the interesting observations of Dr. Gordon and Dr. Joass on the rocks of the Tarbet peninsula, which seemed to support the hypothesis just referred to, I am able to announce that proof of the most clear and convincing character now exists of the distinction between the fish-bearing "Old Red" and the reptiliferous "New Red" of the neighbourhood of Elgin. In the year 1873 I showed that rocks, identical in character with the reptiliferous sandstone of Elgin, and the overlying calcareous and cherty rock of Stotfield, exist on the northern side of the Moray Firth, in the county of Sutherland, and that they there conformably underlie Rhætic and Liassic strata. Very recently Dr. Gordon has added a crowning discovery to his long list of previous ones by detecting in the same quarry the rocks containing the reptilian and fish remains respectively. A retrospect of these two controversies, now so happily laid at rest, is not, I think, without its uses for the student of Highland geology, for it may serve to furnish him with some useful warnings which are in great danger of being overlooked at the present time. The discovery of a few fossil remains in strata where they were previously unknown has completely revolutionised our ideas concerning the age of rock masses of enormous extent and thickness. Resemblances in mineral character have been proved not only to have been, at their best, very unsafe guides indeed, but to have actually betrayed those who trusted in them into the most serious errors. After showing the connection between the geological history of Scandinavia and that of Scotland, and sketching the movements to which the rock masses of the Highlands have been subjected, Prof. Judd went on to say that this subject was one well worthy of the most attentive study. When, he said, the evidence bearing upon the subject is carefully sifted and weighed, we become convinced of the fact that many of these movements—including some on a prodigious scale—must have taken place during what we are commonly accustomed to regard as comparatively recent geological periods. The vast movements which have placed soft and hard masses in opposition along certain parallel lines—generally ranging in a north-east and south-west direction—and the denudation which has worn away the former, while it has left the latter standing in relief, must, I believe, both be referred to the Tertiary period; though the disposition of rock masses brought about by earlier movements would, of course, exercise a certain though subordinate influence in producing the existing forms of the surface of the country.

THE ADDRESS IN BIOLOGY.

The address in Section D was delivered by Prof. W. C. McIntosh, M.D., of St. Andrews, who selected for his subject the "Phosphorescence of Marine Animals." A phenomenon so striking as the emission of light by marine organisms could not fail to have attracted notice from very early times, both in the case of navigators and those who gave their attention in a more systematic manner to the study of nature. Accordingly we find that the literature of the subject is both varied and extensive—so much so, indeed, that it is impossible on the present occasion to give more than a very brief outline of its leading features. Though it is in the warmer seas of the globe that phosphorescence is observed in its most remarkable forms—as, for instance, the sheets of white light caused by *Noctiluca* and the vividly luminous bars of *Pyrosoma*—yet it is a feature which the British zoologist need not leave his native waters to see both in beauty and perfection. Many luminous animals occur between tide-marks, and even the stunted seaweeds near the line of high-water everywhere sparkle with a multitude of brilliant points. As a ship or boat passes through the calm surface of the sea in summer and autumn, the wavelets gleam with phosphorescent points, or are crested with light; while the observer, leaning over the stern, can watch the long trail of luminous water behind the ship from the brightly sparkling and seething mass at the screw to the faint glow in the distance. On the southern and western shores, again, every stroke of the oar causes a luminous eddy, and some of the smaller forms are lifted by the blade and scintillate brightly as they roll into the water. The dredge and trawl likewise produce, both in the shallower and deeper parts of our seas, many luminous types of great interest and beauty. He glanced, in the first instance, at the various groups of marine animals which possess the property of phosphorescence, and continued:—It is found that this feature is possessed by certain members of the protozoa, and by the following groups of the metazoa—viz., cœlenterates, echinoderms, worms, rotifers, crustaceans, molluscoids, molluscs, and fishes. In foreign seas many brightly luminous specimens are met with. Thus Professor A. Agassiz describes *Mnemiopsis Leidyi* as "exceedingly phosphorescent, and when passing through shoals of these Medusæ, varying in size from a pin's head to several inches in length, the whole water becomes so brilliantly luminous that an oar dipped in the water up to the handle can plainly be seen on dark nights by the light so produced; the seat of the phosphorescence is confined to the locomotive rows; and so exceedingly sensitive are they that the slightest shock is sufficient to make them plainly visible by the light emitted from the eight phosphorescent ambulacra." The same author mentions that *Lesueuria* has a very peculiar bluish light of an exceedingly pale steel colour, but very intense. Giglioli, again, found that the beautiful riband-like *Cestus* shone with a reddish yellow light, but in *Eucharis* the latter was intensely blue. In the Chætopteridæ the phosphorescence is remarkably beautiful, bright flashes being emitted from the posterior feet. Marine phosphorescence has some of its most striking examples among the Tunicates. One of the best known instances is that of *Pyrosoma*, the light from which has been so graphically described by M. Péron, Professor Huxley, and other naturalists who have had an opportunity of observing it. It proceeds in each member of the compound organism from two small patches of cells at the base of each inhalent tube. Phosphorescence in living fishes appears to have been accurately observed within a comparatively recent date, though the luminosity of dead fishes has been known from very early times, and has been the subject of many interesting experiments, such as those of Robert Boyle on dead whitings, and Dr. Hulme on herrings. I do not mean to say that the literature of the so-called phosphorescent fishes is scanty, for it extends from the days of Aristotle and Pliny to modern times, but that the writers have had little reliable evidence in regard to living fishes to bring forward. Thus, of upwards of 50 fishes entered by Ehrenberg in his list it is hard to say that one is really luminous during life. In many cases it is probable that the supposed phosphorescence of large forms, such as swordfishes and sharks, has arisen from the presence of multitudes of minute phosphorescent animals in the water, just as the herring causes a gleam when it darts from the side of a ship. Prof. Moseley, for instance, observed in the *Challenger* that when large fishes, porpoises, and penguins dashed through phosphorescent water it was brilliantly lit up, and their track marked by a trail of light. The same feature is observed in hooked fishes, and it is known that fishermen are doubtful of success when the sea is very phosphorescent, for the presence of the net in the water excites the luminosity and scares the herring. One of the most striking instances of phosphorescence in living fishes is that of the luminous shark (*Squalus fulgens*), found by Dr. Bennett. This is a small, dark coloured shark, which was captured on two or three occasions at the surface of the sea. It emitted without irritation a vivid greenish luminosity as it swam about at night, and it shone for some hours after death. The phosphorescence appears to be due to a peculiar secretion of the skin. The eyes of the shark were more prominent than usual in such forms. A survey of the life-histories of the several phosphorescent groups affords at present no reliable data for the foundation of a theory as to the functions of luminosity, especially in relation to food. No phosphorescent form is more generally devoured by fishes or other animals than that which is not; and, on the other hand, the possessor of luminosity, if otherwise palatable, does not seem to escape capture. An examination of the stomachs of fishes makes this clear, except, perhaps, in the case of the herring, which, however, is chiefly a surface fish. Further, it is not evident that such animals are luminous at all times, for it is only under stimulation that many exhibit the phenomenon.

ABSTRACTS OF REPORTS, PAPERS, &c.

Reports on Earthquake Phenomena.

The report of the committee appointed to investigate the volcanic phenomena of Vesuvius was submitted by Dr. H. Johnston Lavis. After pointing out that the work had been greatly hindered by the unfortunate outbreak of cholera in Naples, he went on to say that, nevertheless, daily observations were made of the variations in the activity of the volcano, of which a due record had been kept. The third sheet of the Geological Map of Vesuvius and Monte Somnia had been completed by the reporter, and was exhibited in the hall. The relationship of the varying activity of a volcano in a Strombolian state of activity to barometric pressure, the lunar tides, and rainfall, could not but be regarded as important in solving some questions volcanology. Instrumental means of measuring such presented so many practical difficulties that a scale of activity had been drawn up, which could be learned in a few minutes. Dr. Johnston Lavis described this scale, and also the objections that might be urged against it.—The Secretary read a report drawn up by Prof. Milne on behalf of the committee appointed to investigate the earthquake phenomena of Japan. The report stated that from the end of April, 1884, to the end of April, 1885, the opportunities for making observations had been unusually good. The number of earthquakes felt during corresponding periods in the two previous years had been 2[illegible], 39, and 80. Prof. Milne gave the result of a number of seismic experiments he had made during the year, and proceeded to give an epitome of the results of observations and experiments carried on in Japan in seismic districts, following this up with various recommendations as to the construction of buildings in earthquake districts. If, the report added, the rules and recommendations suggested were adopted in earthquake countries, [illegible] was certain that the loss of life and property might be greatly diminished.

Report on Science Teaching in Elementary Schools.

The report of the committee appointed to consider this subject referred to the fact that drawing had been made a class subject in the schools, and was to take its place with English, geography, elementary science, history, and needlework (for girls). As to the effect of the regulation on the teaching of these class subjects, the annual return of the Education Department showed that the teaching ot geography was actually diminishing in schools, and that elementary science had scarcely gained a footing. In regard to the scientific specific subjects, it would be seen that a slight increase had taken place in the aggregate number, but this was not at all in proportion to the increase in the number of children presented in Standards V., VI., and VII. The report then stated what had been done by the committee towards carrying out the resolution adopted at Southport and Montreal with reference to technical education. The committee last February had reported to the Privy Council on Education that they considered it desirable to make representations to the Education Department, and suggested that the encouragement for the teaching of handicraft might take the form recommended by the Royal Commissioners on Technical Instruction; or that "the use of tools" in boys' schools might be placed in the same position as "practical cookery" in girls' schools. The Council received the report, but did not see their way to proceed further in the matter. The report further contained a commendatory allusion to the experiments in this line that had been made by the Birmingham and London School Boards.—Dr. H. W. Crosskey, Birmingham, hoped that the committee would be reappointed, and that they would continue to enforce upon the Government the necessity of having more satisfactory results in the way of teaching science in elementary schools than the report revealed.—Miss Lydia Becker said the best way to get science introduced into their schools was to put out some of the subjects to which she believed an inordinate amount of time was given. The amount of time devoted to needlework was too large, for girls could learn and practise it at home. Another subject that might be diminished very much was grammar. The time given to arithmetic beyond the simple rules might also be curtailed and scientific subjects introduced. The teaching of science would improve not only the knowledge but the general intelligence of the people of this country. —Mr. Moss moved that the committee be reappointed to continue its labours during the forthcoming year. He urged the desirability of co-operating with the Royal Geographical Society for the purpose of getting a provision for better apparatus for the teaching of geography, the great difficulty in the teaching of it in a scientific manner being the want of those beautiful models and apparatus which were to be found in some of the Continental schools.—After some remarks by Prof. Leone Levi, Prof. Sidgwick, and Dr. Gladstone, the report was adopted and the committee reappointed.

Anthropology and Psychology.

Dr. Alexander Bain, Lord Rector of Aberdeen University, read a paper "On the Scope of Anthropology, and its Relation to the Science of Mind." He endeavoured to point out that the bringing together of the six departments—named respectively, man's place in nature, the origin of man, the classification of races, the antiquity of men, language and the development of civilisation—did not contribute to the mutual elucidation of the several topics, but merely concentrated into a whole the subjects connected with the higher mysteries of man's origin and destination. He next dealt at length with a survey of the researches having in view precise measurements of the bodily and mental characteristics of human beings, and indicated lines on which research might be made so as to reflect new light on our intellectual constitution. The author also reverted to the research into the conditions and the measure of memory as wholly within the means of actual experimental determination; also the important intellectual function of seeing similarity in the midst of diversity, which can be reduced to more or less precision of estimate by suitable means. Taking along with these results the inquiries into the faculties of the lower animals, the author put special stress on the number and delicacy of their senses as the foundation of every attempt to explain the higher aptitudes. Intelligence commenced with the power of discrimination, and increased as that power increased. The record of marvellous feats of exceptional ingenuity was of very little aid in revealing the secrets of the animal mind. In conclusion, he urged the admission of psychology in a more avowed and systematic form into the anthropological section. He would exclude the topics of metaphysical and ethical controversy, and welcome all the researches into the intellectual and emotional regions of the mind.—Dr. Burdon Sanderson said any one teaching physiology would not be expected to include anthropology, and Dr. Bain had shown why it was not done. That was because when we came to the higher functions of man, called mental functions, we had to do with perceptions which were founded upon sensation, which meant interpretations by the mind of those perceptions. He considered that the line at which physiologists stopped was the line at which Dr. Bain begins—namely, measure. He heartily agreed with Dr. Bain in thinking that psychology is the subject that lies at the basis of anthropology, and should be accepted as its foundation.

The Theory of the Corpus Callosum.

Prof. O. J. Hamilton, Professor of Pathological Anatomy, Aberdeen, read a paper on the question—"Is the Commissural Theory of the *Corpus Callosum* Correct?" The results recorded by the author were obtained by certain special methods of preparation. They went to prove that the corpus callosum is not an interhemispherical commissure, as is generally supposed; but that it is in reality the decussation of a particular system of fibres on their way downwards to join the inner and outer capsules. These fibres are not to be confounded with the motor and other direct fibres derived from the cerebral cortex, which decussate at some point lower down.—Dr. Hill, Cambridge University, read a paper on a kindred subject—namely, on the evidence of comparative anatomy with regard to localisation of function in the cortex of the brain. Dr. Hill dealt with this very difficult subject with much clearness, aided by diagrams, and at the close of his address was complimented by Dr. Carpenter and Professor M'Kendrick.

The Tay Whale.

Prof. Struthers gave an intertesting description of the various parts of the anatomy of the whale. In addition to the Tay whale, members of three other whales recently obtained in the district were exhibited for the purpose of comparison, and the analogy of its structure to that of other animals was specially referred to in order to show its identity with the mammal.—Prof. Flower, referring to Dr. Struthers's anatomical labours, said that one of the greatest steps in the knowledge of the subject had been made in the last ten years. The general outcome of the whole was that they now had an idea at least as to the origin of the whale. The whale carried its pedigree in every part of its body. It had been thought that the mammals that live upon land had been derived from progenitors that formerly lived in the sea, and that the mammals may have passed through an aquatic or marine stage before they took to the land, but the observations of anatomy showed that this cannot have been the case. There was no doubt that the whale had been derived from a four-footed land mammal. All observations, for example, had shown that at some period of their life whales had a hairy covering, generally in the region of the mouth, that hairy covering being functionless and very often lost even before birth. In the same way, whales at an early stage of their existence are furnished with a complete set of teeth, the rudiments of the teeth of the land mammal. The organ of smell, although in a rudimentary state, and in some species almost entirely gone, also pointed to the origin of the whale.

Sowerby's Whale.

Prof. Turner, Edinburgh, gave an anatomical description of what is commonly known as "Sowerby's Whale." A specimenof this species of cetacean had been cast ashore recently at Shetland, and he had succeeded in getting certain soft parts of the animal in such a condition as made it possible for him to examine them. It was the first time that this creature had ever been seen by an anatomist. He did not propose to take into consideration the whole anatomy of the whale, but selected certain points in its structure which seemed to him to present the greatest novelty. The first thing that struck him in the appearance of the animal was the peculiar shape of the tail and the character of the flipper or paddle. The posterior border of the tail had a very different appearance from that of the other cetaceans, it being of a beautiful festoon character, instead of being notched; and the colour of the skin was inky black. Then with regard to the stomach, he said that was the most complicated of any animal belonging to the cetacean class, and a peculiarity of the animal was that it had no paunch. In describing the muscular apparatus of the flipper and the construction of the hand, Prof. Turner said that certain muscles which had been called rudimentary appeared to him to be used in connection with the movement of the limb. He also found in this structure of the flippers what he thought were indications of reptilian affinities.—Prof. Flower thought that what Prof. Turner considered reptilian were merely indications of an older form of existence.

The Kinetic Theory of Gases.

Prof. Crum Brown, Edinburgh, opened the discussion on "Kinetic Theories of Gases" by calling attention to two conclusions of the kinetic theory, as usually understood, which seemed to be at variance with observed facts. These referred to the distribution of energy, first among the various modes of action or degrees of freedom; and, secondly, among the molecules. He said the theory led to the conclusion that the energy was equally shared by all the degrees of freedom of the molecules—that was, all those degrees of freedom from or to which energy could be communicated. Now mercury vapour had the ratio of its specific heats, as observed by Kundt and Warberg, equal to 3. This corresponded to three degrees of freedom, necessarily the three translatory motions, and thus the molecules of mercury must be rigid. In hydrogen, nitrogen, &c., the ratio was 7 to 5, corresponding to five degrees of freedom, necessarily the three translatory motions, and two rotational motions about axes at right angles to the axis of figure. Thus, the molecules of these gases must be rigid. This rigidity of the molecules which seemed to follow from the theory was apparently inconsistent with the existence of spectra, and also with some chemical phenomena. Secondly, the distribution of energy among molecules, according to some form of the law of probability, seemed to lead to the conclusion that any chemical change which could occur at a particular temperature would also occur at every other temperature, although at different rates. This seemed opposed to observations.—Prof. Osborne Reynolds said either the kinetic theory was wrong, or the experimental results were wrong. The theory rested on certain assumptions. They found the two did not agree, and he left it to the upholders of the theory to say whether they were ever intended to agree. He did not think so. One important fact had been left out of view—that was the varying resistance with which the motions of different degrees of freedom were accompanied.—Sir W. Thomson said Boltzmann's theorem had exercised many minds, and it was not popular, because it led to results which we did not like, and so it had been considered it was not true. But what reason had they on the other side for believing in it at all? He confessed he had never seen anything to lead him to accept the theorem at all, or to believe it approximately true. He did not think any person living clearly understood it. One illustration had been given, but it was obviously true, independently of Boltzmann's theorem, and particular cases did not prove a theorem to be true. Let them take a ball or a glass globe or an ideal absolutely elastic globe; then if they had two vertical walls absolutely smooth and hard, the ball would bound between the two. But the question was, Would that go on for ever? He said it would not. There would be a diminution of energy. Every one would understand that from the click of a billiard ball. He wished he could give some suggestions as to the kinetic theorem, for he believed as firmly in the kinetic theory of gases as he did in his own existence.—The discussion was kept up by, amongst others, Lord Rayleigh, Profs. Ramsay and J. J. Thompson, but must be studied at length in the official report which will be published by the Association.

Iron or Copper Wire for Telegraph Lines.

Mr. W. H. Preece, electrician to the General Post Office, read a paper on the relative merits of iron and copper wire for telegraph lines. The Post Office, he said, had recently erected a copper wire from London to Newcastle, 278 miles long, weighing 100lb. a mile, with a view of testing its value against the ordinary iron wire, which weighs 400lb. a mile. The mean capacity of the iron wire was ·0169 microfarad, of the copper ·0142 microfarad. The resistance of the iron wire was 11·45 ohms a mile; the copper gave 9·21 ohms a mile. The cost of each was about the same. As regarded speed of working the copper showed a decided superiority, the speeds being, for simplex working—copper, 414, iron, 345 words a minute; for duplex working —copper, 270, iron, 237 words a minute. Copper showed itself more susceptible to rapid reversals of electric currents than iron, and hence it was better adapted for fast-speed working and for telephones. The progress made by the Post Office in improving the rate of working of the Wheatstone automatic apparatus was shown by the fact that while in 1877 the rate was 80 a minute, in 1880 170, and in 1883 250, it had now reached 430 words a minute.

New Theory of the Sense of Taste.

Prof. J. Berry Haycraft expounded a new theory of the sense of taste. As in the senses of sound and sight the sensation is determined by what we know objectively as vibrations, so also different tastes are determined by rates of vibration of the molecules of different substances. This law holds of all the senses, the qualitative differences of particular tastes or sounds being due to compound vibrations. This is correlated with the periodic law that governs certain chemical elements. Thus sodium, potassium, and lithium form compounds that are saline in taste. So in the organic world groups of elements take the place of simple elements. For example, in white of egg, starch, and sugar we have a group of carbon, hydrogen, and oxygen occurring in all. Now, each element or group of elements has a certain character due to certain molecular vibrations and corresponding to timbre in sound. To this peculiar character is due the distinctness of tastes. Only one sense—the sense of temperature—is merely quantitative; in all the others we distinguish qualitative differences, and this is because their end-organs are all fundamentally the same. The exposition was illustrated by apparatus and diagrams.

Action of Cold on Microphytes.

Prof. J. G. M'Kendrick read a paper on the action of cold on microphytes. At the outset the learned professor gave a description of the work of Mr. J. J. Coleman in the construction of cold-producing machines, which had led to the introduction into this country in a frozen state every week of a large quantity of mutton from Australia, New Zealand, and the River Plate. For the purpose of carrying on the experiments into the effects of very low temperatures upon microphytes, a special machine was constructed and worked by a gas motor engine. The experiments consisted in exposing for hours to low temperature putrescible substances in hermetically-sealed tins or bottles, or in flasks plugged with cotton wool. The tins or flasks were then allowed to thaw and were kept in a warm room, the mean temperature of which was about 80°. They were then opened and the contents submitted to microscopical examination with magnifying powers of from 250 to 1,000 diameters. The result of the experiments showed this—that they might take organic fluids and expose them to 120° below zero Fahrenheit for at least 100 hours, and that after being kept in a higher temperature fermentation and putrefaction went on in the ordinary way. These experiments destroyed any hope of any practical result being obtained by sterilisation from cold. It would have been very important from an economical point of view had they been able to preserve meat indefinitely by the application of cold, because they would then have got to the condition of having tins not containing cooked but fresh meat. This hope had been disappointed.

Action of Ozone on Organic Matter in the Atmosphere.

Mr. J. J. Coleman read a paper describing experiments which had been made to ascertain whether the ozone of the atmosphere had any effect in oxidising organic matter without its being split up by the action of germs. In these experiments air had been artificially ozonised much more strongly than was the ordinary atmospheric air, and notwithstanding a stream of it being passed for 30 hours through a solution of white of egg, it was found that there was no oxidation. The surmise of the late Dr. Angus Smith was therefore probably correct that no river purification could take place by the atmosphere unless the organic matter was partially split up by germs of putrefaction. It was also shown by these experiments that the germs of putrefaction were inactive, and in point of fact killed by ozone, but that their spores lived and started into activity where the stream of ozonised air was discontinued.

Separation of Atmospheric Oxygen and Nitrogen.

A paper by M. Brin, descriptive of the process of separating atmospheric oxygen and nitrogen, patented by Brin Frères, was read and the apparatus explained by Prof. MacLeod. (See p. 126, Vol. XXXIV., p. 188, Vol. XXXV.) By this process it is maintained that pure oxygen can be secured in large quantities from the air, and nitrogen liberated from the decomposition of the atmosphere can be converted into ammonia for commercial purposes.—Dr. Vernon Harcourt, one of the London gas referees, said that at the present time in the purification of illuminating gas some gas engineers introduced air into the purifiers, with the view of breaking up the sulphuretted hydrogen into its components of hydrogen and sulphur, but the objection to this was that the inert nitrogen of the air reduced the luminosity of the gas. He pointed out by the use of oxygen, if it could be obtained cheaply enough, this process of destroying sulphuretted hydrogen might be adopted in many of the large gasworks.—Prof. Dewar said he did not think there could be any doubt as to the complete and perfect application of M. Boussingault's method, which was really based on the discovery of the disassociation of peroxide of barium, and this would be the first industrial application of the principle of disassociation to technical manufacture. Of course the real difficulty was the decomposing of bodies of this kind at very high temperatures. There was not only the expense involved, but there was the liability of contamination of the oxide of barium given by the oxygen at high temperatures, especially in the presence of impurities, such as silicates. It was, therefore, clear that one of the chief improvements was the lowering of the temperature and the introducing of iron vessels. In this way the decomposition was not only achieved at low temperatures, but there was a reduction of pressure. M. Brin had the advantage of being free from the risk of producing any silicates or any deterioration of the oxide of barium. As scientific chemists they hailed with satisfaction this very important industrial application of chemical science.

The Glacial Period.

Prof. H. Carvell Lewis, Philadelphia, read a paper on "The Direction of Glaciation, as ascertained by the Shapes of the Striæ," a question on which considerable difference of opinion existed between Irish and English geologists; and Mr. W. F. Stanley, in continuation of a paper which he read last year, suggested certain conditions to account for a former glacial period in Great Britain existing under similar meteorological conditions to those that ruled at the present time. These conditions generally were:—(1) The non-existence of the Isthmus of Panama, by which the warm southern tropical current formerly flowed into the Pacific Ocean; (2) a former depression of North America in W. long. 80 to 90 degrees, diverting the northern tropical current into the Mississippi valley—warm currents bathed the eastern coast of Greenland, and produced a compensating current for the Arctic regions along Western Europe, bringing with it icebergs; and (3) the higher elevation in some interior part of Great Britain of the older strata now denuded, by which at the temperature then ruling glaciers followed from the interior.—In the discussion, it was stated that the same theory was presented by Mr. Hopkins some years ago, when he was president of that section, and Professor Lewis and Mr. De Rance, while admitting the ingenuity and plausibility of Mr. Stanley's paper, controverted its conclusions.

Diatomaceous Deposits in Aberdeenshire.

Prof. W. L. Macadam read a paper on this subject. The principal deposits, he said, are—Kinnord, Black Moss, Ordie Moss, Auchnervon, and Logie Moss. The whole of these masses of diatomite lie in a basin which was at one time a large lake, some five miles long, and embracing Lochs Davin and Kinnord. The principal uses to which this diatomite has been as yet put are in the manufacture of dynamite (where it is an absolver), for ultramarine (where it is chemically combined), for non-combustible paints, for boiler composition, and for silver plate, soap, &c. For dynamite a very large quantity (some hundreds of tons) was cut and sold to the Messrs. Nobel last season, and a great future was looked forward to, but the industry was doomed, for the powerful dynamite had to make way to a still greater giant in blasting gelatine, and what had promised a great future to Aberdeenshire fell from its lofty position as an explosive, and the interests of this county fell with it.

Chinese Insect White Wax.

Mr. A. Hosie read a paper on "Chinese Insect White Wax," in which he stated that, although the province of Ssu-chuan, in Western China, where he had been stationed for the last three years, was the chief wax insect and wax-producing country in the empire, insects and wax were found in other provinces. Mr. Hosie was called upon by the Foreign Office to collect for Sir Joseph Hooker specimens connected with, and all possible information on, the subject of this industry, and the present paper was a revision, with additions, of a report already published in a Parliamentary paper in February last. He described the insect-producing country, the tree on which the insects were propagated, the insects themselves, and their transit from the valley of Chien-chang, their breeding-ground, in the west of Ssu-chuan, across the mountains to Chiating Fu, the habitat of the wax tree. The tree was then described, and details were given of the treatment of the insects, their suspension on the trees, the depositing of the wax, and of a parasite on the insects. The method of removing the wax from the branches of the tree and of preparing it for market was then explained. Thereafter Mr. Hosie detailed the result of an examination of the insects after the wax had been fully deposited, and finally passed to the annual quantity of insect white wax produced, its value and uses.

Electric Safety-lamp for Mines.

Mr. J. Wilson Swan read a paper on an electric safety-lamp for miners, in which he submitted the latest result of an attempt to adapt electric lighting to the requirements of coal-mining. He said it was more than doubtful if any of the lamps at present in use were safe in an explosive atmosphere in a state of abnormally rapid motion, or when subject to a rush of air, such as a blast or the accidental swing of a lamp might occasion. The fragile partition of wire gauze, which alone presented a barrier to the passage of flame from the lighted wick inside the lamp to an explosive mixture of gas outside, was too slight a defence against the danger of explosion. The lamp which he submitted for examination was protected by a very thick glass bull's-eye, light being economised by a silvered reflector behind the lamp. Two sockets within the case provided the means of connecting the battery terminals with the charging circuit. The combined apparatus of battery and lamp weighed 6¾lb., and the cylindrical case containing the cells measured 8in. by 4in. Mr. Swan claimed for the new lamp that it possessed the merit of being absolutely safe. If it was neither so light nor so cheap as the ordinary lamp, it was in both respects at least practicable, and especially was it to be noted that the working cost would probably not be more than that of the ordinary lamps. As regarded the weight, he was not without hope of being able to reduce it.—In the course of a discussion which followed the lamp was spoken of in terms of general approval.—Mr. Swan, in reply to questions, said the lamp did not, like others now in use, indicate the presence of fire-damp. The cost of the apparatus would be about three times that of the ordinary lamp, but its maintenance would cost about the same.

The Standard of White Light.

The committee on a standard of white light reported that during the past year experimental work had not been extensive, as they had no funds at their disposal for experimental research, and they had been chiefly occupied with reviewing what had been done in the past and trying plans for future operations. A consideration of existing standards convinced the committee that the standard candle as defined by Act of Parliament was not in any sense of the word a standard. They had looked into the merits of different proposed standards, and the majority felt satisfied that for all the present commercial requirements the Pentane standard of Mr. Vernon Harcourt, since it had no wick and consumed a material of definite chemical composition, when properly defined was an accurate and convenient standard, and gave, more accurately than the so-called standard candle, an illumination equal to that which was intended when the Act was framed. Yet the committee, while desiring to impress the Board of Trade and the public with these views, did not feel inclined at present to recommend the adoption of any standard for commercial purposes until further information on radiation had been obtained for experiment. They desired to be reappointed and asked for a grant of £30 to enable them to carry out certain researches which they indicated in this direction.

The Fossil Man of Mentone.

Mr. T. Wilson, the United States Consul at Nice, read a paper entitled "The New Man of Mentone." He said that in March, 1884, there was discovered in one of the famous caverns at Mentone a skeleton of one of the ancient and original inhabitants, believed to have belonged to the Palæolithic age. The formation of the floor of the cavern and the process of its filling up presented all the usual evidences of human occupation and industry, charcoal, burnt earth and ashes, hearthstone, split and broken bones of animals (estimated to the number of 15,000 pieces), flint instruments, chips, nuclei, &c., were found in sufficient number, quantity, and distribution, to indicate an indefinitely long occupation. No morsel of pottery was found, nor were any of the stone implements polished. At the depth (from the original surface) of 27ft was found the skeleton of this "new man of Mentone." He was laid on his back with his limbs extended, and had for funeral exquipments three large chips of flint, 6in. or 7in. long and 2½in. broad, in the form of the largest scrapers, placed one on each shoulder, like epaulettes, and one on the brow. It was evidently an interment. The skull was broken into 60 fragments by the pick of the workman; it was carefully taken up and put together by M. Bonfils, and was now exposed in the Museum at Mentone. This was a fortunate accident, for while the rest of the skeleton was being exhumed a quarrel broke out as to the ownership, which ended in the theft and utter destruction of all that remained. Mr. Wilson went on to describe the condition of the cavern where the remains were found
and stated his belief as to their
palæolithic age.—Mr. W. Penge
the man had died where he
not been formally buried,
cavern described woul
inquirers.

The Origin of th

Prof. Hull read
abundant fishes of
half of the species

tributaries, while of the rest only one, Blennius lupulus, belongs to the ordinary Mediterranean fauna; two others are found in the Nile; seven other species occur in the rivers of South-Western Asia; and ten more are found in other parts of Syria. Tristram considered that this assemblage pointed to a close affinity of the fauna of the Jordanic basin with that of the rivers of tropical Africa; but what most struck the observer was perhaps the speciality of the species to Jordanic waters, sixteen out of a total of thirty-six species being peculiar. Assuming that the forms which are common to Jordanic and other waters had been distributed in a manner similar to that by which they had to account for the distribution of lacustrine forms in other parts of the world, they had yet to account for the presence of the forms which were special and peculiar. After referring to the formation of the Jordanic basin, Prof. Hull argued that by the subsidence of the floor of the sea along the line of the Jordan valley an inland lake was formed whose waters were first derived from those of the ocean itself, in which were inclosed the fishes, molluscs, and other forms which inhabited these waters themselves. The law of "descent with modification" would come into operation, and they might suppose that throughout the Miocene and Pliocene periods the process of modification in form, colour, and habit gradually proceeded. The fittest forms would survive, and differentiation between those of the outer and inner seas would result in an almost entire specific change. Prof. Hull also read a paper on the cause of the extreme dissimilarity between the fauna of the Red Sea and Mediterranean, notwithstanding their recent connection.—Dr. Carpenter said he did not know that they had any change so remarkable as that seen in the Sea of Tiberias. It was fed by streams of fresh water, which had gradually washed out the salt water that occupied the sea. The same thing was going on in the Black Sea, the salinity of which is about half that of oceanic water, and less than half that of the Mediterranean, and this is maintained by an under current of salt water through the Dardanelles and Bosphorus, and the fishes had adapted themselves to this condition of the element.—Canon Tristram combated Prof. Hull's theory in regard to the fishes in the Sea of Tiberias, and pointed out that they were identical with the species of fish found in the Nile and in the African lakes. It seemed to him that the solution of the question was to be found in there having existed a chain of lakes connected with the Lake of Tiberias, just like the great American belt of lakes, and that these were peopled by fresh-water fish. —Prof. Hull, replying to Canon Tristram, said he was at a loss to understand from the geographical conformation of the region; how a chain of lakes could have existed such as the Canon believed to have been. It was an interesting fact that the mollusca of this lake appeared to be such as would result in the gradual change from marine forms into fresh-water forms, so that there was some ground for his view—even supposing Canon Tristram had his chain of lakes—that the forms were originally marine forms, and had modified into fresh-water forms.

Mount Roraima.

Mr. Everard im Thurn, British Guiana, read an interesting account of his recent ascent of Mount Roraima, a marvellous mountain—not, as generally stated, in British Guiana, but just outside British Guiana and in the Brazils. Roraima was first discovered some forty-five years ago by the brothers Schomburgk, and had since excited the interest of scientific men. In mere height the mountain was a dwarf, as its summit was only between 8,000ft. and 9,000ft. above the limit of the sea, and only some 5,000ft. above the level of the plain from which it rises. The interest in the mountain lay, not in its height, but in its extraordinary formation, and in the apparent inaccessibility of its summit, for to have some conception of Roraima they should imagine a flat-topped pillar, itself some 2,500ft. in height, set on a very steeply-sloped, truncated cone of about another 2,500ft. in height. Moreover, the sloping base on which the pillar-like portion of Roraima stands is, over the greater part of its surface, rendered but just barely passable by reason of a complete covering of huge boulders and rocks, such as would present the appearance of an enormously magnificent moraine; but that it is clothed, obscured, and rendered yet more impassible by one of the densest and most tangled forests to be found even in the tropics. Besides, on many days throughout the year—only, however, the Indians avow, when white men are about it—the mountain is enveloped from base to summit in densest mist, and it is hardly ever clear all its parts from huge masses of drifting vapour. [illegible] the 8th December last without any difficulty [illegible] than might be [illegible] ordinary [illegible] of endurance had been made and abandoned as hopelessly impracticable; and, being adequately supplied with provisions, they were enabled to spend three weeks on the mountain and learn much concerning it. The ascent was made from the southern side—first up the sloping part of the mountain, grass-covered and swampy; and then up a much steeper slope, entirely covered by moraine-like masses of huge fragments of rock, over which had grown a dense forest of small but gnarled trees, matted together by ferns and climbing bamboos. From this they ascended by a broad but uneven, and in many parts much broken ledge, which runs diagonally up the face of the rock from the top of the forested slope to the upper edge of the cliff which forms the summit of the mountain, climbing down and then up the sides of a deep ravine cut through this ledge by a stream of some size, falling over the upper edge of the cliff down on to the ledge. Mr. im Thurn's observations dissipated a common notion about Roraima—that this mountain, so remarkable in form, is solitary, unique, and peculiar. It is in reality only the most lofty and most striking of a group of similar mountains—a group resembling, when seen from a sufficiently distant height, an indescribably vast natural forum in ruins. No stranger sight, he fancied, was to be seen than that which met their eyes on reaching the top of Roraima. In the foreground, on either hand, rose a fantastic pyramid of rock, and within, on the right, three detached pillar-like blocks of stone lying evenly side by side on the top of a huge squared block, pointed, in marvellously close resemblance to three great guns, outward through the entrance. Within the thus strangely-guarded gate lay a great plain, with a generally uneven surface, clothed with a grass-like but very peculiar vegetation. On this plain were ranged, in orderly disorder, many single masses and piles of masses of great rocks from 20ft. to 80ft. high, each single rock and pile of rocks being of perfectly indescribable, almost incredible, strangeness of form. It seemed a disordered gallery of countless vast stone monsters. He was what seemed a "logan" stone, there an "Old Man of Hoy," there again an archway, there a terraced Mexican pyramid, and so on —a gigantic human mask of stone, a cap of stone, a human figure of stone, animal figures of stone, and hundreds of similar natural grotesques. In short, it seemed as if there had been gathered together and put away on that lofty and isolated small summit all those grotesque, apparently artificial, natural rocks, which, attracting the attention of the curious traveller, are usually found scattered singly and at wide intervals over the face of the whole earth. Mr. im Thurn was of opinion that each of the rock monsters on the top of Roraima, whether it consists of a single rock or of a pile of rocks, is gradually melting away under the influence of the aërial denudation which on Roraima, the very home of all mists and rains and storms and winds, exercises, in a degree hardly approached elsewhere, its unchecked and powerful sway. Another noticeable aspect of Roraima—the ever-fruitful mother of streams, as the Indians call it—was that, gathering their waters on this marvellous top, and starting with a wonderful leap of 2,000ft. down over its cliff, were streams which flow in various directions to swell, with no inconsiderable contribution of water, the Orinoco, the Essequibo, and the Amazon, the three chief river systems which water the greatest part of the Atlantic side of the Continent of South America. After stating how he took farewell of Roraima on Christmas Day, Mr. im Thurn concluded by saying that he and his companions found the way up Roraima; but, that done, they had exhausted their means, and were unable to do the further exploration of the mountain which was most desirable. He often hoped that he might be fated yet to do that further work (applause)—he always wished that, whether he or another did it, it might be done. The knowledge which he had gained would enable it to be done with comparative ease; and if there was anyone, there or elsewhere, who would undertake it, that knowledge should be placed as fully at his disposal as it would be used by himself.

EXPLOSIVES.

THE Saturday evening or popular lecture during the meeting of the British Association was delivered by Mr. Harold B. Dixon, F.C.S., of London, who took for his subject "Explosives." In commencing, Mr. Dixon said that when the Council of the British Association asked him to give a lecture on explosives to the working men of Aberdeen, he felt that there were many members of the Association better fitted to speak to them than he; but he also felt that if he came as a working man to speak to working men, they would give him their attention and their forgiveness if anything went wrong. He then proceeded to expound [illegible] theory of explosives. He began with combus[illegible] which is oxidation, for oxidation—that is, oxygen uniting with carbon, is combustion, resulting in the formation of carbonic dioxide. So they might have a combustible gas, as hydrogen. Now, an explosion differed from combustion of a gas only in being more rapid. Thus, hydrogen burnt in an open glass vessel burns slowly, but if it had previously been mixed with air, it burns more rapidly. Explosion, then, was the rapid combination of gases in combustion. Solids do not explode as such; they must be changed into gases. Next it must be noted that before such combination takes place there is needed a certain temperature. Coal gas mixed with air at the normal temperature does not explode. This temperature of ignition is different for different substances, but definite for each. A drop of phosphorus in a volatile solvent if put on paper and waved gently through the air first leaves a white deposit and then ignites. Again, bisulphide of carbon, a volatile liquid, ignites very much below red heat. So far the combustible, the oxygen to burn it, and the temperature of ignition. Take, now, a mechanical mixture of two gases—hydrogen and oxygen, in the proportion of two by weight of hydrogen to one of oxygen. On ignition the gases unite with an explosion. The particles nearest to the flame come into collision and cause around them heat so great that the neighbouring particles are also ignited, and this goes on till the change has passed through the whole mass. It is to be noted that the change is not the same all through the tube; there is a change after the first ignition, and this is carried through the tube containing the gases. The change goes on from layer to layer of the mass, with greater and greater pressure, till at the last layer the pressure alone is enough to cause explosion. Compare with the mixture in a tube the same mixture held in soap-bubbles on the hand. In the tube there is developed what is now technically called the "Explosive wave," which throws such light on the explosion of nitro-glycerine, dynamite, and gun-cotton. Many explosives are merely mixtures of gases. To show how hydrogen, mixed with oxygen, explodes, fill with hydrogen a bell-jar 18in. long, whose mouth is closed with cartridge paper; through the mouth so closed and placed downwards, pass a glass siphon whose longer arm passes a little higher than the blind end of the jar, and ignite the gas at the end of the siphon. For a time it burns with a singing noise, then the flame flickers, and passes back into the jar with a loud explosion; this being due to the mixture made by the influx of oxygen through the opening in the cartridge paper. Next take solid mixtures—gunpowder. This is carbon, sulphur, and nitre powdered and mixed. On ignition the carbon forms carbonic dioxide, the sulphur sulphurous acid, the oxygen being supplied from the nitre. There is thus a sudden expansion of gases. The value of gunpowder, which as an explosive is a very poor thing, lies in its slow rate of combustion. Next, chemical mixtures—such as gun-cotton, which is clean cotton wool so nitrated with nitric acid that each molecule of it contains in itself oxygen enough to burn the carbon nitrogen and hydrogen in it. Consequently, on ignition, gun-cotton is completely burnt, leaving no ash, and producing no smoke. We must note here the difference between rapid combustion and detonation. Detonation is produced with the explosive wave. Gun-cotton, for example, can be ignited only when dry; it can be detonated by means of mercury and silver fulminate whether it be damp or dry. It is thus a safe storable explosive, proof against ordinary fire. This is shown by pouring over gun-cotton some carbon bisulphide and igniting, when the gun-cotton melts away. Mr. Dixon then went on to tell how he was led to experiment on this subject, and how he was led to the true theory of detonation. Once at the Royal Institution, London, before showing the experiment of igniting a mixture of nitric oxide and carbon bisulphide, he made the unfortunate remark that there would be no noise; but on ignition, there was a loud report. He found that on that occasion he had used for the experiment a longer tube than usual. That the long tube was the cause of the sound was proved by exploding the gases in tubes of different lengths; in all there was a sound, but the sound in the larger tubes became a loud report. This led him to believe that a new physical factor had been introduced, that the explosion got faster and faster as it descended the tube, and at last the pressure alone was enough to cause explosion. No sooner had he set about experimenting to prove this than there appeared in France a paper by M. Berthelot containing the same results, and announcing the discovery of the explosive wave. The next thing was to measure the rate of the explosive wave. The apparatus for doing this is a small scaffold about 6ft. long. Attached to one of the uprights is a piece of steel tubing about 8ft. long—the "firing piece." This is attached to a hundred yards of gaspipe, which passed round the hall till it ended in another piece of steel tubing attached to the other upright. The free ends of the steel tubes are closed by stop cocks, and are separated from each other by the length of the scaffold. In each steel tube, at a little distance from the free end, is a bridge of silver wire. And at each end of the cross-piece of the scaffold is an electro-magnet, the two magnets being about 4ft. apart. The current that makes and breaks the magnet passes through the silver bridge of the tube at the same end of the scaffold: so at the other end. The whole hundred yards of tube is then filled from the firing-piece with a mixture of hydrogen and oxygen; the stop-cocks are closed; the charge is then fired from the firing-piece by an electric spark; the flame, passing the silver bridge of the firing-piece, burns it, breaks the current, and down drops the armature of the magnet of that side; passing round the tube, it burns the silver bridge of the other piece, breaks that current, and down drops the armature of the magnet of the other side. The time between the falling of the armatures is the time the explosive waves takes to travel one hundred yards. By this apparatus we are enabled to determine the relation between the velocity of explosion and the molecular constitution of a body. Each particle is moving in straight lines at a rate depending on the temperature of the gas. In the union of hydrogen and oxygen a certain quantity of heat is developed; the product is steam; and knowing how much heat this absorbs, we can tell the temperature to which the product, steam, is raised. Hence we can calculate at what velocity the molecule of steam is moving at the temperature of the explosion. The temperature being 5,000° Fah., the rate of movement is about 3,000 yards a second. So for other gases. The results show that the explosive wave is not the same as a sound wave. Comparing the different substances, we find that there is a fixed relation between the molecular rate and the explosive rate, the variations from theory being due to imperfections in experiment. Here, therefore, we have a new chemical constant.

THE ELECTRIC LIGHT AND ATMOSPHERIC ABSORPTION.

THE Friday evening discourse during the meeting of the British Association was delivered by Prof. W. Grylls Adams, who, taking for his subject "The Electric Light and Atmospheric Absorption," in reference to the experiments carried out by the Trinity House at South Foreland, said:—The absorption of light by the earth's atmosphere was a subject of very great importance, for it affected and modified our views of everything around us. The sense of sight revealed not only the outline and colour of bodies immediately around us, but that very absorption by the atmosphere enabled us to judge of distances, and lent the charm of tone and colour to the landscape; it warned us of the gathering cloud, and, in the twilight of the morning, it told us of the coming sunshine. Light revealed to us not only things within our atmosphere, but Prof. Stokes, in the course of his lectures here, had shown the various ways in which it might be employed to investigate the condition and composition of the sun and stars, and to resolve the nebulæ. Within the last ten days it had revealed to us that, in the centre of a nebulous mass of matter, there had been a concentration of the luminous gases into a central mass, as though a new sun were just caught in the act of its formation. Yet we must remember that we had now only received the record of an event which happened many thousands of years ago, and that the waves which had brought it to us, travelling at the rate of 192,000 miles a second, had been on their journey for that period of years. The lecturer then explained and illustrated various matters in spectrum analysis, touching on the theory of Stokes, Bunsen, and Kirchhoff regarding the sodium light and reversal of the sodium band. He then came to the subject proper of his lecture, speaking more particularly of the experiments made at South Foreland. During the past year, he said, interesting experiments have been carried on at the South Foreland Lighthouse on the relative intensities of the most powerful artificial lights with which we are acquainted, and on the general absorption of their light by the atmosphere in different states of clearness. We have only to go back a few years in lighthouse illumination to find as our brightest oil lights either the Fresnel four-wick lamp, or the Trinity House four-wick lamp of about 300 candles, giving a cylinder of orange yellow light of about 4in. in diameter. By the introduction of the electric light at the South Foreland fifteen years ago, under the advice of Faraday, a source of light of 1,200 candles was obtained within a circle ½in. in diameter. This concentration of the light within so small a space is of vast importance in its use behind a lens, and greatly increases the brightness of the light and the distance to which it can be seen. Its advantages to the mariner are shown from the reports of Prof. Faraday and Mr. Holmes on the comparison of these lights, and from a French report in 1870, which says: "The advantages of the system have been highly appreciated by mariners, and the increase of range of the lights has been very marked in slightly foggy weather. It certainly enables mariners to continue their voyage, and to enter a port at night, when they would not have been able to do so with oil lights." A comparison of electric and oil lights of the first order was made by M. Petit, hydrographer to the Belgian Government, some years ago—soon after the electric light was permanently established at the South Foreland. He estimates the relative efficiency of the electric light of 1,200 candles, and the oil light of 300 candles, and finds that on 76 nights in a hundred the electric light was seen at a distance of more than 20 miles, whereas the strongest oil lights then used were only seen 29 nights in 100 at the same distance. Improvements have been made in all lights by adding extra rings of wick, bringing the candle power of the six-wick oil light up to 730 candles, and increasing the cylinder of flame to about 4½in. in diameter. In the meantime, gas has also been introduced for lighthouse use, and by the addition of ring after ring of burners the largest gas lights regularly used consist of 108 jets, giving a light of 2,400 candles, and giving a cylinder of flame 11in. in diameter. The oil light 4½in. in diameter, giving a light of 730 candles, and a gas light 11in. in diameter, giving 2,400 candles, will give beams of light which are more and more divergent as the source of light is larger, and as seen from any point in the axis of the beam appear of equal brilliancy. When placed behind a very powerful lens they are nearly equal in brilliancy to the electric light of 1,200 candles in the permanent lighthouse, which for the last fourteen years has been supplied from the Holmes magneto-machine, and in the observations made on the sea the three lights have been seen over the same range. Following M. Petit, we may say then that both oil and gas have so improved that the practical efficiency has been raised to 76 per cent. But the efficiency of the electric light does not stop at 76 per cent., for the increase in the illuminating power which is possible with the electric light diminishes the risks to shipping, and raises the practical efficiency of lighthouse lighting from 76 per cent., the best that can be done by any other means, to 90 per cent., leaving only ten nights in a hundred when the light is not seen 20 miles away. By a proper arrangement and more powerful lenses the efficiency may be still more increased. Of the remaining ten nights in a hundred there are some when even the strongest lights cannot be seen for a distance of two or even one mile, as has been shown on a few occasions at the South Foreland during the past year. The lecturer then referred to the observations made at South Foreland, mentioning that in order to study the effects of very dense fogs in eclipsing powerful lights steam was allowed to issue from the steam pipes introduced into the photometric gallery 380ft. in length at the South Foreland Lighthouse. The steam was let out at various points so as to fill the gallery with a dense and fairly homogeneous mass of condensed steam, the supply being kept up from points further away from the lights than the observer was. Such a mixture of air and condensed steam may fairly be taken to represent a dense sea-fog or genuine Scotch mist. The experiments have shown that using the large New Island lens with the Wigham gaslight of 2,400 candles, and the smaller lens with the electric light of five times the power, or 12,000 candles, the electric light in clear weather was at least sixteen times as bright and in foggy weather was about thirteen times as bright as the gas light; the excess of absorption for the electric light being about 20 per cent. more in foggy than in clear weather.

SIR JOHN LUBBOCK ON ANTS AND BEES.

THE most crowded sitting of the Biological Section of the British Association was that at which Sir John Lubbock read his paper—"Recent Observations on the Habits and Instincts of Ants and Bees." Sir John Lubbock said: One of the most interesting questions connected with the instincts and powers of animals has reference to the manner in which they find their way back after having been carried to a distance from home. It has by some been attributed to the possession of a special "sense of direction." On this subject Mr. Darwin suggested that it would be interesting to try the effect of putting animals "in a circular box with an axle which could be made to revolve very rapidly, first in one direction, and then in another, so as to destroy for a time all sense of direction in the insects. I have sometimes," he said, "imagined that animals may feel in which direction they were at the first start carried." On this subject M. Fabre has made some interesting and amusing experiments. He took ten bees, marked them in the usual manner with a spot of white, and put them in a bag. He then carried them half a kilomètre in one direction, stopping at a point where a cross stands by the wayside, and then whirled the bag rapidly round his head. While he was doing so a good woman came by who was not a little urprised to find the aged professor standing in front of the cr solemnly whirling a bag round his head: and Fabre fears strongly suspected him of so Satanic practice. However this may be, havi sufficiently whirled his bees, M. Fabre started back in the opposite direction, and carried prisoners to a distance from their home of th kilomètres. Here he again whirled them rou and then let them go one by one. They made o or two turns round him and then flew off in t direction of home. In the meanwhile his daugh Antonie was on the watch. The first bee did t mile and three-quarters in a quarter of an ho Some hours after two more returned. The ot seven did not reappear. The next day he peated this experiment, of course with differ bees. The first returned in five minut and two more in about an hour. Again three o of ten found their way home. Sir John Lubbo detailed other experiments of M. Fabre, and c tinued: These experiments seem to M. Fa complete and conclusive. I am not ashamed confess that, charmed by M. Fabre's enthusia dazzled by his eloquence and ingenuity, I was first disposed to adopt his view. Calmer conside tion, however, led me to doubt, and though Fabre's observations are most ingenious, and very amusingly described, they do not carry c viction to my mind. There are two points specia to be considered: first, the direction taken by bees when released; second, the success of bees in making good their return home. As rega the first point, it will be observed that the success bees were in the following proportion—viz., 3 o of 10, 4 out of 10, 17 out of 49, 7 out of 20, 9 out 40, 7 out of 15, or altogether 47 out of This is not a very large proportion. Out the whole number no less than 97 lost their w May not the 47 have found theirs by acciden Instinct, however inferior to reason, has the adv tage of being generally unerring. When two o of three went wrong we may, I think, safely d miss the idea of instinct. Moreover, the dista from home was only one and a half to two mil Now, bees certainly know the country for so distance around their home—how far they genera forage I believe we have no certain informatio but it seems not unreasonable to suppose that if th once came within a mile of their nest they wo find themselves within ken of some familar la mark. Now, if we suppose that 150 bees are let o two miles from home, and that they flew aw at random, distributing themselves equa in all directions, a little consideration w show that some thirty of them would f themselves within a mile of home, and consequen would know where they were. I have never mys experimented with Chalicodomes; but I h observed that if a hive bee is taken a distance, behaves as a pigeon does under similar circu stances—that is to say, she flies round and rou gradually rising higher and higher and enlargi her circle until, I suppose, her strength fails, or comes within sight of some known object. Aga if the bees returned by a sense of direction, th would have been back in a few minutes. To fly o and a half or two miles would not take f minutes: one bee out of the 147 did it in that ti but the others took one, two, three, or even f hours. Surely, then, it is reasonable to supp that these lost some time before they came in si of any object known to them. After further c sidering M. Fabre's observations, Sir John s —I have myself tried experiments of t same kind with hive bees and ants. For instance took 40 ants which were feeding on some ho and put them down on a gravel path about yards from the nest, and in the middle of a squ 18in in diameter, which I marked out on the p by straws. They wandered about with every yearance of having lost themselves. I mark down where they left the square and then to them near the nest, which they joyfully enter Two of them, however, we watched for an ho each. They meandered about, and at the end the time one was about 2ft. from where she start but scarcely any nearer home; the other about away and nearly as much further from home. Th crossed the boundary in all directions. One of t most interesting questions in connection with i stinct arises from the remarkable habits of certa solitary wasps (Sphex Ammophile). The amm phile, for instance, having built her cell, places it as food for her young a full-grown larva of Noct segetum. Now if the larva were uninjured would struggle to escape and almost inevitab destroy the egg, nor would it permit itself to eaten. On the other hand, if it were killed, would decay and become unfit for food. The inse however, avoids both horns of this dilemma. Havi found her prey, she pierces with her sting t membrane between the head and the first segme of the body, thus nearly disabling the caterpill and then proceeds to inflict eight more wounds b tween the following segments, lastly crushing t head, and thus completely paralysing her victi but not actually killing it; so that it lies helpl and motionless, but, though living, let us hope

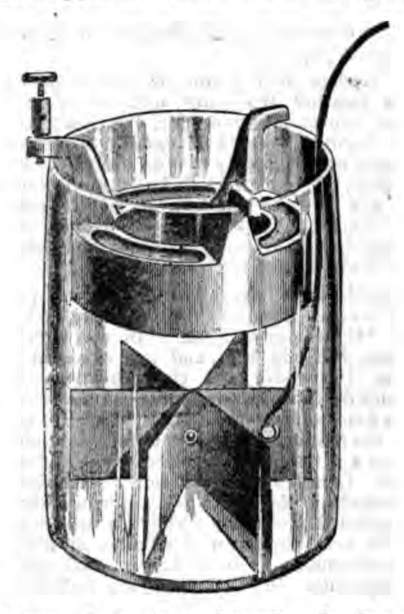
e. Now, M. Fabre argues that this remark- stinct cannot have been gradually acquired. examine some of the other solitary wasps, e whether their habits may afford us any That an animal of prey knows where its is most vulnerable has not in itself anything l or unaccountable. The genus Bember kills ects on which its young are fed, and supplies l with fresh victims from time to time. s like Ammophile and Sphex store up the once for all. They are grievously wounded, ot altogether paralysed. Here, then, we he very condition which M. Fabre considers be fatal to the tender egg of the wasp. ot necessarily so. The wretched caterpillars a wriggling mass at the bottom of the clear space is left above them, and from nmit of the cell the delicate egg is suspended ine thread, so that even if touched by a llar in one of its moribund struggles it simply swing away in safety. When the grub is hatched, it suspends itself to this by a silken sheath, in which it hangs downwards over its victims. Does one em struggle? Quick as lightning it s up the tube out of harm's way. instincts are modifiable by change of stances, cannot, I think, be doubted. bre, indeed, regards instinct as something ble and unalterable. But innumerable cases be quoted to show that this is not so. Per- owever, it may be asked—Why should the change its habits? Several reasons might be ed. The prey first selected might be exter- d, or, at any rate, diminish in numbers. gh each species, as a general rule, confines o one special victim, some exceptions have been noticed. For instances, Sphex flavi- habitually preys on a species of grass- but on the banks of the Rhone they it on the contrary, attacking a field whether from the absence of the grass- or not he was unable to determine. r ingenious experiment of M. Fabre's was ith Chalicodoma. This genus is inclosed in hern cell, through which at maturity the insect eats its way. M. Fabre found that asted a piece of paper round the cell the ad no difficulty in eating through it; but if osed the cell in a paper case, so that there pace even of only a few lines between the the paper, in that case the paper formed an l prison. The instinct of the insect taught bite through one inclosure, but it t wit enough to do so a second time. One most striking instances of stupidity (may is given by M. Fabre in the case of one of his ite bees, the Chalicodoma pyrenaria. This builds cells of masonry, which she fills with as she goes on, raising the rim a little, and aking a few journeys for honey, then raising again, and so on until the cell is completed. en prepares a last load of mortar, brings it in ndibles, lays her egg, and immediately closes cell; having, doubtless, provided the mortar and, lest during her absence an enemy destroy the egg or any parasitic insect gain admittance. This being so, M. Fabre cell which was all but finished, and during ence of the bee he broke away part of the ering. Again, in some half-finished cells e away a little of the wall. In all these e bee, as might be expected, repaired the ef, the operation being in the natural f her work. But now comes the curious

In another series of cells M. Fabre a hole in the cell below the part the bee was working, and through which ney at once began to exude. The poor little bee, however, never thought of repair- breach. She worked on as if nothing had ed. In her alternate journeys she brought rtar and then honey, which, however, ran fast as it was poured in. This experiment ated over and over again, and with various ations in detail, but always with the same

It may be suggested that possibly the bee able to stop up a hole once formed. But uld not have been the case. M. Fabre took the pellets of mortar brought by the bee, ccessfully stopped the hole himself. The n, therefore, was due, not to a want of but of intellect. But M. Fabre carried his nent still further. Perhaps the bee not noticed the injury. He chose, re, a cell which was only just begun, ontained very little honey. In this e a comparatively large hole. The bee re- with a supply of honey, and, seemingly much ed to find the hole in the bottom of the cell, ed it carefully, felt it with her antennæ, and ushed them through it. Did she then, as naturally have been expected, stop it up? it. The unexpected catastrophe transcended ge of her intellect, and she calmly proceeded into this vessel of Danais load after load y, which, of course, ran out of the bottom as she poured it in at the top. All the afternoon she laboured at this fruitless task, and began again undiscouraged the next morning. At length when she had brought the usual complement of honey, she laid her egg, and gravely sealed up the empty cell. In another case, he made a large hole in the cell above the level of the honey; a hole so large that through it he could see the bee lay her egg. Having done so, she carefully closed the top of the cell, but though she closely examined the hole in the side, it did not enter into the range of her ideas that such an accident could take place, and it never occurred to her to cover it up. Another curious point raised by these ingenious experiments has reference to the quantity of honey. The cell is by no means filled; a space is always left between the honey and the roof of the cell. The usual depth of the honey in a completed cell is 10 millimètres. But the bee is not guided by this measurement, for in the preceding cases she sometimes closed the cell when the honey had a depth of 5 millimètres, of 3, or even when the cell was quite empty. No; in some mysterious manner the bee feels when she has provided as much honey as her ancestresses had done before her, and regards her work as accomplished. What wonderful, but what a narrow, instinct! She has built the cell and provided the honey, but there her instinct stops; if the cell is pierced, if the honey is removed, it does not occur to her to repair the one or fill up the other. Mr. Adlerz has written a very interesting paper on the curious species of ant Stenamma Westwoodi. This little ant lives with the horse ants, following them "when they change their nest, running about them and between their legs, tapping them inquisitively with their antennæ, and even sometimes climbing on their backs, as if for a ride, while the large ants seem to take little notice of them." I have ventured to suggest "they almost seem to be the dogs or the cats of the ants." When we consider the immense number of ants in a nest, amounting in some cases to over 500,000, it is a most remarkable fact that they all know one another. If a stranger, even belonging to the same species, is placed among them, she is at once attacked and driven out of the nest. Nay more, I have found that they remember their friends, even after more than a year's separation. This is not by any sign or pass word, because even if rendered intoxicated, so as to be utterly insensible, they are still recognised. As regards the mode of recognition, Mr. M'Cook considers that it is by scent, and states that if ants are more or less soaked in water, they are no longer recognised by their friends, but are attacked. He mentions a case in which an ant fell accidentally into some water. "She remained in the liquid several moments and crept out of it. Immediately she was seized in a hostile manner, first by one, then another, then a third; the two antennæ and one leg were thus held. A fourth ant assaulted the middle thorax and petiole. The poor little bather was thus dragged helplessly to and fro for a long time, and was evidently ordained to death. Presently I took up the struggling heap. Two of the assailants kept their hold; one finally dropped, the other I could not tear loose, and so put the pair back upon the tree, leaving the doomed immersionist to her hard fate." His attention having been called to this, he noticed several other cases, always with the same result. I have not myself been able to repeat the observation with the same species; but with two, at least of our native ants the results were exactly reversed. In one case, five specimens of Lasius niger fell into water, and remained immersed for three hours. I then took them out, and put them into a bottle to recover themselves. The following morning I allowed them to return. They were received as friends, and though we watched them from 7.30 till 1.30 every hour there was not the slightest sign of hostility. The nest was moreover placed in a closed box, so that if any ant were killed we could inevitably find the body, and no ant died. In this case, therefore, it is clear that the immersion did not prevent them from being recognised. Again three specimens of Formica fusca dropped into water. After three hours I took them out, and after keeping them by themselves for the night to recover, I put them back in the nest. They were unquestionably received as friends, without the slightest sign of hostility or even of doubt. Not the least interesting fact which has resulted from my observations has been the unexpected longevity of these interesting insects. The general opinion used to be that they lived for a single season like wasps. Aristotle long ago stated that queen bees live for six and some even for seven years. Bevan, however, observes that "the notions of both ancients and moderns upon this subject have been purely conjectural. Indeed, it appears to be somewhat doubtful whether the length of life which the former seem to have attributed to individual bees was not meant to apply to the existence of each bee community." The nests, however, which I have devised have enabled me to throw considerable light on this question. The queen ants are so easily distinguished from the workers that they can be at once identified, while if a nest be taken in which there is no queen, we can satisfy ourselves as to the workers, because, though it is true that workers do sometimes lay eggs, these eggs invariably produce male ants. Hence in such a case the duration of the nest gives us the age of the workers; at least, they cannot be younger, though, of course, they may be older. In this way I have kept workers of Lasius niger and Formica fusca for more than seven years. But what is more remarkable still, I have now two queens of the latter species which I have kept ever since 1874, which, as they were then full-grown, must now be nearly twelve years old. They laid fertile eggs again this year, a fact the interest of which physiologists will recognise; and though a little stiff in the joints and less active than they once were, they are still strong and well, and I hope I may still keep them in health for some time to come. I need not say that I shall do my best, but I hope that the interest I feel in them myself may not have tempted me to trespass too long on the kindness and indulgence of the Section.

THE MORRISON GRAVITY BATTERY.

THIS battery was devised by J. F. Morrison, of Baltimore, Md., at the time superintendent of the Municipal Telegraph of that city, for the service of the fire-alarm telegraph, then just completed by the Gamewell Fire Alarm Telegraph Company of New York. It proved to be such an excellent battery in every respect for fire-alarm purposes that the Gamewell Co., after two years' test, adopted it as the standard fire-alarm telegraph battery, and it is now in use in over 300 towns and cities. The peculiar form of the zincellement—a bevelled ring supported by three arms—presents a greater surface with less weight of metal than any other. The binding or connecting post is a feature. It is interchangeable, and keeps the contact points where the elements are connected high and dry above the evaporation from the liquids. The copper elements are broad and thin, made in such form as to present the greatest surface to the action of the battery. The connecting wires are riveted to the copper, and carefully insulated with gutta percha through their entire length. The sulphate of copper can be fed to the battery at any time without disturbing the equipoise of the fluid. It is easy to clean, and can be used up to the last ounce of metal below the arms. Its use has, until lately, been confined to fire-alarm purposes, but now it is being used by the B. and O. Telegraph Company in their district service with marked success. The Southern Electric Company, of Baltimore, Md., of which Mr. Morrison, the inventor of the battery, is the president, are the sole manufacturers of this battery. The zinc elements are made from the highest grades of spelter, such as "Star Lehigh," "Bertha," &c. The battery is one that will continue to grow in favour as its many desirable qualities become better known.—*Electrical Review.*



A DAILY paper reports that some important experiments have been made at Middlesbrough with liquid fuel for steamships. One of the most successful has been with the steamship *Emanuel*, of that port, which was fitted with tanks to hold the oil, a waste product from the Middlesbrough Chemical Works. The steamer has just returned from a trip to the Mediterranean, and the master and the engineer report most favourable results.

SCIENTIFIC NEWS.

THE Andromeda nebula has occupied the attention of astronomers during the week, but no agreement as to the nature of the new star has been arrived at. While some observers declare that it is not physically connected with the nebula, others assert that there is evidence beyond question showing its physical association with the nebula. There seems to be no doubt that the new star is diminishing in brightness already. Dr. Wentworth Erck, writing to us on the 11th inst., says :—"Mr. Common's evidence, founded on a photograph of the 15th August, 1884, as to the relative brightness of the nucleus and a certain exceedingly faint star at a distance of two minutes, is scarcely admissible, his comparison being of photographic energy, whereas we are now concerned with optical energy. It is well known that the photographic energy of a faint star far exceeds that of a comparatively light nebula. The spectroscopic evidence is as yet unable to decide whether the nova is merely an extreme condensation of the nebulous matter, or a star commonly so called. Although the spectrum of the nova does not at present resemble those of the temporary stars which have suddenly become conspicuous objects, it would be rash for this reason to assume that the nova does not belong to this class of temporary or variable stars. On the whole, it seems most probable that the new object will be found to be some one of the fifty stars mentioned by Bond as within ten minutes of arc of the nucleus ; that it belongs to the class of temporary, or long-period variables ; and that its apparent connection with the nebula is only optical, not physical."

Our readers will regret to hear that Mr. Walter Bentley Woodbury died while on a holiday trip at Margate. Mr. Woodbury was in the habit of taking laudanum to procure sleep, and unfortunately took an overdose. Mr. Woodbury, who commenced photographic work at the age of seventeen, had, we believe, completed his fifty-first year. Mr. Woodbury was a prolific inventor, and since 1864 had taken out no fewer than thirty patents.

Mr. Azel Storrs Lyman, one of the most prolific of modern inventors, died recently, at the age of "threescore and ten." He was born at Potsdam, N.Y., in 1815, and was educated at Illinois University for the ministry. An incurable deafness, however, changed his career, and he devoted himself to inventions. He was one of the first in making fountain pens, having obtained a patent for a combined holder and nib in 1848. Lyman's next invention was an alarm for indicating the want of water in steam-boilers, and this was followed by a water-gauge. Next he constructed an air-engine, in which and in air-pumps he made several subsequent improvements. In 1856 and the following years Lyman obtained patents for a method of cooling and ventilating rooms, and subsequent improvements of the same. He next invented an ingenious invalid's bed for fever patients, the idea of which was to have an ice-holder above and at the back of the head of the bed, from which a passage led to just above the patient's forehead, thereby providing a steady flow of cold air. In 1857 Lyman began to develop his ideas of an accelerating gun, which was the subject of many subsequent patents, the last of which was for an accelerating cartridge, obtained in June last. Early in life he also bestowed his attention on the manufacture of paper pulp from wood fibre, and he obtained a patent for a method of separating the fibre of wood in 1858, which was followed by several others for the same purpose, as well as for utilising straw and other fibrous substances, the recovery of spent alkali, and other important details of paper manufacture.

M. Bouquet, a mathematician of some eminence and a Sorbonne professor, died last week at Paris, at the age of sixty-six.

The death of the Dutch African traveller, D. D. Beth, is announced from Mossamedes.

The death is announced at Berlin of General Baeyer, chief of the Trigonometrical Survey Department of the Grand General Staff there. The deceased, who was born in 1794, and had therefore reached his ninety-second year, was the son of a peasant farmer, and fought under Blucher as a private in the various campaigns of the Liberation war. He had a European fame as the author of various well-known works on geodesy.

The death is announced in Paris of M. Lunier, member of the Academy of Medicine, who was well known in the English medical world as the author of many important works, and as the editor of the *Annales Medico-Psychologiques*. Amongst his writings, the best known in this country are a work on the progressive increase in the number of lunatics, and on the effect of alcoholic drinks in the direction of increasing the number of cases of madness and suicide.

One of the best map engravers of the time, Selmar Siebert, died recently on board a steamer returning from America. The best official maps of the United States were engraved by his hand, and so were the finest charts of the Prussian General Staff.

The British Association will meet in Birmingham next year on September 1st, Sir William Dawson, Principal of McGill College, Montreal, being president-elect. The meeting of 1887 will be held at Manchester ; but there is a possibility of that arrangement being altered, as it is not unlikely that the American Association will hold its meeting in London. Mr. Atchison was appointed secretary in the place of Prof. T. G. Bonney, who resigns.

During the meeting some interesting and curious statements have been made. Thus, Prof. Hull said the question of a canal from the Mediterranean through the Jordan Valley had now been conclusively settled. Col. Kitchener, R.E., and Mr. John Armstrong had carried out a survey of the country from the mountains of Sinai in the south to the mountains of Palestine in the north. They had determined the levels of the country that would be traversed by such a canal as Mr. Prance had spoken of. The water-shed or summit-level between the Dead Sea and the Gulf of Akabah rose 700ft. above the Gulf of Akabah, and therefore the depth of the canal would have to be 700ft., and its length would be from 40 to 50 miles. That was a problem which the boldest engineer would not face.

Capt. Douglas Galton said the action of the Government [Legislature] had tended entirely to stop the progress of electric lighting ; and Mr. Preece said he was satisfied that if houses were to be lit by electricity it must be by the aid of secondary batteries. These batteries had proved themselves to be the solution of the question of domestic electric lighting.

Mr. James N. Shoolbred gave some facts bearing upon the electric lighting of the Forth-bridge works. The electrical plant employed in the lighting of the works consisted, he stated, of 13 dynamo machines, 100 large arc lamps of 2,000 candles each, 500 incandescent lamps of 20 candles, and about 12 miles of mains. Among the many interesting operations which had occurred was the lighting of the deep-water caissons for the main piers, in some cases from 70ft. to 80ft. under water. Those at South Queensferry were lit by incandescent lights, while at Inchgarvie, owing to blasting operations being necessary, arc lamps were employed. The firing of the blasting charges was also performed from the same dynamo which was providing the lighting.

According to Mr. Buchan, secretary of the Meteorological Society of Scotland, the heaviest rainfall in the British Islands is experienced in the West Highlands, where, at Glencroe, for instance, the annual fall is over 128in. Mr. Buchan stated that a series of large inquiries had been opened up at the Ben Nevis observatory, which would lead to "important, scientific, and practical results." Prof. J. A. Ewing states that having recently paid a visit to the top of the Ben, he was convinced that the atmosphere would preclude the use of the instruments he has devised for observing earthquake movements.

The new gallery of fishes at the Natural History Museum, South Kensington, is now open to the public. An addition has been made to the osteological gallery by throwing open the pavilion at the west end, in which are exhibited skeletons and skulls of elephants, the giraffe, &c.

Prof. Agassiz is to have a marble bust in th new Academy buildings at Neufchâtel. A suf ficient sum of money has been collected by th students of the Academy.

The King of Sweden has informed th Academy of Sciences at Paris that upon attain ing his 60th year, in January, 1889, he intend offering a prize of 2,500f., in addition to a gol medal, valued at 1,000f., to the author of th most important discovery in mathematica science. The judges, who have already bee nominated, consist of three gentlemen, the firs being a Swiss, the second a German, and th third, M. Hermite, a member of the Par Academy of Sciences.

The Gresham Committee have given notic that the lectures founded by Sir Thoma Gresham will be read to the public on the fo lowing days, at 6 o'clock in the afternoon, i the theatre of Gresham College, Basinghal street, in the order stated :—Astronomy (th Rev. E. Ledger), 6th, 7th, 8th, and 9th October ; Physic (Dr. Symes Thompson), 13t 14th, 15th, and 16th of October ; Rhetoric (M J. E. Nixon), 20th, 21st, 22nd, and 23rd October ; Law (Dr. J. T. Abdy), 27th, 28th, 29t and 30th of October ; Divinity (the Dean Chichester), 3rd, 4th, 5th, and 6th of Novembe Geometry (the Dean of Exeter), 10th, 11t 12th, and 13th of November ; and Music (D Henry Wylde), 17th, 18th, 19th, and 20th November. The Gresham Committee will pro ably keep to six o'clock so long as they obtai any audience at all for their lecturers.

The electric railway between Newry an Bessbrook, co. Armagh, was tested last Satu day, and the line will probably be open f traffic in the course of a few days.

It is stated that Eucalyptus leaves not onl prevent scaling in steam boilers, but also cau the old scale to fall off. Eucalyptus "trees now form a favourite bedding plant some of the London parks, and there ought be no difficulty in testing their powers. Pe haps, however, it is the leaves from full-grow trees only which are effective.

USEFUL AND SCIENTIFIC NOTES

Wimshurst Ebonite "Cylinder" Machin — Messrs. Tudsbury and Sons, Edwinstow Newark, are introducing an entirely new form Wimshurst influence machine, which they call "cylinder" machine, in which the sectors are at t circumference, and in a 12in. cylinder are separat from the opposite pair diametrically by a distan of about 11½in. The cylinder is made of very th ebonite, and a 12in. machine gives, according Messrs. Tudsbury, 9in. sparks in air. Furth they inform us that they have frequently had t machines standing out of doors on wet grass for hour or two, and yet, on turning the handle, th have commenced to work freely.

"The Lost Voice."—"The Lost Voice" is t name of a song written by P. G. Mocatta, music Alfred Allen, published by the Medical Batte Company. It is descriptive of the manner in whi a lover who had lost his voice was successful in h suit by means of the ammoniaphone.

A BORED tube well, 300ft. deep, lined with ext strong wrought-iron tubes from the surface to t chalk, has recently been completed by Messrs. Isl and Co., on the premises of the Belfast and Lond Aërated Water Company on Bankside. The cha was reached at 204ft. from the surface, after pa ing through 36ft. of peat and gravel, 75ft. of Lond blue clay, 93ft. of mottled clays and light and brow sands, with pebbles—Woolwich and Reading be Many objectionable springs were met, especially the gravel bed overlying the London blue cl These had to be excluded from the well by mea of the tubes, which are of even size, driven so distance into the chalk, preventing, therefore, a percolation from above. The supply is pump direct from the chalk springs, and at the rate 72,000 gallons per day. The same firm is about bore a 7·25in. tube well, from 400ft. to 500ft. de for the Ealing Local Board.

FOR testing the quality of the leather used belting, M. Eitner proposes, in the *Revue Industriel* the following simple method :—A small piece is c out of the belt and placed in vinegar. If t leather has been perfectly tanned, and is theref of good quality, it will remain immersed in t vinegar, even for several months, without any oth change than becoming of a little darker colour. on the contrary, it is not well impregnated wi tannin, the fibres will promptly swell, and, after short time, become converted into a gelatinous ma

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more: and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

ASTRONOMICAL.

[24764.]—I DARESAY every notice of 31 M. will now be interesting. I got my first look on Sept. 4th, when the new star was easily seen with 1½in. finder. I thought it quite as brilliant as a 6th mag., and found it quite sharp and well defined with 300 on 9in. On the 5th and 6th I was away from London, and found the new star, very easily seen with binocular and power of 4. Since then I have only seen it on Wednesday, Sept. 9th, when air was so thick ν Andromedæ was invisible to unaided eye; yet the new star was sharp in telescope with 90 diameters.

Incidentally, I may say that when I see the sky away from London I become aware of the great disadvantage one labours under in London, and I am almost ready to give up trying to see anything. I am surprised at Mr. Gaudibert's failure with 44 and 75 Cygni, as I saw them both the moment I turned the telescope upon them and measured the angles 300° and 330°.

Σ 306 Cassiopeiæ has a faint *comes* in the direction of 128°. This is not new, but 1′ distant in the same direction is a nice triple star, the P. A. of both *comes* being about 10° ±, and distances 12″ and 24″.

Σ 2097 has a faint *comes* at about 5°, well known; but at 180° ±, about 35″ distant is another, and a third in same direction, a little more distant.

Σ 2505 has faint *comes* at 10° 40′, besides three more distant ones.

I should like to ask Mr. Gaudibert (letter 24735) if "scattered" light *is always found round* bright stars in reflector? Does he not regard this as proof in good air of a mirror defective at edge? Secondly, Does a refractor leave the environs of star *quite* clear, or is there not some obtrusive blue outstanding? *Re* letter 24607 which Mr. Gaudibert hopes someone will answer: Does he not think it is best left alone? It appears to me to lack genuineness.

If a 8½in. mirror does not raise a disc with 300 and 600 it is defective, no doubt, providing the air is good. A 5in. achro produces a much larger disc than an 8½in. mirror, and a small aperture will show a disc, when a larger will not, in bad air. Mirrors are not a failure on bright stars; they perform better than refractors of equal size. The giants I know nothing about; but it is only on small stars one requires a giant.

E. Holmes.

CO-OPERATION OF AMATEURS.

[24765.]—AS co-operation offers numerous advantages, and to none more than to amateurs, much of the valuable information received through the pages of "Ours," at present reluctantly abandoned through want of facility, could be put into practice were a number residing in the same locality to join in forming a workshop in common. Here could be obtained practical interchange of ideas, motive power at a minimum cost, and much else not accessible to a single worker.

With this object in view I should be happy to communicate with any Liverpool readers of the "E. M." willing to co-operate.

Wm. Johnson.

Falkner House, Falkner-square, Liverpool,
September 8th.

MICROSCOPICAL.

[24766.]—THE question raised by Mr. Cooper in letter 24672 in the last number of the ENGLISH MECHANIC (whether daylight or lamplight is the better for working with the microscope) is, I think, evidently one which can be settled only by experience. It amounts to this: "Taking a given sort of object, and a given power, by which can you see best—daylight or lamplight"? for whatever tires the eyes less will be less likely to hurt the sight. Personally, I prefer lamplight, even in the daytime, with any power higher than about 500; but I conceive the golden rule to be not to strain the eyes, and anyone can tell by his feelings when he is straining them. I would, therefore, say, "Take into account the kind of objects you look at most, the power you are using, and the light which is at your command, and do not strain your eyes." Of course, a candle or a gas jet in a chandelier, are thoroughly bad; but anyone who can afford a microscope can also afford a paraffin lamp; and the diaphragms beneath the stage, with, on occasion, the turning down of the other lights in the room, enable the light to be regulated, so as to suit any power which is at all likely to be used. The point is to get neither a dazzling illumination, which kills the object and fatigues by excess, nor a dim light, whereby it is an effort to see details. When anyone first takes up the microscope, his eyes ache, because this way of looking is an unusual way of employing them; but this soon disappears, and I presume the rule is to leave off as soon as watering or irritation is conspicuously felt. They are much sooner felt in those old-fashioned instruments in which the observer looks straight downwards.

As to magnifying power, with respect to which two correspondents wrote the week before last, no simple general statement can be made, since (certain technical matters apart) it varies with the distance between the eyeglass and the front lens of the objective—or, practically speaking, with the length of the microscope tube, at the two extremities of which these are placed. The eyepiece, which is pushed in at the top of the tube, has two lenses in it, the lower of which is called the field-glass, and the upper the eyeglass, and this second is usually set in a longer or shorter projecting "nose." Object-glasses, again, may be short and stumpy, or long and slender, and the tube is not of the same length in all microscopes. The farther from any of these causes the operative part of the objective is from the eyeglass the greater is the amplifying power. Thus, a distance of 15in. will give thrice the magnification of one of 5in. The standard distance is 10in. The same object-glass will not suit a long and a short tube; one which has been made for the one will not work well with the other, and it is necessary to remember this in buying object-glasses. Again, pushing the eyepiece up and down the tube has the same effect as turning the screw collar of the objective to and fro, as far as distinctness of view is concerned. Hence, with objectives which have no screw collar or "adjustment," a *point of best view* may be sought for by pushing the eyepiece (i.e., the brass fitting which contains the eyeglass and the field-glass) up and down. The farther the eyepiece is pulled out, the greater will the amplification be; and a change in the magnification, though a less considerable one, is also produced by turning the collar or adjustment.

But for a given length of tube, with a given objective and eyepiece, the eyepiece being in a certain position—e.g., pushed fully home—and the objective having its adjustment in a certain determinate position (if it has an adjustment)—with these provisos, I say, the magnifying power may be found in either of two ways, both of which suppose that an object of known size (e.g., a stage micrometer) is being looked at. For either way, put a stage micrometer on the stage, and bring its divisions into focus. Then, to estimate the magnifying power roughly, lay a measuring rule across the stage, and look through the microscope with both eyes open. One eye will then see the divisions on the micrometer, and the other those on the rule; and then, for instance, if a division of a hundredth of an inch on the micrometer corresponds to one of an inch on the rule, the power used is one of a hundred. To estimate more accurately, it is necessary to have a camera lucida or a Beale's neutral tint reflector. Turn the microscope till its tube is horizontal, and lay a sheet of white paper on the table perpendicularly beneath the eyepiece, on which the reflector or camera lucida has been fixed. On placing the eye just above the edge of the prism of the camera lucida, or over the round hole in the Beale's reflector, the lines on the micrometer will appear on the paper. Raise the microscope on books or anything else that may be convenient, still keeping the tube horizontal (and, if necessary, supporting it in that position), so that there is the same distance between the eye and the paper as there is between the eye and the stage. Get the light again, and with a pencil dot down on the paper the distance between two of the micrometer lines as they are shown on it. Measure with a rule the distance between the dots; and the latter, divided by the former, gives the magnifying power. Thus, if seven thousandths of an inch by the micrometer measure 4in. by the rule $4 \div \frac{7}{1000} = \frac{4000}{7} = 571$, and 571 is the amplification.

The amplification afforded by a determinate combination—of an inch with a B, a quarter with a C, or whatever it may be—under given circumstances, is the product of their separate amplification under those circumstances. Thus the same magnifying power of 50 would be given by an objective magnifying ten times and an eyepiece magnifying five times; and, on the other hand, by an objective with a magnifying power of five and an eyepiece with one of ten. The microscope is intended for the use of these two things—eyepiece and objective—conjointly; and attempts to ascertain their separate magnification must either be rough, or pre-suppose the use of special apparatus. But the above supplies an easy means of ascertaining how much one eyepiece or objective magnifies more or less than another, with the same length of tube, and allowance can easily be made for differences of length. Suppose, for example, that either of the methods described in the last paragraph has been tried with an inch and an A, and the magnification has been found to be 50. If, when tried with a C, leaving the inch in its place, the amplification is 90, the C magnifies 1⅘ more than the A; or, if it is tried with a quarter, leaving the A in its place, and the amplification is 225, the quarter magnifies 4½ more than the inch; and then, if the inch, on being tried separately, should prove to magnify ten times, the A must magnify five times, so that to make up the 225 the quarter must magnify 45 times. Or conversely, if the A eyepiece, on being separately tested, should prove to magnify six times, the inch must do so only a little more than eight times, and the quarter 37½ times. Thus, if the separate amplifying power of either a single eyepiece or a single objective be accurately known, those of all the rest, both objectives and eyepieces, may easily be computed. I should certainly think it the wiser plan for anyone who desires to enter into these investigations to have the separate amplifying power of one of his eyepieces or objectives exactly measured by an optician.

But if reference to an optician is impracticable, the amplification of low-power objectives and eyepieces may be roughly measured by the following process:—Take a low-power eyeglass (e.g., that in the eyepiece of an A) or a low-power objective (e.g., a 2in.), and suspend it steadily (for instance, by a loop of wire) over a finely-divided scale, so that the divisions on the scale are in focus. Place by the side of this a rule, and on looking down, the divisions on both will be seen, those of the one magnified, within the circuit of the lens, and those of the other of their natural size, outside its rim. The two may then be compared, and the magnification ascertained; and if a camera lucida is available, or if the skill of the experimenter suffices to construct a temporary one, greater accuracy may, of course, be obtained. The magnifying power of the eyeglass may indeed be ascertained by merely ascertaining its focus. Thus an eyeglass, which when unscrewed and used as a simple lens (e.g., as one of the lenses of a triplet), focusses at an inch from the object looked at has a magnifying power of ten, one which focusses at half an inch has a magnifying power of twenty, and so on. This rule, however, is restricted to eyeglasses which are composed of a single piece of glass; it will not apply to objectives, which are made by putting together several distinct lenses. To eyeglasses, however, it will apply; and by its means the amplification of an eyeglass may be found, wherefrom the amplification of an objective used with that eyeglass may easily be computed. For instance, if the eyeglass magnifies ten times, and the total magnification when it is employed with an inch objective is 110 times, the inch by itself must magnify eleven times. I say when *it*, the eyeglass, is employed with the objective; but, as a rule, *it* is not employed—i.e., is not employed *alone*. In the ordinary use of the microscope another lens is also employed, which is screwed in at the lower end of the eyepiece, and is called the field-glass. The use of this lens will easily be found out by unscrewing it and taking it out, as has occasionally to be done in cleaning the eyepieces. The field will then be seen to be small and dull, and the magnifying power will be altered. To estimate the effect of a gvien eye*piece*, therefore, first ascertain the amplification of the eye*glass*—i.e., of the lens nearest the eye. This may be done by ascertaining the length of focus, which is readily obtainable; for in ordinary—i.e., Huyghenian—eyepieces, the field-glass is fixed in the focus of the eyeglass, so that it suffices to measure the distance of the one from the other. Secondly, ascertain how much the eyeglass magnifies with an objective, which may be done by taking off the field-glass, and evaluating the total magnifying power, as described above, with a rule laid across the stage, a camera lucida, or a Beale's reflector. Thirdly, screw on the field-glass and repeat the process with the rule, &c., which will show the actual magnification of the eyepiece as a whole.

As to the measurement of the angle of aperture of an objective (on which, and on the effect of aperture, questions were also asked), the angle in question may be ascertained by an Abbe's apertometer. These are sold by Mr. Baker, of Holborn. It is scarcely worth while getting one for the sake of a single microscope, however desirable an apertometer may be as part of the stock of a microscopical society. But the angle of aperture answers to the obliquity of light with which an objective will give a bright field. Every objective has the power of receiving rays which are not at right angles to the outer surface of its front lens, but oblique to it. Thus, if while a wood section or anything of the kind is under view with an inch, the mirror is moved more and more to one side (shifting it at the same time so as to keep the light on the object), a point will be reached, if the lower aperture of the stage does not come in the way, where the object appears bright, but lies on a dark ground, as if it were illuminated by a spot-lens or a paraboloid. The rays directly proceeding from the mirror are then too oblique to pass through the objective, and only scattered rays enter; hence it is that the field is dark, and the angle of aperture may be estimated by measuring the exact point where the light goes out. To do this, arrange the microscope as if for examining an object, but without an eyepiece. Darken the room, and place the lighted microscope lamp at a considerable distance from the instrument—the farther the better. Turn the mirror away on one side, remove any substage apparatus, and focus the objective down as far as possible, or till its nose comes through the hole in the stage. On looking down the tube, the image of the light will be seen like a star; and on turning the microscope tube on the joint by which it is inclined at various angles, this star will be seen to go out, now at the top and now at the bottom of the objective. Notice the point at which it disappears; measure the angle through which the tube is moved to pass from the one to the other, and you have, roughly, and with some exaggeration, the angle of aperture. The measurement may be effected by a large sheet of paper, on which a large semicircle has been drawn, and divided into degrees. This, in fact, is the principle of the instrument called the apertometer, commonly used by opticians for determining the angle of aperture for objectives. The angle of a condenser may be measured in the same way [illegible].

With respect to the last question asked—the difference between two objectives of the same power, but differing in angular aperture—it is obvious, in the first place, that the higher angled objective has the advantage, for it transmits all the rays which the other does, and more oblique rays as well. This is an important point in working with a dull light, or with high eyepieces. The exact proportion of light transmitted under the same circumstances is as the squares of the sines of half the angles of aperture; and the sine of half the angle of aperture is called the N.A., or numerical aperture. Thus, suppose an objective to have an angular aperture of 10°, or a thirty-sixth of a circle, half that angle would be 5°, and the sine of 5° is ·087, which would be the N.A. of such an objective. An objective of *twice* the N.A., or of N.A. ·174, would admit *four* times as much light; one of *thrice*, or of N.A. ·261, *nine* times as much; and one of *four* times the aperture, or of N.A. ·35, would admit *sixteen* times as much light. Now ·174 is (approximately) the sine of 10°, ·261 that of 15° 8', and ·35 that of 20° 29'; so that objectives of twice those angles of aperture—i.e., of A.A.'s of 20°, 30° 16', and 41°, admit respectively four, nine, and sixteen times as much light as one of 10°.

With this advantage, however, is conjoined what is for many purposes a defect:—The depth or thickness of the object which is in focus at once *diminishes* as the square of the N.A. (i.e., of the sine of half the angle of aperture) increases. Thus objectives of the above angles would have a "penetrative" power, as it is called, of respectively a quarter, a ninth, and a sixteenth of that possessed by an objective of A.A. 5°. Hence an objective of low angular aperture will show at one view both the elevations and the depressions on an object—the whole thickness of a section, for instance, or the bodies of polycistina and their spines; while with a higher angle, one part will have to be put out of focus to get another in. A third, *e*, point of difference between low and high angled objectives has regard to their power of "resolving," or showing as distinct objects, fine lines or dots closely set together, as on diatoms; and here the rule is that for every ·01 of N.A. an objective will theoretically show, without a condenser, and with central light, 964 such lines or dots to an inch. Thus the dots on *Pleurosigma angulatum* are about 52,000 to an inch. To exhibit them, therefore, a numerical aperture of ·54, corresponding to an angular aperture of 65° 22', is theoretically sufficient. If the objective is an air (or dry) lens, all that is needful is to find by a sine-table the sine of half its angle of aperture, from which, by the above data, its illumination, penetration, and resolving power may at once be deduced—e.g., suppose its angle of aperture is 90°, or a quarter of a circle; what we then want is the sine of half 90°, or 45°. This, by tables of natural sines, is ·71 nearly. Such an objective, therefore, is theoretically able to resolve 68,000 lines or dots to an inch, possesses 71^2, or 5,041 times the illumination, and has $\frac{1}{5041}$th the penetration of a lens of N.A., ·01, or of A.A., 1° 8'. If the objective is a water or an oil immersion, the sine of half its angle of aperture has to be multiplied by the index of refraction of the fluid in which it works (1·33 for water and 1·52 for oil) to find the quantity—still called its numerical aperture—which has the above relations to illumination, penetration, and resolution.

In the following table, A = angle, and B = sine of half that angle.

A	B	A	B
5° 0'	·044	92 30	·722
7 30	·065	95	·737
10	·087	97 30	·752
12 30	·109	100	·766
15	·131	102 30	·780
17 30	·152	105	·793
20	·174	107 30	·806
22 30	·195	110	·819
25	·216	112 30	·831
27 30	·238	115	·843
30	·259	117 30	·855
32 30	·280	120	·866
35	·301	122 30	·877
37 30	·321	125	·887
40	·342	127 30	·897
42 30	·362	130	·906
45	·382	132 30	·915
47 30	·403	135	·924
50	·423	137 30	·932
52 30	·442	140	·939
55	·462	142 30	·947
57 30	·481	145	·954
60	·500	147 30	·960
62 30	·519	150	·966
65	·537	152 30	·971
67 30	·556	155	·976
70	·574	157 30	·981
72 30	·591	160	·985
75	·609	162 30	·988
77 30	·626	165	·991
80	·643	167 30	·994
82 30	·660	170	·996
85	·676	172 30	·998
87 30	·692	175	·9990
90	·707	177 30	·9999

By this table the numerical aperture of any day objective, whose angle is given in column A, is the corresponding number in column B: thus, if the angle is 60°, the N.A. is ·707, and so on. The N.A.'s of intermediate angles may easily be found by taking proportional parts. For between 0° and 60° the N.A. increases by about ·02 for every 2° 30' of aperture; between 60° and 70° by about ·018; between 70° and 80° by about ·016, and so forth, the increase continually diminishing: so that after about 160° no appreciable advantage is gained by increase of angle. Suppose, then, a day objective has an angle of aperture of 124°. The increase of N.A. for every 2° 30' of angle is in that part of table about ·010, or ·002 for every 30': so that as the N.A. for 125° is ·887, that for 124° will be about ·883. To ascertain the N.A. of a water or oil immersion, the number standing in column B against its angle in column A, or found by the use of proportional parts, must be multiplied by 1·33 or 1·52 respectively. For example:—Question: What is the numerical aperture of a water immersion objective whose angle of aperture is 108°? Answer: By the table, the sine of half 107° 30' is ·806; and as in that neighbourhood the rate of increase for every 2° 30' is about ·013, or nearly ·003 for every 30', the sine of 54° or half 108° will be about ·809. Multiplying this by 1·33, we have 1·068, the approximate numerical aperture of such an objective. Question: What is the N.A. of an oil objective whose angle is 151°? Answer: The sine of half 150° is, by column B, ·966, and considering that the rate of increase in that part of the column is between ·006 and ·005 per 2° 30', or ·0011 per 30', the sine of half 151° will be about ·968, consequently the N.A. = ·968 × 1·52 = 1·47. Question: An oil objective is stated to have an N.A. of 1·25: what ought its angle to be? Answer: Just as the N.A. is obtained from the number in column B by multiplying by 1·52 and by 1·33 for oil and for water objectives respectively, so the number in column B which corresponds to their angle may be found by dividing by 1·52 or by 1·33. Then 1·25 ÷ 1·52 = ·822. But by reference to column B it will be found that ·819 corresponds to 110°, and that the rate of increase is there nearly ·013 per 2° 30'; so that the angle ought to be rather less than 110°. Question: To water and oil immersions, of what aperture should an air objective of 135° theoretically correspond with respect to light, penetration, and resolving power? Answer: The N.A. of such a dry objective is ·924 by column B. As to the water immersion, then, ·924 ÷ 1·33 = ·695; and as to the oil, ·924 ÷ 1·52 = ·608. By inspection of the nearest numbers to these in column B, it will be seen that the angle of the water immersion would be 88°, and that of the oil somewhat less than 75° (more exactly 74° 52').

The resolving power of objectives also varies with the kind of light wherewith they are used. The number given above—964 dots or striæ per inch for every ·01 of N.A.—is calculated for light coming from about the middle of the spectrum, and having a wave-length of ·5269 μ, or of rather more than half a micromillimètre. This is about a fifty-thousandth part of an inch, a millimètre
being ·3937in., or rather less than a twenty-fif
an inch, and a micromillimetre or μ being a
sandth of a millimetre. The resolving pow
creases as the wave-length shortens, so that i
violet, whose vibrations are ·42μ long, it is
greater than in the red, where the vibrations
a length of ·62μ or more: but everyone
speak of his own objectives and his ow
of them, and I confess that in what
I have made with light which I hav
tempted to get of a single wave-length, I hav
more by vagueness of illumination than I
gained in other ways: and whatever light a
uses, he must not expect the actual perform
an objective to equal its theoretical capabi
for this would suppose two impossible thing
ideally perfect objective and an ideally p
microscopist. High-angled glasses are more
cult to use than low-angled, because they
more oblique light. They are also more diffic
make of the same degree of excellence.
nose of an objective be unscrewed—a process
is not generally advisable—the inner or u
facing surface of the front lens, which is
into it, will be seen to be convex, and the b
the angle is the more the bead thus forme
proaches to being a sphere. A low-angle
jective transmits the light to the eye
from near the summit of this bead:
in one of higher angle it is sent also
farther down the sides, the back lens of the
tive being broader, or being situated so as to g
up the rays and transmit them to the eyepiec
a low-angled lens, therefore, only the summ
the bead and the neighbourhood of it need
accurately worked to shape, the more sloping
of the sides being cut off or fixed in the brass
or the light from them being arrested by a
which allows only the rays from near the mid
axis of the object-glass to pass upward. But
high-angled objective the back surface of the
lens has to be worked true down this slope, a
further down the greater the angle. This
course, more difficult, and consequently high-a
lenses are apt to be more deficient than low-a
in the exactness with which they bring to a
all the rays from every part of the glass. I
made with correspondingly greater care, ther
they are likely to be lacking in colourles
definition, or both, even though, in virtue of
greater angle, they show closely-set dots or
which a lower angled objective with sharper d
tion will not exhibit. What is called defini
the most valuable power of showing outlines
the margins of diatoms as lines, and not as b
and it frequently happens that a high-a
objective will through its aperture show d
striæ on difficult diatoms; but will show them
in an indistinct, a glaring, or a milky field, w
outlines, those of the edge or of the midrib
dull and vague, and where, consequently, deta
structure—other than dots and striæ—are dim
or even indecipherable. This milkiness and
distinctness, however, may arise apart from
fault in the objective itself, merely because it
not been properly "adjusted to cover," and a s
movement of the screw collar will often b
matters right in the most striking way. H
angles need a screw collar more than low a
and, finally, high angles, *cæteris paribus*, f
nearer the covering glass and the object.

Francis Gran

AN EASY METHOD OF MAKIN PERFECT PLANES.

[24767.]—HAVING tried to work pe
planes by hand, and failed (probably through
of experience), I made a machine to work t
This machine has been so successful, both a
gards working perfect surfaces and shortening
process, that I am sure many of my brother
teurs in optical work will like to hear of it.
ordinary method of procedure was to grind
three glass plates, either upon each other or t
metal discs, laboriously scraped to fit a Whitw
surface plate. This was done to get rid of
irregularities which exist in all pieces of ordi
plate glass. The glass plates were then to p
and figure, and I am sure that everyone who
tried it will agree that it is most tedious w
However, with the little machine I am abo
describe, the fine grinding and consequent po
ing is done away with, all that is necessary b
to secure the plate of glass in the machine
proceed at once to figure it.

The machine is mostly made of wood, and in
a manner that anyone can make it or ge
made for a few pence. The wheels
Fig. 1) A and F, and the face-plate D.
made of hard wood in this manner: A suit
piece of wood is bored to fit tightly on to a s
piece of ¼in. gas-pipe; the wood is then turned
on the pipe; the wheels work on three
spindles driven into the bed of the machine.
gas-pipe of the wheel F is wrapped with wa
thread at P to prevent the band slipping.
guide C is made of a piece of strong gath i
with a piece cut out at the end L, so as to al

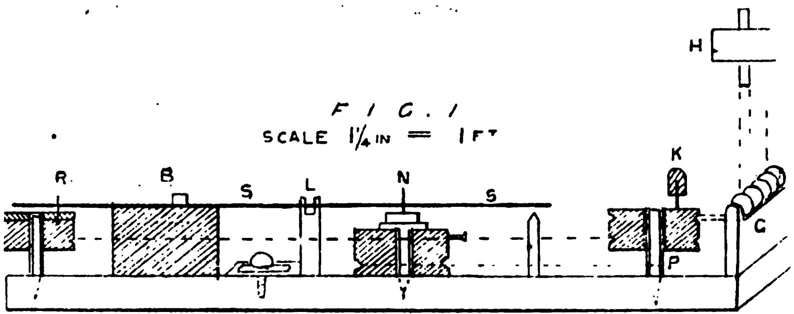
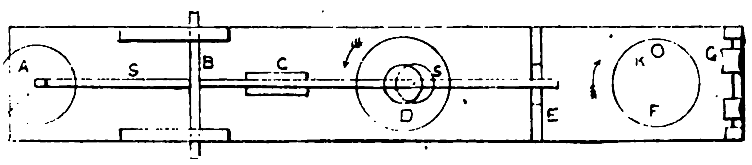


FIG. 1. SCALE 1¼ IN = 1 FT

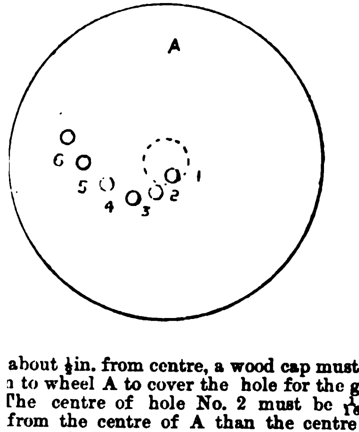
FIG. 2.



S to slide easily through it; the lower the guide has a slot in it for adjusting, and ped to the bed of machine with a small screw. At G are two fairleader pulleys cotton-reels) to take the band from pulley pulley H, which is fixed on end of a slowly ıg shaft in a manufactory, the pulley H f such size as to cause machine to make) strokes a minute.

amateur cannot get his machine turned he rforce have to turn it by the handle K. nust be drilled on face of wheel A for the in R, as on Fig. 3; and as hole No. 1 will

FIG. 3.



about $\frac{1}{8}$in. from centre, a wood cap must be n to wheel A to cover the hole for the gas-The centre of hole No. 2 must be $\frac{1}{16}$in. from the centre of A than the centre of . 1, and the same for holes 4, 5, 6. The (Fig. 1) is to keep the rod S steady; the is of iron, $\frac{1}{8}$in. broad and $\frac{1}{8}$in. thick.) $\frac{3}{16}$in. diameter is drilled through N for the pin at the back of the to pass through, and it must have position on S that the polisher will be moved istances on each side of the centre D. Sup-the glass discs are 2in. in diameter, the s must be 1$\frac{1}{8}$in. and 2in. in diameter re-ly, and must be of lead, $\frac{1}{4}$in. thick. The s must be coated with pitch, $\frac{1}{8}$in. thick, and ve each a pin fastened into the back (see about $\frac{1}{8}$in. in diameter. The pitch must ree grooves made in it with a straightedge, g. 5. The top of the polisher must not e $\frac{1}{16}$in. below the underside of the rod S. isher will rotate very steadily on turning chine. The method of holding the glass the face-plate is in principle the same as d by that teacher of teachers, Mr. H. A. , of Stourbridge, for specula. Four tacks . 6) are driven into the face-plate, each dis-in. from the centre. A piece of strong tied to tack No. 4, passed round 3, 2, and 1, d to the wood screw Z, which has a small lled through it. The glass T rests on a wet cloth; and having put the glass in its e screw 2 is turned outward until the string iently tight to hold it in place. Having d three circular pieces of glass, 2in. in dia-nd $\frac{3}{8}$in. thick, choose the three best surfaces ng with the colour test. (For a full expla-f this beautiful test, see a letter by our end, Mr. Brashear, of Pittsburg, on p. 99, L. of ENGLISH MECHANIC.) Scratch with a file on the three worst surfaces the numbers 1, 2, 3, to distinguish them. Having formed the small polisher on disc No. 2, put No. 1 on the face-plate, and adjust the guide C, so as to move the polisher $\frac{1}{16}$in. over each side of the glass, and place the crankpin R so as to give a stroke of 1in. (i.e., to move edge of polisher $\frac{1}{4}$in. over edge of glass). Now polish, using rouge and water for about two hours. By this time all the irregularities will have disappeared, and with the polisher stroke given above, the surface will be slightly concave. Now polish disc No. 2 *for the same length of time* as No. 1. By this time the

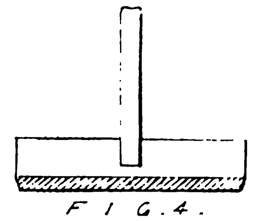
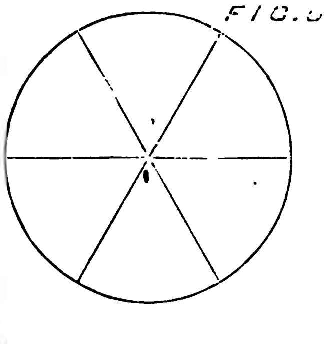


FIG. 4.

irregularities will probably have disappeared, and on testing 1 and 2 together the surfaces will be found to be regular concaves. All that is now wanted is to depress the edge until the surface is flat. To do this, form the large polisher on No. 2, and put No. 1 on the face-plate, and without altering the stroke, polish for 40 minutes. Then polish No. 1 for the same time, and again test them together. The concavity will be found to have diminished. Now move crankpin R one hole farther from centre, and again polish for 20 minutes, and test as before. Probably the discs will be now almost corrected, and a few more polishings will finish them without having to lengthen stroke again. When the con-

FIG. 5.



cavity is very small, each disc must be polished only for a few minutes. When the discs show the parallel bands, or one tint all over the surface, cease working them, and proceed to work No. 3 in the same way. As the parallel bands might be produced by a perfect concave and perfect convex, a third is necessary to test them with. Most probably, however, all three, when fitted together, will show the parallel bands (mine did) without farther correction. If not, they must be corrected by a few minutes' polishing with the large or small polisher, or by altering the stroke as required.

To give an idea of the rapidity of the process, I may say that I finished disc No. 3 in three and a half hours. A word about testing the flats. To test, wipe the discs with a clean cloth, then pass the surfaces over the back of the hand, now hold them up before your face and blow sharply between them, then put them close to your ear, and close them together. If you hear the slightest sound of grit, repeat the process until the surfaces close without any noise. Put the discs on a piece of wood for some minutes to regain equality of temperature, and then lift them up on the piece of wood to examine them. Do not hold them in the hands. Do not jump at once to conclusions about the figure of the flats. Two perfect planes will present the following appearances, which are dependent on the thickness and regularity of the film of dust particles separating the discs: Firstly, the discs may show one tint all over the surface; this shows the discs are in very good contact, and are optically perfect. Secondly, the discs may show the broad parallel bands if in good contact, or narrow parallel bands if not in very good contact; this also shows optical perfection. Thirdly, the bands may be irregular, showing that the dust particles are uneven. Care must be taken not to use too long a stroke, or the edge of flat will be turned down. This process is so simple and so thoroughly under control, that anyone who follows out these instructions will be able to make perfect planes with the utmost ease. If anyone tries it, I hope he will make known the results in "Ours."

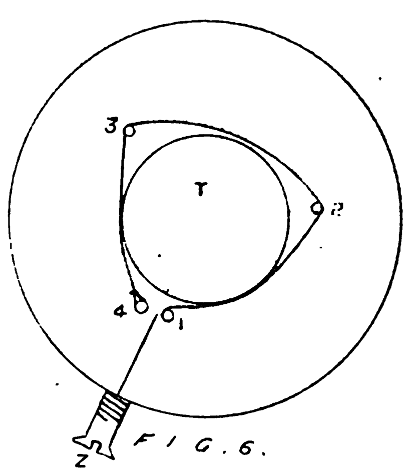


FIG. 6.

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WHAT IS "CREATION"?

[24768.]—IN letter 24729, page 31, "F.R.A.S." has given us a definition of the term "creation," as he understands it. For my part, I would rather have had his definition of the term "evolution"; but he may perhaps yet favour us with this also. I think, however, that in stating precisely what he understands by "creation" he has, by removing any cause for misapprehension, done well.

He seems to imagine that in my communications on this subject I have been confounding "creation" with what might be called "construction," and his reason for imagining this appears to be that he restricts the use of the term "creation" to *matter* only. Now, I may explain that I do not so restrict its application. If any case can be instanced of the appearance of an object—in so far as we can judge—*ex nihilo* as regards the matter of which it exists, then I agree with him that such an appearance could be described only as a "creation." But suppose that some new *energy* similarly appeared without having been transformed from any of the energies known to us, I would call this also a "creation," and I would like to know whether or not he would refuse it the name? I have further applied the term "creation" repeatedly, and that, apart from the *matter* in which these became evident, to the first appearances of new and previously non-existent characters, whether mental or physical without evoking dissent from "F.R.A.S.," even though in letter 24408, page 367, I asked him directly whether or not he took exception to it.

We have every reason to believe that during the progressive history of our planet, new and previously non-existent organic forms and characters have constantly appeared, and are appearing, in a manner inexplicable by "Natural Selection." Such first appearances I have ascribed to "Creation," without for one moment supposing or suggesting that they consisted of, or sprang from, matter which before had no existence in our material universe. If "F.R.A.S." or other correspondent can suggest how otherwise these may have been brought about, why not openly declare it?

Until this can be done, I hold that seekers after the truth stand upon more exact and scientific ground when they either refer these difficulties directly to "Creation," as I have defined it, or manfully and prominently acknowledge the insufficiency of "Natural Selection" *per se* to account for organic nature, than do those who, to screen their ignorance, ascribe the phenomena to a so-called theory of "evolution," which they cannot define, resting content with such reference as a complete and sufficient explanation. **H. B. F.**

[24769.]—THE dictionary defines it as the act of making something out of nothing; but as action can only result from a centre, and a centre is something, the definition is wrong—that is, no argument can result from nothing. Take a mineral solution: it only crystallises at a normal or central temperature, which is its visible creation. Yet we may know it is there in a higher or lower temperature by taste, scent, &c., which, however, are derived from the independent centre from which all the properties of the mineral are evolved. Take a vegetable seed, or animal egg: they are all subject to this central temperature, higher in some, lower in others, without which life is subdued or quiescent; but not for long, for as the centre changes so does the temperature, and the lesser the temperature the more insignificant are the morphological changes. Yet the centre is independent; cut and analyse the seed, egg, or protoplasm, the interior centre cannot be found; it is too deep. The most developed seed is the onion, and notwithstanding its regular formation, its real centre of creation, both past, present, and future, is hidden. I fail to see anything mystical or spiritual in this, unless, indeed, a ghost of an onion is in the market for credulity to stare at. For why should our romancists stop at the vertebrate class? Why not terrify the vegetable and mineral world? But no—for as "heat is under the special guidance and government of the nerves" ("Foster's Physiology"), and as vegetation is not a recipient of a higher natural (?) heat, we must not expect much sensibility in this direction—very slight indeed. So much for temperature; but the same can be said of all other natural phenomena—viz., they all proceed from a centre, and exist by contrast or opposition. In my last letter I left a breach, which I hoped would have been entered by someone. It would have been a friendly visit, and I should have taken it as a kindness, as at present I am all alone. I quoted Goethe: "Matter can have no existence and be in motion without mind, and neither can mind exist without matter." He should have said, "neither can mind exist (*and be in motion*) without matter." Here we have a contrast. How so? In the different motion. Now, directly we admit an ingoing and an outgoing current in brain or nerve function (*vide* Bastian, "The Brain an Organ of the Mind"), we must also admit a centre to come to and depart from. Yes, a material and mental centre, with a different motion or current for each. You cannot tell what particular part of the brain is the centre: it might be the foot or great toe, for the brain extends to all parts, being the centre of a universal centre. Haven't you ever thought with your hand? I have. Physiologists call this a reflex action; but this is rather tame when they experiment on a headless or brainless frog. You see the centre is universal in the individual, and there must be action and re-action in every part, even to the most minute. This ought not to be a revelation to scientists. Surely they must have seen that the motion of life from a centre is directly opposite to the motion of matter from the same centre. For example, let us take temperature. Our normal degree is 54°. A Polar bear or East Indian would have it different, and blood heat varies from the highest to the lowest organism. Now, as we depart from the centre, no matter how many or few degrees it originates, we see two opposite kinds of vibration or motion which can extend to infinity, but the centre is the only place or form where extremes meet. Heat or rapid vibration diffuses and radiates, while cold coagulates and contracts—quite a different action from the same temperature. Then suppose Goethe had said: Heat can have no existence, and be in motion without cold, and neither can cold exist and be in motion without heat—he would have been correct, but only because heat and cold are dependent for their production on a universal centre having its degree impressed on the most minute form as well as on the whole, yet quite independent of the individual form, which has its beginning and end to and from the centre. The motion or action of the body or matter is external or outward, while that of the mind is internal or inward; yet they both act from a universal centre which is the life of the creature created in a form for use both bodily and mentally two in one. All this is mechanical and nothing mysterious, as take a table, chair, lathe, &c., the material comes from the centre where it grew, and its form from the central mind of the workman. These are inanimate objects, yet all subject to the universal centre for material, design, measurement, and form. In conclusion, can you show anything that does not proceed and has its existence from a centre? **Fiddler.**

[24770.]—IN reading over the letters which have appeared in "Ours" on "What is 'Creation'?" I fail to see why creation should be so much objected to, because whatever evolution may explain, or *seem to explain*, it does not do away with the necessity of creation, unless evolution means that things began to be of themselves. Now Darwin, in his "Descent of Man," p. 65, says: "The question whether there exists a Creator, or Ruler of the universe, has been answered in the affirmative by the highest intellects that have ever lived." And Mr. Herbert Spencer, Darwin's "great philosopher," speaks in his later works of an "infinite and eternal Energy from which all things proceed." That looks very like creation and belief in a Creator. Besides giving evolution its utmost due, it only puts the handle a little further back; for after all said and done, the enigma is still unsolved, "Did the fowl or the egg come first?" or why should two animals fed upon the same pasture, oil-cake, and roots, produce in the one case beef and in the other mutton, if there was no special creation?

Dens.

RAILWAY TRAFFIC RETURNS FOR THE YEAR 1884.

[24771.]—THE publication of the returns relating to railway capital, traffic, and working expenses for the year 1884, together with the statements of the chairmen at the half-yearly meetings, have once again directed special attention to the decline of first and second class traffic and the increase of third, also to the decline in goods traffic. The total capital shows an increase, the receipts a decrease, and 183 additional miles of line have to be worked, consequently a decline in dividend must result.

The following tables give the summaries of the returns for the year 1884, and it will be noticed that even in the present depression of trade the third class shows an increase both in numbers and receipts.

The total receipt per train mile was a little over 4s. 11½d. (59·56), and the working expenses 2s. 7½d. (31·59), showing a net profit of nearly 2s. 4d. (27·97) per mile.

MILEAGE.

Number of miles run by passenger trains	143,144,694
Number of miles run by goods and mineral trains	126,682,783
Number of miles run by mixed trains	2,985,743
Total	272,803,220

PASSENGER TRAFFIC.

	Number of journeys.	Receipts.
First-class passengers	34,582,539	£3,481,017
Second " "	62,265,220	3,105,008
Third " "	598,144,101	17,606,040
Season tickets (766,691)	"	1,763,491
Excess luggage, mails, &c.	"	4,074,894
Total	694,991,860	£30,030450

GOODS TRAFFIC.

	Weight in tons.	Receipts.
Goods traffic	75,712,330	£20,879,968
Mineral	183,615,556	15,528,656
Cattle, &c.		1,237,780
Miscellaneous		24,188
Total	259,327,886	£37,670,592

MILES OPEN.

Miles of railway open 31st December, 1883	18,681
" " opened during year 1884	183
Total miles opened 31st December, 1884	18,864

		Increase.
Number of locomotives	14,827 =	358
Number of passenger carriages	33,031 =	727
Number of vans, waggons and all other vehicles (not including private traders' waggons)	479,695 =	21,338

CAPITAL PAID UP AND RAISED.

Ordinary	298,983,446	
Guaranteed	95,603,613	
Preferential	205,809,234	
Loans	14,793,420	
Debenture stock	186,274,654	
		Increase.
Total	£801,464,367 =	£16,513,055

RECEIPTS.		Increase of
From passenger traffic	£30,030,450 =	£521,717
		Decrease of
" goods "	37,670,592 =	1,030,727
" miscellaneous "	2,821,601 =	30,617
Total	£70,522,643 =	£539,627

WORKING EXPENSES.

	Total.	Cost worl per in pe
Maintenance of way and works, &c.	£6,622,539	5·
Locomotive power	9,465,793	8·
Rolling stock	3,399,397	3·
Traffic expenses	11,279,062	9·
General charges	1,636,595	1·
Rates and taxes	1,937,691	1·
Government duty	398,577	0·
Compensation for personal injuries	183,657	0·
Compensation damage and loss of goods	202,400	0·
Legal and Parliamentary expenses	323,900	0·
Steamboat, canal, and harbour expenses	1,305,415	-
Miscellaneous	461,798	0·
Traffic expenditure not classified	52,343	-
Total	*£37,217,197	£3 [=2s.

(* Exclusive of £52,060 received by North Lo for working other lines, but included in al figures.)

			Decrea
Total receipts as above	£70,522,643	=	£53
Total working expenses as above	37,217,197	=	15
Net profit therefore	33,305,446	=	38

Number of miles run by passenger trains	increase	4,96
Number of miles run by goods and mineral trains	decrease	1,31
Number of miles run by mixed trains	increase	24
	Total increase	3,90

	Numbers.	Rece
	Decrease.	Decr
First-class passengers	1,805,338	£18
Second-class "	3,831,564	22
	Increase.	Incr
Third-class "	16,910,625	53
Season tickets	144,641	7
Excess luggage, mails, &c.		30

Passengers, three classes,	increase	11,273,72 num
Goods, &c.	decrease	1,185,026 t
Mineral	"	5,870,056
Total	"	7,055,082

Attention should here be directed to a important question, which must, at no very dis date, be practically considered. The writer re to the increase of train miles, and the decrea receipts per mile. With a decline in business, certain that competition becomes much more se but it is a mistake to run useless mileage certain trains, simply for the sake of nom competition. During the year 1884, the passe mileage was increased not less than 4,967,754 m There is great reason to believe that a large por of this extra working is due to the running of trains, which do not pay half or even a quarte the working expenses; indeed, the writer figures and proofs that there are trains run which do not average six passengers, and, as a are composed of six vehicles. Again in co quence of the number of empty first and se class compartments on trains, the total weig needlessly increased, often causing the runnin two engines. The writer is of opinion that reducing the number of useless empty trains, the removal of empty carriages from other tr working expenes can be very considerably red without curtailing the accommodation give the travelling public.

Sept. 8. **Clement E. Stretto**

CORRECTING SCREWS.

[24772.]—IN regard to Reichel's method correcting screw-guides, which you kindly lished last week, may I now appeal to our prac men to give us the methods employed in Eng practice to remove that form of error know drunkenness?

I think I remember that in cutting long s a die is sometimes fixed as a kind of trave stay, opposite to the V-tool, and called "the do That die should act partly like the guid Reichel's arrangement, first process, except th does not control the traverse. Have no friends noticed that when they put the stock dies on to a lathe-cut screw, the handles of stock advance with a slight see-saw-like movem the very slight drunkenness being magnified the length of the handles?

I hope "J. K. P.," Mr. Wenham, and others think the subject worth their attention.

F. A.

. 61 ANDROMEDÆ, &c.—HYGINUS -DOUBLE STARS—TO MR. GAUDI- RT.

773.]—I SHALL always be happy to supply
owsett (letter 24699, p. 11) with any infor-
n in my power on the objects he may refer
. II. 61 Andromedæ: I found the *comes* about
g. in Herschel's scale in the autumn of 1875.
s seldom been measured, the only results
n to me being Dawes's, as quoted by Smyth,
urnham's. I do not think there is any prob-
y of its being variable. I saw it easily with
the other evening. P. xxi. 1 Cygni (Σ 2762):
h mentions the nearest *comes*, the one *s.p.*
his Dembowski gives 225·1° 57·7″, 9·2 magni-
and observes, "Ve n'è una quarta, ma è
o lontana"; Franks's distances are under-
Σ 2666 Cygni: Dembowski says, "1867·697
culare 210 vedo due stelline di 10ª a grande
za, ed una doppia esigua seguente." Power
d a field of 8·8′ diameter. No measures of
very distant stars are known to me. I do
now of any star near the *comes* to Vega at
140″ ±; but there are doubtless many little
about there. Mr. Dowsett does not say *how*
o the *comes* his suspected star is.
ht I ask "F. R. A. S." (letter 24729) to
y reperuse Mr. Neison's article on Hyginus N.
e *Astron. Register* for September, 1879? I
Mr. Capron forgets that all editions of
r's map were most carefully examined by
and Schmidt; moreover, the copy of Mädler's
e refers to exhibits any amount of "novæ"
er the moon. My own idea is that the map
estion was probably swallowed by some
ious turtle in Ascension, and rescued by Dr.
fter a severe fight, in which the map suffered.
however, is merely an hypothesis.
star near O Σ 371, mentioned by Mr. Gaudi-
n letter 24735, p. 32, is probably too faint and
t to have been noticed by any double star
ver. O Σ measured on one evening a distant
at 267·8° 47·8″, which is the star mentioned
elestial Objects." Struve occasionally mea-
prominent stars of this kind when within
a close pair; but he would ignore any faint
t a much smaller distance.
367 has probably closed up slightly since its
ery by Σ; but there has been no change in
gle. Σ gives 65° 0·4″ ± as the mean of three
' estimations in 1832 and 1834; he never
d the stars. In Σ 0·4″ answers to a real
ce of 0·52″. O Σ's last measure in 1866 is re-
l by him, as the stars were not seen divided,
he distance is misprinted 0·53″ for 0·33″ in
ill. De could only get vague elongations
ds 79° and 68° in 1862 and 1866 with powers
d 670. In 1869 he judged it to be single. As
ars are nearly equal, Schiaparelli's angle
l be diminished by 180°. The star was, of
, only slightly elongated at Milan. Perrotin,
e, found the disc elongated "d'une manière
e sensible," with a power of 1,000 on the 15in.
3. The latest measures are Engelmann's, who
62·1° : 0·22″ : 1883·94. As Mr. Gaudibert will
e change, if any has occurred, is only in the
ce. I am astonished that he should see it
ted with so low a power as 370 on 8½in. I
able to identify the pairs near β 54 (Σ 2557).
. Gaudibert would give the approximate dif-
es in R.A. and Dec. between any new pair
ds and some known object, I should have a
chance of being able to identify his *novæ*.
he same field" is a trifle vague, as the field
e 50′ diameter or only 5′. β 144 and 145 are
but cannot be Mr. Gaudibert's pair, which
faint and insignificant. I saw the objects I
Mr. Gaudibert with my 6½in. Calver, a power
0 being usually employed for this class of
I cannot help thinking that many of Mr.
ibert's elongations of extremely close double
are due, as he mentions, to a prior knowledge
positions of the *comites*. The following list
se pairs will, I hope, be of use to him. If he
ongate Σ 2367, he should see these easily. I
he approximate places for 1885, so that I hope
ll have no trouble in finding them; but I
ask him not to refer to catalogues giving
ngles and distances until he has looked them
I give the magnitudes of the bright stars of
irs, but no angles or distances. All the latter,
ver, are under 1″. In none of the pairs does
equality exceed two magnitudes.

	h.	m.	s.		°	′	mag.
1.	19	15	42	+	35	20	
2.	19	52	23	−	2	32	7·2
3.	20	1	21	+	12	37	7·2
4.	20	16	4	+	45	0	7·0
5.	21	10	7	−	9	42	7·0
6.	21	34	8	+	57	1	
7.	21	53	47	+	60	45	7·0
	22	6	16	+	39	37	7·9
9.	23	45	46	+	41	29	7·5
10.	23	55	32	+	39	0	8·5
11.	4	19	52	+	15	21	5·0
12.	11	47	32	+	74	24	6·5

1 is one of the stars composing an 8·0 and 8·7 mag. pair, 10″ apart. No. 6 is one of the stars composing an 8·2 and 10·0 mag. pair, 7″ apart. No. 9 has a faint *comes n.p.* No. 11: this is 71 Tauri. The places are probably correct to the nearest minute of arc, and there should be no difficulty, therefore, in finding the objects. I mention this as Mr. Gaudibert seemed to have some trouble in finding some of the objects in former lists.

Sept. 14. **H. Sadler.**

THE ANDROMEDA NEBULA.

[24774.]—THOUGH ordinary observations with "common telescopes" of this latest celestial wonder are not, perhaps, likely to be of much service to science, except so far as they relate to the photometrical branch of the subject, I may be permitted to say a word or two about the nebula, as last winter it was frequently examined with a view to trace the details described by the late Rev. Prebendary Webb in the *Intellectual Observer*, vol. iv. p. 346, and consequently I am the more impressed by the marvellous change that has taken place during recent months—a change that is not only evidenced by the appearance of a bright star-like nucleus; but which is palpable in the more luminous portions of the nebula itself, which instead of showing signs of gradually increasing condensation from the border towards the centre, as was formerly the case, seems to be of uniform texture for some distance round the Nova, while in the immediate neighbourhood of the latter it appears to be less condensed, so that the star stands on a comparatively dark background. These observations were made on September 7th, 9th, and 11th, with an 8½in. Calver reflector, with eyepieces magnifying from 40 to 280, one of the so-called canals being easily seen on each occasion. On 11th September there appeared to be a faint brush of light attached to the Nova on the following side, which was at first thought to be due to the eyepiece; but as it was persistent under various powers, and was also visible in my 4in. Cooke refractor, it probably answers to the "knot of light" recorded by Mr. Tarrant (letter 24733). **Thos. Gwyn Elger.**

Kempston, Beds, September 12.

[24775.]—DURING the past week I have carefully observed this object and the nebula in which it appears to be set. The former certainly is well defined, and looks very stellar in the midst of its cloudy bed. With this gem in the near centre, the nebula altogether wears the appearance of a new celestial object; but, as its former leading feature, *the nucleus* remains conspicuously in the same position intact, the nebula proper looks unaltered. The nucleus is less prominent and less luminous, arising, no doubt, *en contraste*, from the greater brilliancy of the new-comer. This star, being devoid of diffraction rings, appeared to me to result from its position, either in or having the nebula as a background, the soft hazy light of which, in either case, would entirely destroy the usual accompaniment of rings surrounding fixed stars, as seen in the telescope. The star would thus assume a planetary disc with steady light. As to the locus of this star, the inference arrived at very naturally is, that it is situated *in media* of the Queen of Clouds. But why place it at such a remote distance, where stars, as yet, defy resolvability? The fact of its appearing so large as a star of the seventh magnitude, would support the hypothesis that it and the nebula are in no way connected. May it not exist in space between us and the nebula? To place it inside the nebulous region pre-supposes the existence of a globe of far more gigantic proportions than any yet conceived. Hitherto as nebulæ have been resolved, their component stars have been scattered over the field of vision as infinitesimal dots of light closely packed resembling star dust; but in no instance has any star been seen in their midst of a size that will at all compare with any standard of magnitude that has yet been adopted. Isolate it from the nebula, consider it as a temporary star infinitely remote from the earth, yet infinitely nearer us than the nebula; and the conjectures as to the cause of its appearance are greatly simplified; but place it where the nebula is, and a multitude of difficulties arise that will be insoluble.

I will not intrude more on your space, as sufficient has been indicated to draw attention to that one point which I have nowhere seen mentioned—viz., that the new star is located between the earth and the nebula. The telescope has been a Calver 6½in reflector, with powers varying from 80 to 450.

Southampton, 13th Sept. **S. S.**

THE NEW STAR IN 31 M. ANDROM.— THE NEBULA IN THE PLEIADES.

[24776.]—THE first opportunity I had of observing this marvellous object was on the evening of the 4th, and, like most other observers, was greatly astonished at the change that has taken place; my experience has been the same as Mr. Ingall's (letter 24730). With a high power (500) that part of the nebula preceding the new star appeared so much decreased in lustre as to become almost invisible, whilst that portion following the new star was apparently brighter than usual. The probable reason of this, as Mr. Ingall has pointed out, is that the new star has not appeared in the centre of the old nucleus, but some few seconds preceding it. It occurs to me, in consequence of this, to suggest the question whether this new star is really situated in the body of the Andromeda nebula, forming part and parcel of its substance, or whether it is not possible that a pre-existing faint star, in the same line of sight as the nebula (but whose light has been overwhelmed by the lustre of the nucleus of the latter, and thus rendered invisible) has not suddenly blazed out? Its present conduct certainly bears some resemblance to those new stars which have appeared from time to time, in the rapidity with which it has brightened to its present magnitude. This star will now, of course, be watched very closely, and if it should, after brightening still more, gradually dwindle again into invisibility, instead of remaining permanent, I think it will tend to support the hypothesis I have ventured to put forward. Of course I am aware that at present the spectroscope has pronounced it to be the same in spectrum as the nebula, and further, to my sight at least, it bears a resemblance to it in its colour. Still, I mention the idea for what it is worth.

There is a faint star situated in the nebula, south and a little preceding the new star. Can anyone kindly inform me of its magnitude? It is held easily with a low power on my 12in. Calver reflector.

As the subject of nebulæ is now likely to receive a considerable amount of attention at the hands of astronomers, the question of the existence or non-existence of a nebula near "Merope" in the Pleiades is one which it is well worth while trying to solve. In Vol. XLVIII. Part 2 of the *Memoirs* of the R.A.S. is an interesting and valuable paper by Prof. Pritchard, "On the Relative Proper Motion of 40 Stars in the Pleiades," in which it is incidentally mentioned that, during the whole course of the observations of this group, in which two telescopes, one of 12½ and the other of 4in. aperture, which were supplemented by a third, the De la Rue reflector, of 13in. aperture (specially used for this purpose) were employed, "no trace of the nebula was as much as suspected." Against this we have equally positive observations as to its existence given by Webb in "Cel. Objects," p. 399. Small telescopes seem to have a better chance than large ones with this object. Can any of our readers add anything on the one side or the other?

Sept. 14. **W. Goodacre.**

THE NEW COMET.

[24777.]—THE comet discovered by Mr. Brooks was seen here on the evenings of the 9th and 11th very near γ in the constellation of Boötes, and on the 11th it was well within a triangle formed by γ, β, and λ. The telescope used is a Dollond, 3½in., and with this sized aperture the comet is at present difficult to pick up.

Hendon, Sept. 12. **P. F. Duke.**

THE S.S. "ARAWA'S" REMARKABLE RUN TO NEW ZEALAND.

[24778.]—I HAD the pleasure of being a passenger by the Shaw, Savill, and Albion Company's noble steamship *Arawa*, on her recent (second) voyage from Plymouth to Tasmania and New Zealand, when she accomplished the unprecedented feat of steaming from Plymouth to Hobart in 35 days 7½ hours, and from Plymouth to Otago in 38 days 30 minutes, representing an average speed of 14 knots an hour over the entire passage. Having gone home last year in the N.Z. Shipping Company's steamer *Tongariro* in the then-unequalled time of 37 days, I can show a better record than Jules Verne's "Round the World in Eighty Days," for I went round the world in seventy-five days actual steaming. This may serve to illustrate the vast stride now being made in ocean steaming, for such a feat would have been impracticable only a few years ago. It must be remembered that an average speed of 14 knots maintained continuously for 38 days is a very different affair from keeping up such a speed, or even a considerably higher rate, during the short Transatlantic run of seven days or so. The *Arawa* could easily maintain 15 or 16 knots on a short trip; in fact, she did log 17 knots in the only really favourable breeze she had in her New Zealand voyage, and ran 195 knots, by patent log, in 12 hours. The passage was characterised by persistently unfavourable winds and seas, even where the reverse might have been almost confidently counted upon—in "running down her longitude" between the Cape of Good Hope and Tasmania. So that there is nothing to prevent an equally quick or even a quicker trip being made regularly. "Except the coal bill," somebody, perhaps, will say. This, however, brings me to the main point of my letter. The special feature of the *Arawa's* recent passage was that it was accomplished on a consumption of only 52 tons of coal per diem. For a ship of over 5,000 tons at an average speed of

[illegible]

I came upon a passage which, I think, is sufficiently apropos of the subject to be quoted:—

"The phenomenon of phosphorescence is very [illegible] At Darling[illegible] [illegible] a few yards [illegible]

[illegible]

W. [illegible]

[illegible]

by hand, when contact is made the [illegible] in the opposite direction [illegible] revolves for a much smaller part [illegible] than that which [illegible]

As regards the [illegible]

[illegible]

ıg chain of forms and states of eternally
created matter.
'." commits the mistake of fastening on
election" as the only factor of evolution,
in distinctly enumerates several other
is seems no proof to me that "H. B. F."
works "carefully." **F. W. H.**

-MAY I invite our friend "F.R.A.S."
r his definition, p. 31? Is it really an
language to talk of *creating* anything
-existing material"? We must come
original meaning of the word "create."
F.R.A.S." is perfectly entitled to define
the word, and to adopt the hard defini-
Westminster Confession of Faith. But
the question whether that definition is
riginal, only, or proper meaning of the
, I submit that when a true artist is at
ork is creation—that is to say, he em-
hought of his mind in pre-existing mate-
, for instance, a marble statue; the
isted, the sculptor *created the statue*, he
to existence, for the statue is not the
rble, but the artist's thought set forth
ble. Now, that is the *very meaning of*
eation as applied to the universe. The
en to it by the Westminster Confession,
ly adopted, we must admit, is merely a
t in degradation—a product of theologi-
taphysical ignorance. We have the far
wider idea, the identical idea which I
ven as to the artist and his work, ex-
probably the oldest embodiment of
ght, the most ancient of the Hindoo
ngs. In these the operation of creating
as the embodiment of the thought or
nfinite Self-Existent expressed *in His*
substance, not as calling something into
t of nothing. Our own Sacred Writings
the fact of the expression of that will.
be light and there was light": "Let
ing forth," and so on. There is not a
ify the addition "out of nothing," nor
nsistent with the fuller statement of
es of Menu, while the only further
n the subject is perfectly consistent
hings which are seen were not made of
n do appear."
have here the link which unites to-
pposing ideas expressed by different
ese pages and held by the two classes,
terialists who will see nothing but hard
and motion, and the creationists, who
things as independent products of
. It is by the recognition of the active
living will—mind in nature—that the
becomes reconciled; and on another
ill endeavour to show how.

Sigma.

ʀAL SALTS IN DANIELL'S BATTERY.

IT is rather difficult to understand
age anyone proposes to attain by using
da in a Daniell cell, but neutral salts
nerally so employed for many years.
t was so used very soon after the cell
; but it is, perhaps, the very worst
ose, because it results in the formation
de of copper on the copper surface.
nmon-sense course is to use the salt
ttery itself generates—viz., sulphate of
n continuous working, simply means the
moval of part of the solution in the
d replacing it with water. Neither
lute acid prevent polarisation, as Mr.
ses (p. 37); in fact, there is no polari-
Daniell, unless much over-pushed, and
urs at the negative plate, not at the
ell. In fact, Mr. Brown's ideas as to
hich occur in batteries are so incom-
e will save much time and money by
what is really known. Experiment
the basis of knowledge, and the best
ing is to see for oneself what occurs.
e loss of time to try all sorts of experi-
t a principle to guide one, or to fancy
ll find out anything new by merely
as thoroughly done in the infancy of
and the results of which may be known
one.
l in the zinc cell of the Daniell has
ct—to separate the zinc from the one
, the sulphate of copper, which is in
nt for the whole action which goes on,
same time conducting the current.
est conductor, but acts on the zinc as
l circuits are set up by a deposit of
tral salts have not this defect, but are
rse conductors. **Sigma.**

DENTISTRY.

I THINK many of your readers have
my original question. I am not think-
nant that if it takes four years to make a full-blown dentist, that a mechanic in a few months can perfect himself in the trade. I wish to keep strictly to the mechanical part, and not to the surgical. It seems to me that any man who has received an engineering training by passing through the pattern, moulding, and fitting shops, is well able to do, after a little practice, the moulding or impression of teeth, the moulding and casting in vulcanite, and his fitting-shop experience will do the rest for him, in finishing and carrying out of plate work, and I am informed by a dentist that he can then earn £4 to £5 a week by making for the trade, and this requires no pass examination.

Since this discussion has been on, I have received offers from qualified dentists saying that they would make me thoroughly efficient in all mechanical work in a course of practical lessons extending over three months, in the evenings. So mechanics can judge from this what is within their grasp. A nice light employment which can be carried on at home, with an addition to their incomes.

I trust we have not heard the last of A. Mallard: he could, no doubt, tell us more; and I look for his reply to the last two letters. A series of practical papers on this subject would be esteemed by all mechanics, and it would have the merit of dealing with a subject which has not yet been thrashed out in these columns. **Mechanic.**

AUTOMATIC MUSICAL INSTRUMENTS.

[24790.]—A FEW lines for a further explanation of the action of my pianoforte player appears to be called for, as "A. S. L." has not clearly comprehended the movement in its entirety.

If notes represented by perforations in the paper had to be caught and sounded by the plunger passing under the edge of the vibrating bar only during the short space represented by its rise above their tops very frequent missing of notes would occur; but it happens that the tops of the plungers, when caused to fall out by a passing perforation in the paper, do nearly always get pushed against the felted edge of the bar, either at some portion of its rise or descent, and then instantly drop under at the top of the stroke; consequently, having time to do this during the greater part of the revolution of the crank, misses never occur, and short intervals in time are thus equalised in cases where any slight irregularities may exist in the holes in the paper music bands. **F. H. Wenham.**

COMPOUND LOCOMOTIVES.

[24791.]—I HAVE been much interested in the correspondence with reference to the above; but very little information has appeared giving the power or tractive force of these engines, so I shall be glad to see the views of others on the subject.

In the case of the large N.W. compounds the tractive force for every lb. of effective pressure in the cylinders would be, for the two h.p. cylinders, 65lb., and the one l.p. cylinder, 150lb.; this is half what it would be for two cylinders the same size. The boiler pressure is 175lb., and the average in the h.p. cylinders, when cutting off at $\frac{1}{4}$ of stroke, might be 120lb., and assuming the back pressure to be 50lb., we have 70lb. as mean effective pressure, and for the l.p. cylinder, say, 30lb. effective. This will give a tractive force at the rails of 4,550lb. for the h.p. engine, and 4,500lb. for the l.p., or a total of 9,050lb.

The G.E.R. compounds have a boiler pressure of 160lb., and a tractive force of 46lb. for the h.p. cylinder, and 96lb. for the l.p. If these figures are multiplied by the same average pressures as above, we have a total tractive force of 6,100lb.; this works out rather low for engines of that size.

I have taken these figures for the purpose of comparing the two types of compounds, and so far the N.W. engines seem to have half again as much power as the G.E.R.; but having heard that Mr. Worsdell's compounds are really working more economically than the ordinary class, are very good at speed, and start more readily with a heavy train, this being accounted for by steam direct from the boiler being admitted to the l.p. cylinder when the other is on the dead centres—more than has been said of Mr. Webb's.

The N.W. engines have every advantage on their side—viz., more heating surface, larger cylinder capacity, and higher boiler pressure.

However, I hope someone better acquainted with the facts will be good enough to enlighten us.

E. L. P.

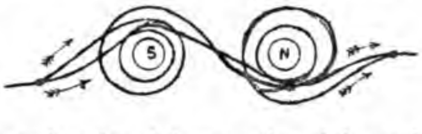
THE total energy stored up in gunpowder is about 340,000 kilogram-metres per kilogram of powder, or, in English measure, a little under 500 foot-tons per pound of powder. The potential energy of 1lb. of gunpowder is, as nearly as possible, one-tenth that of 1lb. of coal, and one-fortieth of that of 1lb. of hydrogen. It is not even equal to the energy stored up in the carbon which forms one of its own constituents.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[56649.]—**Extra Currents and Testing by Received Currents.**—You say, I do not see in his ("Experimenter's") illustration where the neutralisation takes place. If the wires, in the first case, be pulled off the legs of the magnet and bent into a perfect circle, it will be found that the extra current in one half of the circle helps the other half travelling round the whole circle opposite to the hands of a watch; but in the second case one-half of the circle will be clockways, and the other half opposite, clearly opposing each other. Again, you say, if the only circuit current for the extra current was as shown in the sketch, through the coils, I could understand the neutralisation; but there is the outside circuit current. Where do you expect to find the extra current but in the coils of the receiver? The battery current passes through transmitter line to distant receiver (there is no extra current up to this point); but directly it enters the receiver coils the extra current commences its work. You are quite right with regard to the action of the extra current on the automatic receiver relative to the prolongation of signals; also, I agree with you that *all* the extra current may not be suppressed; but every little is a help when working at 400 words per minute. The basis of testing by R.C. you will find in "Kempe's Handbook of Electrical Testing," p. 445.—EXPERIMENTER.

[56649.]—**Extra Currents, &c.**—That two currents in the same direction, meeting at a point, can neutralise each other, as "Experimenter" of a few weeks ago pointed out, is certainly a property of current electricity hitherto unknown. His explanation of testing resistances by the strength of received currents is also very clear. The coils of a fast-working relay or Wheatstone receiver are wound differentially—that is, with two equal and separate wires side by side, which are joined up in multiple arc thus. This arrangement does not lessen the action of the magnetism of the core in producing extra currents; but a current, in starting to flow in one direction in a wire, tends to induce one in the opposite direction in a parallel wire, so that each induced current tends partly to cancel the other. It will be seen that though a longer time will be required to magnetise the core to a given strength, the core will demagnetise more rapidly, which is more important. It has been found in practice that an increase of speed is gained by this arrangement. A tangent galvanometer is adjusted (by means of a movable magnet) to give a deflection of 49½° with 50 Daniell cells or their equivalent through a resistance of 20,000 ohms; then a current is sent from the distant station with the 50 cells through 10,000 ohms at each end of the line, and the strength of the current is noted on the tangent galvanometer. If we got a deflection of 49° the insulation resistance would be infinite (not 49½°, because in this case we have the resistance of the line in circuit too); if the deflection is less (reckoning in tangents), we know that the amount of leakage is greater, or, what is the same thing, the insulation resistance is less. A table is supplied which gives at once the resistance corresponding to any deflection, which, multiplied by the number of miles, gives the insulation resistance per mile. These tables are worked out from a formula which may, I believe, be found in "Kemp's Testing," with its proof. Of course, any partial disconnection on the line would weaken the current; but the lines are tested regularly for conductivity, and also if any fault of this description came on it, would be noticed in working, so that in practice no error is made thus.—W. S. H., Manchester.



[56649.]—**Extra Currents, &c.**—I overlooked this question put to me, and having been much away for some time, have only lately gone over the arrears of reading questions and replies. I fully agree with the ideas expressed by "Telegraphist," and consider that the effect of the multiple arc winding is not to entirely do away with the extra current of an electro-magnet, but to greatly lower its E.M.F. The action is just as he puts it on p. 38. As to the other part of the question, I have not had personal acquaintance with these tests, and cannot just now spare time to look up the particular subject. But the principle is very simple; and I will ask "Telegraphist" to read p. 276 of my "Electricity," where, while the special case is not dealt with, the general principle is. Given a known resistance and a known E.M.F., we know the current which ought to be indicated by a galvanometer. If a less current is shown, it is evident some new condition is introduced. If the diminution is momentary only, it is due to some cause which temporarily absorbs energy, such as a magnetic or inductive charge. If it is permanent, the cause must be either an opposing E.M.F., such as is produced by electrolysis, or else a diversion of current by "leakage." This latter is the condition of the case under consideration, and the problem is simply the calculation of the resistance of the "shunt circuit," which is set up by the leakage of the line. Of course, it is easy enough to construct a table which will at once show this from the readings of the galvanometer when all the other conditions are fixed, such as the use of a battery of a definite E.M.F., and a total resistance so large that the small variation of the line wire itself by temperatures are of no moment. Such a table is constructed from the comparison of the current due and that received to the relation between the circuit resistance and that of the shunt circuit, which would carry off the missing current under the known E.M.F.—SIGMA.

[56956.]—**Ball Bearings.**—I for one should like to see this subject thrashed out. I have ridden long-bearing machines (Haynes and Jeffries' old tangent) 1¾in., and my opinion is that when the full weight of the rider is put on a long spindle machine, there is a certain amount of spring or strain on it, which means friction. Another reason is, when the machine falls on the crank (which is no rare occurrence) there is a permanent set given to the spindle; and it is a difficult and sometimes risky job to make it run true again. I repair hundreds of machines, and see it daily. Now, with balls it is different, for the spindle is short, and therefore not so liable to spring; and in case of a fall and strain, there is little or no friction, for the balls only touch on points in comparison with plain bearings. There is no comparison between bicycles and engines, for one is always liable to falls and strains, and the other is free from them. If you spin a ball bearing wheel and a plain ditto, how do you account for the balls spinning so much longer than the plain? In my opinion, ball bearings are like a scale hung on knife edges, and plain like a scale hung on plain bearings.—W. TAYLOR.

[56956.]—**Ball Bearings.**—On page 16, Mr. Chas. Hosken summarily disposes of ball bearings for "cycles" on the ground that they are not used by railway engineers, carriage builders, lathe-makers, and machinists. This appears to me to be a very one-sided and biassed way of thinking, and undoubtedly the design as far as possible should be adapted to the circumstances surrounding and governing the piece of mechanism in question, and not the least important factor is cost. Now, in good watches we find that the bearings are composed of a couple of rubies, and answer in every respect. If I were to adopt Mr. Hosken's argument, I might ask, Why are ruby bearings not *universally used?* In this case the answer is clear: they would cost too much, and could not be found in sufficiently large quantities or size. This being so, it is proved at once that it is not always convenient to adopt universally that which may answer exceedingly well for some particular object; and if we apply the test of cost to ball bearings for railway rolling stock, we shall at once see that that alone would be sufficient to exclude them from that class of vehicle; for though demand has reduced the price of ball bearings for bicycles from £2 for front and £1 for hind wheel, which was what used to be asked, yet the price is not much when we consider that the balls must be of hardened steel, and then ground perfectly spherical, and that the collars in which they run must also be of hard steel and rendered perfectly true, and that since the balls only touch on such a limited area, a very large number of them would be required to withstand such a heavy weight as a locomotive. For instance, suppose an engine in running order weighs 50 tons, and that the bearings of a bicycle support 1cwt., and cost £1; then, 50 tons divided by 1cwt. gives 1,000 bearings, which at £1 each = £1,000. Even if it was half that, we see at once they would be quite out of the question; but another great reason why ball-bearings do answer for bicycles, and are not used for many other machines, is the presence of grit in the one case, and absence of it in the other. The bearing of a steam-engine axle properly fitted will last a long time, because the shaft really floats on a film of oil; but if the same amount of grit were introduced into it as is found in a bicycle bearing, it would cut itself to pieces in a very short time. Bicycle bearings have not a great weight to carry—very rarely 2cwt.; but they have to contend against a great deal of grit, any amount of vibration and knocking about, and are subject to strains in every conceivable direction, and are held in place by an (in spite of its hollowness) elastic fork. The bearings have not a fair chance, and from the very nature of their shape the ball bearings are just the thing to withstand these all-round strains, and the balls being hard, and the friction a rolling one, the grit becomes pounded like mortar in a mill, and then washed out by the oil, instead of grinding the axle or bearings, and, therefore, I am of opinion that there is not the slightest doubt of the fact that they are particularly suited for cycles, especially as, without unduly increasing the distance between the cranks, it is well nigh impossible to exclude dust and grit from front-wheel bicycle bearings, although this is somewhat easier with the hind wheels. If the frame of bicycle or tricycle were perfectly rigid, and the dust absolutely excluded, then it would be a question as to the merits of the rolling friction of hard steel balls, or that of a perfectly fitted shaft oil-borne. Into this I am not prepared to go, and in all probability if the latter were perfectly fitted, the difference in the friction would not be much; but even then, if both were neglected, the ball-bearing, owing to its friction being a rolling one, would suffer but little. It is possible that Mr. Hosken's experience is based on the cheap class of goods; but my experience of a light Humber bicycle over the rough Yorkshire roads for about 1,000 miles, resulted in my finding that the double row bearings for front wheel, not concentrically adjustable, were still quite firm, and did not require to be adjusted. Since then I have used a concentrically adjustable ball-bearing, with the result that I think they run easier, and remain firm longer than any plain single or double-coned bearing.—E. J. S.

[57118.]—**Paper Caps for Toy Pistols (U.Q.)**—Phosphorus, three parts; gum arabic, half part; water, three parts; sand, two parts; brown oxide of lead, two parts; colouring, one part, as you may choose; mix the above together to a paste for use. But let the above stand in your vessel for one hour before mixing, and mix with care.—A. S., Castleford.

[57169.]—**Boiler Construction.**—I should think "T. M. S." ought to get Mr. Nicholls' book on boiler building. It is called "The Theoretical and Practical Boiler Maker," and its price is 7s. I believe it is sold by Mr. Nicholls himself, at Blackpool. But surely your correspondent. who has to ask such questions, is not going to make and use steam boilers without expert advice. If so, he ought to be carefully looked after in the public interest.—J. S. M.

[57174.]—**Steam Canoe.**—A canoe of that size is quite unsuited for steam power, and the idea of utilising the "new steam motor," which works under atmospheric pressure, is ridiculous, for the engine would weigh more than the canoe can carry. See the back numbers, for many replies to similar questions; but if you are wise, give up the idea of putting a steam engine into a canoe of those dimensions.—PORTHOS.

[57175.]—**Sand-blast.**—The sand-blast was illustrated in Vol. XXVII. p. 437. Any ordinary arrangement of dead-weight bellows will serve to supply the air.—NUN. DOR.

[57176.]—**Microscope Lamp.**—"J. B." should see the arrangement exhibited at Mr. Swan's stand at the Inventions, or read all about Mr. Stearn's electric lamp for microscopes in No. 933 of this paper, where there is an illustration of apparently just what he wants.—NUN. DOR.

[57179.]—**Leather Scrap.**—I don't see why leather should lose any of its nitrogen by exposure to the weather; but for a definite answer to the query, I expect the querist will have to experiment.—J. T. M.

[57199.]—**Gas-Engine.**—Where did "G. G." get the gas engine of 2-man power which will not maintain a power equal to a boy of nine? There is no table for getting the power; but 30 cubic feet of gas should yield a horse-power for an hour, there or thereabouts.—A. SIEGER.

[57200.]—**Indicator Diagrams.**—Work the mean pressure in each cylinder out by itself to ascertain the power exerted by that cylinder, and then add the three together to get the horse-power of the combination.—C. KERR.

[57203.]—**Numbers of Locomotives.**—The rule by which the numbers of locomotives are determined is no rule at all. It depends entirely on the loco. superintendent. Why not ask on what rule they are painted?—L. N. W.

[57244.]—**Dentistry.**—Your correspondent, A. Mallard, is evidently not a dentist, and evidently has a very crude notion of the actual work of a dentist. If he will read the *Transactions* of the Odontological Society, which he invests with such wondrous powers, he will find that a dentist requires to have some knowledge of anatomy, materia medica, and chemistry—matters which neither a knowledge of mechanics nor the reading of the *Transactions* will teach him. As A. Mallard truly says, there is nothing in dentistry which subtle brains and lissom fingers may not hope to accomplish; and, as he also wisely advises, Never go into the water unless you can swim, or, as it may be put to fit himself, Never teach anyone what you do not know yourself. He refers to my professional vanity; but as I have at present no profession, and no more professional vanity than a potato, his reference has no point. The only difference between us is, that I know from long and successful experience what is necessary to become a "superior sort of dentist," and he does not.—998 (An old member of the Odontological Society).

[57244.]—**Dentistry.**—My object in writing was not to convert A. Mallard to my views (that apparently would be a thankless task), but to lay before the readers of the "E. M." a short statement of facts in connection with the past, present, and future of the profession, so as to enable them to judge for themselves what kind of "a superior sort of dentist" would be likely to be manufactured out of a Society-*Transactions*-reading "decent mechanic." The human mouth is made up of structures far too delicate to be subjected to the risk of irreparable ruin by blundering and incompetent hands, and it was for the purpose of creating a standard of educated competence in the interests of public protection, that the "Dentists Act" was passed by the Legislature. There was, or is, no trade-unionism in the matter. As well might that charge have been brought against the first medical acts—the Pharmacy Act of the Chemists and Druggists, the Veterinary Act, or, indeed, any other statute of a similar character. In judging of what is necessary to make a competent dentist, A. Mallard presumes to set up his opinion against the united wisdom of the British Parliament, the British Medical Council, the Councils of the Royal Colleges of Surgeons of England, Edinburgh, and Ireland, and the Faculty of Physicians and Surgeons, Glasgow. The readers of the "E. M." must be left to judge which is of most value, and I feel sure "998" will join me in forgiving his sneers.—DENTAL REFORM.

[57244.]—**Dentistry.**—As a real dentist of over 30 years' experience, I would say, that while fully indorsing what A. Mallard says in regard to the great amount of humbug in dentistry, as also the utter ridiculousness of trying to put the dentist on the same level as the physician, it should be kept in view that the humbug as well as the tall talk about the profession, and the attempts to make it appear as if the qualified man (let the readers of "Ours" remember that the qualified man and the competent dentist are by no means the same) was something superior to the mere mechanic (as the competent dentist is termed), all arise from the inrush into the business, at and since the introduction of vulcanite, of all and sundry who had failed at their own trade. Medical men who could not get up a practice, and the "superior sort of dentists," who got their knowledge from the *Transactions* of the Odontological Society, said transactions having hardly anything to do with practical dentistry. But the greatest bit of humbug, as well as a most barefaced attempt to deprive the regular bred dentist from rising above the work bench, is the Dentists' Act referred to by "Dental Reform," and whenever the first prosecution of a real dentist takes place, there will then be some chance of having it settled whether dentistry is a trade, a profession, or, as real dentists maintain, a combination of both, but greatly more trade than profession.—DENS.

[57251.]—**Agglomerate Blocks.**—I have no interest in this matter beyond getting at the truth. On p. 550, No. 1065, "C. D. R." said: "There are quantities of so-called agglomerates that have not a particle of manganese in them." I thought it would be interesting, if not useful, to readers of your paper to learn how they might distinguish these fraudulent agglomerates, and I assumed—rashly, it now seems—that, of course, "C. D. R." would not make such a statement unless he knew it was true. I regret that I was mistaken.—SILVERTOWN.

[57252.]—**Free Reeds.**—Refer to a reply of mine which appears on p. 17. As "G. L. B." has been asked to give a description of the "tuning bellows" (as well as myself), it is but fair that interested parties should expect a reply from that gentleman.—G. FRYER.

[57274.]—**Organ Pedals.**—There is not a hard-and-fast line respecting the making of organ pedals. Some builders follow the plan recommended by the College of Organists. We use our own plan, which we find generally gives satisfaction. We make the centres about 2½in. apart, just in front of the sharps. Where I am now I cannot give you the exact particulars; but if you are in a hurry, and care to advertise your address, I will send you the needful particulars, or I may shortly send particulars how to make a set if the Editor cares to find room.—URANIUM.

[Please send.—ED.]

[57324.]—**Wire on F. M.'s.**—I beg to thank Mr. Bottone for reply, page 39; the resistance stated is for the full length of 18oo. wire on the armature, about 2lb. 3oz., therefore. I understand Mr. B. that only 4lb. of 16oo. will be wanted for the field system, which is barely twice the weight on the armature, and some authorities assert that in the best dynamos there should be five times the weight on the fields to that on the armature. So before purchasing the wire, await confirmation from Mr. Bottone on the subject.—TUBAL CAIN.

[57340.]—**Organ Tuning.**—Our price would be from £2 2s. to £2 10s. for 15 to 20 stops. This would include two thorough tunings in the year, and if near (within 20 miles) to our factory, any slight repairs. If the reeds were to be tuned once per month, the charge would be from £3 3s. to £4, according to distance and travelling expenses. Any organ ought to be thoroughly tuned through twice every year, and if any quantity of reeds (four or more), they should be gone through once a month to keep everything in a satisfactory condition.—URANIUM.

[57348.]—**Back-ache.**—You say you have been advised to try this and to try that—have you been advised to try the hot-air and vapour bath? If not, do so at once, and in due time report result in the "E. M." I have known something about back-ache in my time; I will give you my latest experience about it. On Thursday, Sept. 10, and two following days, I had some very heavy work to do, causing great fatigue. Sunday morning found me suffering from severe pain in back and in almost every joint, with the addition of a severe cold through working in a draughty building. I at once applied to my family friend, H. A. Bath, took a gentle sweat for sixty-five minutes, and now, Monday evening, I have neither ache nor pain, cold nearly gone, and have done my day's work with pleasure. Try it, "Hammer and Tongs"; try it, "Pen and Pencil."—HINCKLEY MAN.

[57348.]—**Back-ache.** — If "Hammer and Tongs" and "Pen and Pencil" would just get half a dozen single-fluid half-pint bichromate batteries, having the plates all attached to a frame, so as to admit of their being raised and lowered by a simple windlass arrangement, they would both find that the gentle, continuous current given off from them and applied to the back by means of wet sponges would afford them wonderful relief, and in all probability effect a cure if persevered with for some little time. I speak from experience, having known what it is to suffer and grow almost hopeless of ever receiving any benefit from ordinary medical treatment. Besides, we have found such a simple arrangement of surprising utility in our family for treating neuralgic pains, headaches, sore throats, sleeplessness, &c., and in fact, any other little ailment that has happened to crop up, proving quite a family doctor in itself, and a ready and inexpensive means of obtaining relief without the help of the disagreeable medicine chest.—RENDRAG.

[57255.]—**Storage Battery.**—In answer to your last question, I meant ten c.p. lamps. The Electrical Power Storage Company, 4, Great Winchester-street, E.C., possess the patents for storage batteries taken out by Faure, Swan, Sellon and Volckmar.—BUNSEN.

[57380.] — **Cracked Boilers.**—Take litharge and red lead of equal parts, and mix thoroughly, and make into a paste with concentrated glycerine to the consistency of soft putty; fill the cracks well, and smear a thin layer on both sides, so as to completely cover the surface. This layer can be rubbed off, when nearly dry, by using an old knife or chisel.—A. S., Castleford, Yorks.

[57381.]—**Trouser Stretchers.**—I think "J.T." will find the following plan better than a stretcher. Get a piece of thin stiff board about 1in. less in width than the trousers when folded flat. Fold the trousers carefully, directly you take them off, with the creases back and front, lay them out on a table and place the board on them so as not to project over the edge, or it will make a sharp crease. Weight the board with a few heavy books or other weight, and leave it all night. If you must use cramps, line them with plush.—J. B.

[57392.]—**License.**—A license to hawk and a license to sell plate being two entirely different things, a hawker who sells plate should take out both licenses. If the querist is in doubt as to whether his acts amount to hawking, he should consult the local officer of excise.—KAPPA.

[57394.] — **A Fishy Question.** — If "Sou'-Wester" will send particulars of his query to Mr. F. Murray, Post-office, Chadwell Heath, Essex, he will probably obtain the information he requires. —Q. K.

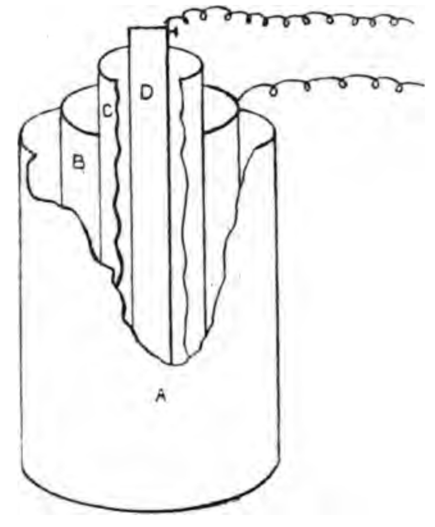
[57395.]—**Asbestos Paint.**—Your correspondent does not say whether this refers to asbestos paint ground in oils, used for all purposes in place of ordinary lead paints, and which are fire-resisting to a great extent, or to the asbestos *fireproof* paint. If his inquiry refers to the asbestos oil paint first mentioned, this may be thinned like ordinary paints, with linseed oil, turpentine, and ordinary dryers; but if his inquiry refers to the fireproof paint, it would be advisable for him to apply to the manufacturers for the requisite fireproof liquid for thinning.—THE UNITED ASBESTOS COMPANY, LIMITED.

[57396.]—**Leclanche Battery Management.** —In some instances I have seen cells accurately fitted in boxes, so that the glass of one cell stands tight and flat against its neighbour. This should not be, as they always creep over, and short-circuit each other. A block of ½in. dry deal (paraffined if you like) is inserted between each cell to insulate it as regards the creeping from each other.—EXPERIMENTER.

[57397.]—**Swing.**—Two years ago I saw at Biebrich on the Rhine what "R. J. P." requires. Two stout wooden uprights firmly fixed in the ground and well stayed, a stout piece mortised across top and projecting a few inches beyond posts. Near each end of this top bar were hooked to eyebolts two long iron rods, the other ends of which hooked into other four eyebolts, two on either side near the edge, and about half-way from centre, to end of a stout plank about 9ft. long. It seemed a capital and safe thing for children. Writing from memory, and away from home, I am unable to refer to sketch.—H. A.

[57398.]—**Tin and Brass—to Crystallise.**—Sulphuric acid, 4oz.; soft water, 2 to 3oz., according to strength of the acid; salt, 1¼oz.; mix; heat the tin or brass over a stove, then with a sponge apply the mixture; wash off directly with clean water, and then dry the article and varnish with damar varnish.—A. S., Castleford, Yorks.

[57403.] — **Battery.** — I should recommend "A. H. M. F." to make six Bunsen batteries; they should be about the quart size, which is a very convenient one. It is composed of an outer cell, which contains a zinc cylinder (this can be got at any ironmonger's) rolled, and also well amalgamated. It contains a fluid of sulphuric acid and water. Inside this is a porous cell, containing a carbon block; it contains nitric acid. Below is a small outline of the battery. It will cost you about 10s. without the acid. I have ten of my own. Will be glad to tell you anything else concerning it, amalgamating, &c. I would not advise you to use Dale's granule battery for it. A, earthenware pot; B, a cylinder of zinc; C, a porous pot; D, a block of carbon; nitric, inner cell; H_2SO_4 and water outer.—GEORGE.



[57407.]—**Brewing License.**—A license to brew beer, otherwise than for sale, where the annual value does not exceed £15, is only 5s. If the annual value is under £10, the license is 6s. —KAPPA.

[57415.]—**New M.R. Engines.**—It is said designs are out for new engines with 19in. cylinders, large boilers, and 7ft. 4in. coupled drivers; in all probability these will be the 1,730 class referred to by the querist. Whether one of the new engines has been built or not I cannot say.—KAPPA.

[57419.]—**Fancy Door-Mats and Hearth-Rugs.**—Among the new industries that have lately arisen is one which utilises a certain class of tailor's cloth-cuttings, which formerly were a great drug on the markets, excepting scarlet cuttings, and these have more than doubled in price since this industry assumed anything like a trade some few years since. These mats and rugs are woven in the old hand loom, and girls are occupied in placing small pieces of cloth between the weft threads according to a pattern suspended before them. Those patterns bear a close resemblance, in many instances, to those of the ordinary pile hearth-rug, and require a more than casual inspection to convince one that they really consist of waste clippings. After coming from the loom they have then to be levelled, for which purpose they are passed through a rotating cylindrical cutting machine, in order to remove the superfluous pieces from the surface. Cloth or list hearth-rugs have been made for generations in Yorkshire and some other parts of England, but chiefly for home use and pastime. When a young couple were going to get married, the first thing they thought about in the way of furniture was making a cloth or list-rug; and the work was set about in this way:—A piece of canvas was stretched in a frame, then holes made in the canvas, and the bits of cloth put through the holes, when they stood up in a pile about 1in. or 2in. long. Nearly all the cloth cuttings used in this industry come direct from London. This may be surprising to some, seeing that Yorkshire is the centre of the woollen cloth manufacture; but the class of cloth used can be got in larger quantities in London than anywhere else; this explains itself. Though hundreds of rugs have been made weekly for some years, there are scores of places, perhaps hundreds, in England where they have not yet even been seen.—WHITEHEAD.

[57425.]—**Argentic Nitrate.**—Treat the precipitates with hydrochloric acid, and boil for some time, with addition from time to time of a little nitric acid to prevent reduction of the citrate. Filter off the precipitate, and wash with boiling water—

$$Ag_2CO_3 + 2HCl = 2AgCl + CO_2 + H_2O$$
$$Ag_3C_6H_5O_7 + 3HCl = 3AgCl + C_6H_8O_7$$

Transfer the precipitate to a porcelain basin, add solution of sodium hydroxide and one or two pieces of sugar, and boil the mixture, stirring constantly. As soon as the precipitate settles rapidly to the bottom, leaving the liquid clear, the heating is stopped, and the precipitate washed with water till no longer alkaline. The moist precipitate is then dissolved in pure nitric acid, and evaporated to obtain crystals of silver nitrate—

$$2Ag_2 + 6HNO_3 = 4AgNO_3 + 3H_2O + N_2O_3$$

—SOUTH KENSINGTON.

[57433.]—**Hydraulics.**—It is quite feasible to punch discs 6in. diameter and $\frac{3}{16}$in. thick from wrought iron. The pressure on every square inch of the punch must not be less than 2½ tons, taking the tensile strength of the wrought iron to be 23 tons per square inch. Of course, in designing the press to obtain the necessary pressure allowance—say, one-fifth—must be made for loss by friction.—TEMERAIRE.

[57440.]—**To Mr. Eaves.**—The dynamo (query 57185) is shunt wound, the wire on the F.M.'s being No. 18, and having a res. nearly 60 times greater than the A. To convert it into a compound-wound machine, the shunt coils would be No. 20 wire, and the series coils No. 14 wire. It is perfectly practicable to make a compound dynamo, giving 60 ampères and 10 volts; and if you make one I shall be pleased to help you. With regard to your kind remarks concerning myself, I may say this: that having a grateful sense of the many facts and wrinkles that I have gleaned from the pages of this valuable journal, I shall always consider it a pleasure to contribute my mite to the fund of general information for which the "E. M." is so justly celebrated.—W. H. EAVES, Coventry.

[57444.]—**Tunnel under Canal.**—If the proprietors do not object, there is no reason why a tunnel should not be made under a canal, or anywhere else. Whether an Act of Parliament is desirable or not depends on the use to which the intended tunnel is to be put.—KAPPA.

[57446.]—**Nitrous Fumes.**—By placing in the porous cell crystals of bichromate of potash, the nitrous fumes are much lessened, although not entirely suppressed. As far as I am aware, there is no substitute for nitric acid, although, if that be kept concentrated, iron may be used in place of carbon, and in this case the fumes are not so plentifully given off. Strong nitric acid does not act on iron.—J. KEAN, Northampton.

[57449.]—**Sanitary.**—A "note to the nuisance inspector" will not settle the matter at once—at least in London. It will lead to unpleasant circumstances for the writer of the note. The contractor undertakes to clear away dust: he is not compelled to take vegetable refuse, fish offal, and the other muck which people who pretend to be clean stuff into their dustholes. If "R. B. W." cannot bury his vegetable refuse in his garden, he should burn it, and if he has nothing but gas-stoves, he should make up a fire of wood in his yard. He will probably find that the dustmen will take it away for a trifle; but as he has no right to expect his fellow ratepayers to pay for clearing his rubbish away, he will, perhaps, not consider it extortion if the dustmen do ask for beer money. There ought to be, for sanitary reasons alone, at least one open fire in every house, in which matters can be destroyed in the most effectual manner by the only real disinfectant—fire.—SANITARY DUSTHOLE.

[57450.]—**Induction Coil.**—Paraffin wax is, I think, preferable to shellac varnish as an insulator, and it only requires a thin, but entire, coating over each layer, although I have used, and with success, a thin paper steeped in paraffin between the several layers of wire.—J. KEAN, Northampton.

[57450.] — **Induction Coil.** — "Voltaire" cannot go wrong in using either paraffin wax or shellac varnish as an insulator for the secondary coil: the one is used as often as the other, both being equally good insulators. Where paraffin wax is used, it is customary to steep the wire in it before winding, and between each layer wrap a strip of fine paper which has been previously steeped in the wax. Shellac varnish is applied in two or three coats, the first coat being thin, so as to be easily absorbed by the covering of the wire, and allowed to dry thoroughly before a second is applied. When this is done the layer of wire is further insulated with a strip of paper previously soaked in the varnish and allowed to become hard.—BOBADIL.

[57451.] — **Lightning - Paper.** — Mix five measured drachms of nitric acid with an equal volume of strong sulphuric acid in a small glass vessel; allow the mixture to cool completely. Immerse some thin, dry, unsized paper, pressing it down with a glass rod; cover the vessel with a glass plate, and set it aside for 15 or 20 minutes. Lift the paper out with a glass-rod, throw it into a bucket of cold water, and wash it thoroughly in a stream of water till it no longer reddens litmus paper. Dry it at a very gentle heat. —W. P. W.

[57454.]—**Wimshurst Electric Machine.**—TO "A. F. H."—For producing large sparks the jars should be half-gallon size, and about half the height of jar covered with tinfoil; 16 sectors would be best, about 4in. in length, and not more than ½in. broad at the outer end, and placed ½in. from the circumference of the glass. Thin dielectrics are always better than thick ones. The nearer the plates are together, the greater is the efficiency of the machine.—J. E. WIMSHURST.

[57455.]—**Killing Rats by Electricity.**—Vastly better to kill them by kindness, as described in the "E. M." Dec. 13, 1878, p. 351. A rat will never go, if he can help it, to where another has died.—R. J. L.

[57455.]—**Killing Rats by Electricity.**—I should say there would be an almost insurmountable difficulty in insulating such a length of wires so as to keep up the potential of the terminals of an ordinary induction coil. There are some forms of dynamo that might answer; but would not the rats get to understand this trap also?—J. BROWN, Belfast.

[57455.]—**Killing Rats by Electricity.**—It is not stated in this query how the rats are to be killed by electricity. If by a mere shock, I am afraid two wires round twenty acres of land will do very little good, as there are doubtless plenty of rats already within that area who would never go near the wires, and if they did would be little the worse for it. I should say it would be a better plan to pay a little more attention to the fowl-houses, and to see that no holes are left for the rats to get in, and when the animal has succeeded in making one, there is the place to set a cunningly-devised trap. Electricity can be utilised for closing the small openings by which the fowls enter. This need not be opened first thing in the morning, as they could leave by another door at the upper part of the house, a door which would open outwards and close by its own weight. They would learn to use this door if it were left partly open for a day or two, and had a small hole or two in it to show light. If the house is in proper repair, you will soon find out how the rats get in, and surely with that information they ought to be caught.—OS.

[57456.]—**Australian Duties on Watchmakers' Materials.**—The Victorian Tariff does not separately mention watchmaking materials, but I think the duty is 25 per cent. New South Wales admits these goods free of duty.—O. T. MORGAN.

[57458.]—**Surveying and Measuring.**—"J. C. H." should apply to the Secretary of the Surveyors' Institute, 12, Great George-street, Westminster, who will give him all the information he requires. The examination is a stiff one, and I believe the candidate must produce proof of five years' articleship to a surveyor.—F. M. ROGERS, 21, Finsbury-pavement, E.C.

[57463.]—**Electrically-worked Clock Dials.**—All that is necessary is to mount on the shaft of the minute hand of any dial a ratchet wheel of 60 teeth, actuated by [illegible] magnet, which will then move it one to[illegible] one minute space of the dial at each im[illegible]om the acting clock. Of course, a catch [illegible]ired to prevent the wheels from turni[illegible] GMA.

[57465.]—**Dyna[illegible]rging.**—Indifferent which you use, [illegible]y be shunt wound. Directions for volt[illegible]on.—S. BOTTONE.

[57467.]—**Boile[illegible]**—Before boiling, the water contains air [illegible]xpelled when heated. Of course the plain water occupies less space than the (water + air) did.—GLATTON.

[57467.]—**Boiler Query.**—I think it should come quite natural to "Soutar" that the fall of water in boiler is caused by the great heat which it contains. I don't think it very wise to draw fires at 60lb. pressure.—JOHN M. MACKAY, Glasgow.

[57467.]—**Boiler Query.**—I have never seen any boiler fittings so accurate as to entirely prevent the escape of steam at 60lb., much more difficult would it be to prevent hot air at that pressure from making its escape, else why is there always a partial vacuum in a boiler suffered to go cold, but because a quantity of said heated air has escaped; also, there are no gas-fittings that I have ever seen which, if disconnected at night by closing the stop-tap, will not blow air in the morning for some time ere they will light. It is a delicate piece of work to make a tap or valve that will entirely confine gas or air, especially under pressure.—A., Liverpool.

[57468.]—**Recovering Gold from Old Watch Plates.**—The quickest way would be to dissolve off the surface with nitro-muriatic acid, and then proceed as usual. Of course, you have ascertained whether it will pay to take off what gold there is. It could be taken off with a file, and the filings put into nitric acid to dissolve the brass. This would perhaps be the cheapest way, as it would leave the gold in the metallic state.—OS.

[57470.]—**Brush Dynamo.**—The disproportion in sizes of wire seems excessive: but I cannot give satisfactory reasons for failure, nor suggest remedy, unless I have full particulars as to size of F.M.'s, size of arm., number of sections, shunt or series wound.—S. BOTTONE.

[57471.]—**Stove.**—Put an iron stove in centre of room, with stovepipe into chimney or out at roof. —OS.

[57471.]—**Stove.**—If "Chilly One" will give the size of the room and state thickness of walls and floor, and character of ceiling, giving also the size of the windows, I will give him particulars of comparative cost of different methods of heating. An asbestos fibre fire placed well forward in the room will require about 1¼ cubic feet of gas per hour for every foot width of the room, and is a costly method of heating such an exposed place, unless there is some special reason for its use. The cheapest method of heating is a coke stove standing well into the room, near the centre if possible.—998.

[57472.]—**Dynamo with Laminated Armature.**—You have not much choice now, as your fields are already wound. If your armature is large enough, it should be wound with 5lb. of No. 16. If it is too small to admit of so large a wire you might use 2lb. of No. 18. These will do for either arc or incandescent, better for the former. The shunt, or compound shunt, is the best system for incandescent lamps; the series for arc.—S. BOTTONE.

[57473.]—**Screw-driver.**—Discussion on this question short time since; hardly worth opening up again.—OS.

[57474.]—**Engine and Boiler.**—I would consider such an engine too small to drive a 5in. centre lathe properly. I would say that supplying the plates would not reduce cost of boiler much, and wouldn't be acceded to by a responsible man of business, as he would get all the blame of a possible blow-up. The time requisite to get up steam depends upon so many arrangements, that it could not be stated in so perfunctory a manner. It is not judicious to take the power off any machine from the rim of its fly-wheel. For what purpose do you require to reverse an engine driving lathes, &c.?—A., Liverpool.

[57476.]—**Pacinotti Ring.**—TO MR. BOTTONE.—Let the F.M.'s be oval in section, 3in. by 4in., and 12in. in height, not counting the pole pieces, which must be large enough for the armature to run in—viz., over 6¾ in height. Wire on armature, not more than three layers; wire on field, No. 14, enough to balance the running resistance of armature.—S. BOTTONE.

[57477.]—**Reflecting Telescope.**—I should recommend "Fria" to get a stout zinc tube made for his reflector. He will find it cheap, strong, and light.—E. HOLMES.

[57478.]—**Electro Deposition.**—Perhaps you have left the nitric acid in the bath. I should use sulphate of copper, as it is cheaper and quite as good. Precipitate the copper with cyanide, allow it to subside and pour away the clear liquid; wash the precipitate several times with hot water and dissolve in cyanide; make a stronger solution when you are precipitating the copper, only add the solution of cyanide as long as a precipitate appears; when this precipitation ceases you can then allow it to subside, and proceed as directed.—OS.

[57480.]—**Kilns.**—Very much space would be required to describe adequately the various kilns employed. "A. J. S." will find a very good description either in Vol. II. of "Muspratt's C mistry" or in Brongniart's "Traité des A Céramiques."—POTTERY TECH.

[57482.]—**Warm Water for Bath.**—A sm iron stove, with a coil of iron pipe in it, would s heat "A Fireman's" bath.—OS.

[57483.]—**Sinking Sphere.**—The volume the segment of the sphere in the liquid will be o third of the volume of the sphere, or two-thirds the volume of the hemisphere. Let r be radius sphere, d the depth in liquid. Then the volume the hemisphere is $(\frac{2}{3}\pi . r^3)$, and of the segm $(\pi . d^2 . r - \frac{1}{3}\pi . d^3)$ or $\frac{2}{3}(\frac{2}{3}\pi . r^3) = (\frac{4}{9}\pi r^3)$. question, then, is what is the value of d, when unity. The π may be cut out from all the te as also r and r^3, because $r = 1$. Then $(d^2 - \frac{1}{3}$ $= \frac{4}{9}$, or $(9d^2 3d^3) = 4$, from which it will be fo that $d = \cdot 774$ of the radius nearly. For the vol of the sphere and hemisphere, see some book mensuration, as Moore's, published by Bell Daldy.—J. S. C.

[57483.]—**Sinking Sphere.**—Let r be the ra of the sphere, x the distance of the centre of sphere from the surface of the liquid when sphere is at rest. Then the volume of the displaced will be—

$$\frac{\pi}{3}(x^3 - 2r^2x + 2r^3)$$

and the volume of the sphere—

$$\frac{4\pi}{3} . r^3$$

but the densities being as 3 to 1, we must have—

$$\pi(x^3 - 2r^2x + 2r^3) = \frac{4\pi}{3} . r^3$$

therefore—

$$x^3 - 2r^2x + \frac{2}{3}r^3 = 0.$$

A cubic equation from which x may be found w r is given; thus when $r = 1$ft., $x = \cdot 226$ft. nea $= 2\cdot 712$in., and in this case the depth to which sphere will sink will be $r - x = 9\cdot 288$in.—M VERTON.

[57484.]—**Electro-Gilding.**—Silver filag work must be annealed, pickled, washed in p water, and well scratch-brushed before being pla in the gilding bath; and if it will not gild all o at first, it must be moved about till it does. W gilt, it must be again scratch-brushed and wa through water. Filagree-work does not look well when it is perfectly bright all over as when it leaves the scratch-brush, so that it better to return it for an instant to the bath to dull the brightness, and the edges and h parts can be finished with a burnisher. I have filagree-work satisfactorily, and the above is method I adopted.—OS.

[57486.]—**Mechanics.**—Let T be the requ tension; then when M_3 is attached to M_1, the t acceleration on $M_1 + M_2$ will be $g - \frac{Tg}{M_1 + M_3}$ i direction downwards; also the total acceleratio M_2 will be $\frac{Tg}{M_2} - g$ in a direction upwards. Now weights being connected by an inextensible c the downward motion at the one end will exactly the same as the upward motion at the o end. Hence the acceleration must be equal, $\frac{Tg}{M_2} - g = g - \frac{Tg}{M_1 + M_3}$, dividing by g and ducing $T = \frac{2M_2(M_1 + M_2)}{M_1 + M_2 + M_3}$. But these wei being equal by supposition, $T = \frac{4M_1}{3}$.—M VERTON.

[57487.]—**Silver Stains on Negative.** have done it with very strong solution of hy sulphite of soda (see p. 177, last volume). O 198, a gentleman recommends rubbing the nega with a piece of sponge soaked in spirits of tur tine, which appears to be productive of marvel results. Next time I shall certainly try thi R. A. R. BENNETT.

[57490.]—**Softening Brass Wire.**—I do think you ever will get it sufficiently soft. So alloy containing lead is what you want.—OS.

[57490.]—**Softening Brass Wire.**—In ans to "Chor," the only and effectual way soften brass wire, heat to a dull red and p quickly in cold water. If you are inexperien be very careful and not overheat your work. above applies to copper also.—JOHN M. MA Glasgow.

[57491.]—**Bisschop Gas-** noise can be caused I should tighten a —if it is ti bearings SAME CO

[5749 discussed handle of out from short one driver out of groove in screw-head; therefore, more force can be applied with careless holding without shearing head of screw.—GLATTON.

[57493.]—**Screwdriver.**—1. With a short screwdriver any unsteadiness in holding the tool is more liable to cause one corner of the edge or point to rise out of the nick in the screw head than with a long one. 2. The long screwdriver has usually a larger handle, which affords a better grip and more leverage—i.e., if the screw be ¼in. diameter, and the handle 1in., the leverage is evidently 4 to 1, whereas if the handle be 2in. it is 8 to 1. This question was well threshed out some years ago in these pages, some correspondents being of the opinion that the extra length of the tool gave extra "leverage" in some occult manner.—J. BROWN, Belfast.

[57493.]—**Screwdriver.** — A screw can be driven easier with a long screwdriver than with a short one, owing to the fact of it being better able to direct the pressure to the centre. If "Curious" will get two poles, one short and the other long, and try to balance each on his hand, he will have less difficulty with the long than with the shorter one, and it being necessary that, for the greatest effect with the screwdriver, direct central pressure should be maintained so that both ends of the blade should work equally, it is obvious that the longer screwdriver is preferable.—W. G. N., Chiswick.

[57493.]—**Screwdriver.**—The probable advantage a long screw-driver has over a short one is, that the former allows more play of the hand and makes a less angle with the perpendicular of the screw than a smaller one with the same amount of play, and therefore the blade is less liable to leave the screw. Presuming that both kept their place in the notch equally well, I should think the actual amount of force exerted would be the same in both; but since the longer one keeps in the notch better than the shorter one, it would therefore drive a screw in with much less trouble.—INSECT.

[57494.] — **Whitworth Scholarship.** — Send three stamps to the Secretary, Science and Art Department, South Kensington, for a Whitworth prospectus.—DAVID STEPHEN, Jun.

[57494.]—**Whitworth Scholarship.**—"Mechanic" can get all the information he requires by obtaining a copy of the regulations and conditions under which the scholarships are founded from John Calvert, Great Jackson-street, Manchester, post free, 6d.—JOHN M. MACKAY, Glasgow.

[57494.]—**Whitworth Scholarships.** — Presuming that you have the necessary mechanical knowledge, you will do well to commence at once the study of the following subjects:—Practical geometry, machine drawing, theoretical mechanics, mathematics, and freehand drawing. As you are obliged to pass in these subjects, it is well to get somewhat advanced with them before taking up the rest, which are—Applied mechanics; sound, light, and heat; magnetism and electricity; steam, chemistry, and metallurgy. You ought to pass first-class honours in at least one subject, and first-class advanced in half a dozen more. All other information can be obtained from the Whitworth Scholarship Prospectus issued at South Kensington.—WH. SC.

[57495.]—**Steam Tube for Launch.**—It being absolutely necessary that the shaft should be water-tight, you cannot do better than fit it with a stuffing-box and gland at the forward end of stern tube, and the after end should be driven into the stern post and fixed with screws; and for rendering this end water-tight, it is usual to surround the tube, from the keel upwards, with a deep layer of pitch. If your boiler has a flange at the bottom, it can be fastened to the boat by clips.—W. G. N., Chiswick.

[57496.] — **Insoluble Gum.** — Glue or gum, better the former, made in the dark and kept in the dark, to which a little bichromate of potash has been added and stirred in, when made is insoluble in water when once dry after exposure to sunlight. To each fluid ounce of melted glue add 15gr. of bichromate in powder.—S. BOTTONE.

[57497.] — **Aluminium Binocular.** — Can be polished off with a little rouge on washleather.—Os.

[57498.] — **Electro - Deposition.** — The best thing you can do is to throw your solution away, and start afresh with one suitable to your purpose. Nitrate of potash is objectionable. The best [illegible] is that given in my "Electricity," [illegible] a quarter of [illegible] of sulphate of ammonia till a [illegible] first [illegible]

[57499.] — **Charging Porous Pots.** — Four parts of oxide of manganese to one of powdered gas carbon for the porous cells of a Leclanché battery.—J. KEAN.

[57500.]—**Gear Wheels.**—You are quite right as to a small drum meaning a less pressure on the teeth. With very small pitches, there is a difficulty in making clean castings, and the teeth want chipping and filing to make them run well. When the wheels are shrouded, it is difficult to get at the corners with the chisel, and the file cannot be used below the pitch line. I am away from my books just now, but will write again if you wish it. Shrouded teeth are much stronger than those not so made.—GLATTON.

[57501.]—**Adulterated Honey.**—In reply to "Anti-Humbug," I do not know of a simple test for adulteration in honey; but if he refers to the articles in the different issues I will name of the *British Bee Journal*, he may gather from them information which may be useful in detecting adulterated honey, or guiding him what to look on with suspicion. In No. 144, Vol. XII., April 15, 1884, *British Bee Journal*, you will find a paper on the "Analysis of Honey," by Otto Hehner, read before the Society of Public Analysts. The same gentleman delivered a lecture at the Healtheries, on the 26th July, on "Adulteration of Honey," which you will find reported in *British Bee Journal*, No. 151, Aug. 1st, 1884, p. 263. And the discussion on this paper is recorded in No. 154, Sept. 15th, 1884, when some of the most practical and experienced men in the bee world spoke on the subject. In No. 153, Sept. 1st, 1884, there is a paragraph giving an account of prosecutions for selling these articles, and there have been other cases reported at times. There would be more of them, but the public do not care for the trouble and expense of prosecuting; and the authorities do not seem to care to take up cases of this kind, or short weight and bad quality in bread: they prefer the mustard, pepper, and spirit cases—which are bad, especially the latter; but what would it matter if a poor man's mustard were 80 per cent. adulterated? He does not often use it, as he has not much meat to eat, and cannot live on mustard alone. I do not know much about wooden nutmegs; but always understood that an enterprising Yankee had originated the idea, and had carried it out, and done a considerable stroke of business, but was eventually found out when the article got into the hands of the cook. This was some time ago, I suppose, when nutmegs were not so plentiful.—J. I. S.

[57503.]—**Backlash in Gearing.**—I would put a flywheel upon B, and feel confident that this would stop its clatter.—A., Liverpool.

[57503.]—**Backlash in Gearing.**—I do not, at present see a way of entirely doing away with backlash; but you could reduce it to a minimum by using accurately shaped machine-cut teeth, when the clearance would be 100th of an inch or even less. The number of teeth is small, and this would be one cause of the noise. If you used two wheels 1½in. wide, and put them side by side on the same shaft, so that the teeth of one were opposite the hollows of the other, and arranged the other shaft with two wheels in the same way, the number of teeth would practically be doubled; but this plan is not so good as using machine-cut teeth.—GLATTON.

[57504.]—**Pottery Glazes.**—The question is very indefinite. You should say whether the formula is required for common redware, yellow-ware, stoneware, earthenware, majolica, English china, or hard porcelain; if this is specified, I will endeavour to assist you, and shall be happy to supply the raw materials if you advertise your address.—POTTERY TECH.

[57506.]—**Wimshurst's Influence Machine.** —TO "W. D."—The glass Leyden jars are 10¾in. long, and 1⅝in. diameter. They can be got from Messrs. Powells' glass-works, Whitefriars. They are not lengthened as he suggests. Students ought to find healthful outdoor occupation just as long as there may be daylight or fine weather left in the evenings. Towards the end of this month we may suppose the summer to be closed, and then I will furnish the Editor with working sketches and instructions useful in making up the machines; and, further, shall be glad to supplement any part of same in response to inquiries through these columns.—J. WIMSHURST.

[57508.]—**To Mr. Eaves.**—The measurements you give of your machine do not contain the height of the electro-magnet on which the exciting coils are to be wound; but a general rule in these machines is to wind 20lb. of wire on the magnets to each pound of wire on the armature; and for a shunt machine the same sized wire is used for both A. and F.M.'s. The amount of wire on your armature is certainly too small; you ought at least to [illegible] 40 yards. The speed must be quite 2,000 [illegible] and the number of 20-candle lamps it would be very few. At a rough guess I [illegible] its power at seven 20 volt 10 c.p. lamps.—[illegible] ventry.

[57509.]—**Altering Lathe.**—If you will take my advice, don't try to convert an ordinary lathe into a screw-cutter and surfacing ditto; unless such a lathe is "perfectly" accurate in each part it would be worse than an ordinary lathe to turn out accurate work upon with the aids of gauges, straight-edges, and so forth. But to fit up a pair of headstocks and a shears fit to slide a bar approximately true is beyond the powers of any ordinary amateur. The requisite tools necessary in order to do such a job would make the cost more than you could purchase one for.—A., Liverpool.

[57510.] — **Coupler to Harmonium.** — The querist would do well to let his harmonium remain as it is, for the result, after applying an octave-coupler to an instrument containing only one row of vibrators, will not compensate for the necessary amount of trouble incurred in the operation of attaching it. If your musically-inclined family are not satisfied with the present instrument, I think it would be wiser on your part to purchase a larger instrument containing a greater number of reeds, if your means will possibly allow.—G. FRYER.

[57511.]—**Slide-Valves.** — "Greenhorn" will find some useful tables in Ainsley's Engineers' Manual.

Let X = inches travelled by piston before cut-off takes place.
S = inches whole length of piston stroke.
T = „ travel of the slide-valve.
L = „ lap on valve.
l = „ lead of the valve.

$$\text{Then } X = S\left\{1 - \left(\frac{2L + l}{T}\right)^2\right\}.$$

—YAMA.

[57514.]—**Valve Query.**—After getting the weight of the lever, why did you not balance it on your knife edge? However, take the area of the valve as 19·635 square inches, then $\frac{41{\cdot}5 \times 92}{19{\cdot}635 \times 5}$ = 38·81b., to which add 3lb. for the effect of the lever, gives 41·8lb. load on boiler.—YAMA.

[57514.]—**Valve Query.**—Let x = pressure of steam above the atmosphere. Now the rule is, the total pressure of steam on valve multiplied by its distance from the fulcrum is equal to the sum of the pressures holding the valve down, multiplied by their distance from the fulcrum. Taking the weight of lever to act at its middle point, we can then form our equation: $5 \times 5 \times 5 \times {\cdot}7854 \times x = (92 \times 41{\cdot}5) + (19 \times 20{\cdot}75) + (4{\cdot}5 \times 5)$

$$x = \frac{(92 \times 41{\cdot}5) + (19 \times 20{\cdot}75) + (4{\cdot}5 \times 5)}{5 \times 5 \times 5 \times {\cdot}7854} = 4{\cdot}31\text{lb.}$$

—DAVID STEPHEN, Jun.

[57514.]—**Valve Query.**—To give a correct reply to this query, "Young Firer" should have given the distance of centre of gravity of lever from fulcrum. Let A = area of valve, W the weight, P pressure of steam, L length of lever, and l distance from fulcrum to centre of valve. The simple rule is $P = \frac{W\,L}{A\,l}$; but to obtain the correct pressure, the weight of valve, &c., must be taken into consideration. Let G = distance of centre of gravity from fulcrum (say 10in.), w weight of lever, and x weight of valve. Then $P = \frac{W\,L + G\,w + x\,l}{A\,l} = 41{\cdot}12$lb., which is the pressure of steam on valve.—D., Manchester.

[57515.]—**Chemical.**—Dip your work, after brazing and cooling, in sulphuric acid; cover the parts you do not wish the acid to touch with lard. —JOHM M. MACKAY, Glasgow.

[57515.]—**Chemical.**—Has "A Worn-out File" tried smoking over his work, except where the joint is to be made; or of grinding away the glass either with a wheel or flat piece of wood or metal coated with emery (or similar grit) and water?—Q. K.

[57516.]—**Tube Well.**— A tube well could be driven through sand and gravel to a depth of 60ft. or 70ft. easily, and provided the water rose to within 28ft. of ground line, it would, no doubt, answer well enough. The work, however, requires special tools, and could hardly be carried out by one not versed in their use. I would advise "J. W. F." to apply to Messrs. Legrand and Sutcliffe, of Bunhill-row, who make this work a speciality.—F. M. ROGERS, 21, Finsbury-pavement, E.C.

[57517.]—**Applied Mechanics.** — Goodeve' "Principles of Mechanics," and "Elements o Mechanism," are both good. Also, Rankine' "Machinery and Millwork" for a more advanced work.—WH. SC.

[57517.]—**Applied Mechanics.**—There is no single book containing sufficient matter to pass this examination. Goodeve's "Principles of Mechanics and Elements of Mechanism," Shelley's "Workshop Appliances," and "Smith on Cutting Tools," are about the best. But the querist should remember, applied mechanics cannot be altogether learned from books.—DAVID STEPHEN, Jun.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, A. S. has replied to 57118.

56996. Melting-Points of Gums and Resins, p. 419.
57006. Unicomb Observatory Hive, 419.
57009. High Speed, 419.
57011. Continental Railways, 419.
57017. Electric Brake, 420.
57018. Gas Works, 420.
57019. Chemical, 420.
57021. Brush Drilling Machine, 420.

57165. Course of the Wind, p. 507.
57167. Wood Planer, 507.
57168. Separating Oil from Tallow, 507.
57188. American Popcorn, 507.
57191. Tuning Clock Bells, 507.
57194. Punch, 507.
57196. Preparation for Hair, 507.
57198. Valves in Compound Engines, 507.

QUERIES.

[57519.]—**Semi-fixed Engine.**—Would "Invicta," or any other reader, kindly tell me what power a pair of horizontal engines, 1¼in. bore, 3in. stroke, would develop at 35lb. pressure? Also if a locomotive boiler of the following dimensions would supply sufficient steam for same: viz., length of boiler, 36in. barrel, 9in. dia.; firebox, 10in. long, 8in. wide, 8in. deep; 14 ⅝in. tubes? Would these be powerful enough to drive a dynamo to light about eight incandescent lamps? Would a single engine, 2in. bore, 3¼in. stroke, be better?—W. SAEGERT.

[57520.]—**Rusting Cast-iron Borings.** — What amount of salammoniac is required to rust 1cwt. of cast-iron borings? I have some hot-water coils to fit up, to stand the pressure of about 30ft., or three floors; how should they be fixed? Should the salammoniac be crushed fine, and then mixed with water? How long should they stand before using, and how long will they keep after being mixed, and the best way to keep them? Should they be wet or dry for caulking, and how long after caulking should they stand before letting in the water?—ANXIOUS ONE.

[57521.]—**Paper Wrapper.**—Can you inform in what year McDonald's patent for the paper wrapper or envelope was taken out? I think it was in 1872. The paper wrapper is used for the extraction of oil from seeds.—E. SMITH.

[57522.] — **Bell-ringing with Leclanche Battery.**—I have a Leclanché battery. I have been trying to make a bell ring with it. I have changed the coils from end to end, one only at a time; but the effect I get remains the same—viz., the hammer is still attracted. I have also changed the wires of the coils, connecting first one and then the other; but then both coils attract. Could you give me the information why the hammer will not vibrate? The hammer, before I connect the wires, swings very easy.—AMATEUR.

[57523.]—**Painting on Velvet.**—Will anyone tell me what medium is used with colours for painting on velvet? Will the ordinary colours I use for oil painting do? If not, what kind of colours should I get? I want to decorate some cushion-covers with flowers, &c., and any information will be welcomed.—TERRE VERTE.

[57524.]—**Banjo.**—I am making a small banjo, with 8in. drum; can any friend give correct length of handle, also what pitch to tune it to? Is there any advantage in making the handle hollow? If so, does the hollow extend the whole length of finger-board?—BANJOSTER.

[57525.]—**Cleaning Stove Front.** — A Victoria bronze-fronted stove has been spotted by wet lime; can any of our readers inform the best way of cleaning it and restoring to its original state?—CELT.

[57526.]—**Heat in Dynamo.**—I am in charge of an installation of 70 incandescent lights from an ordinary direct Siemens machine, and I experience a great deal of trouble, owing to the machine running hot. Will any reader be good enough to tell me the cause and remedy? I may mention the temperature of the room is 105° Fahr.—SUEZ.

[57527.] — **Imitation Engraving on Nickel Plate.**—A short time ago I saw some nickel-plated articles ornamented with various designs, which appeared to have been engraved; but, on inquiry, I was told they were not engraved, but the nickel had been burnt away by the use of acids, it acting on such parts of the nickel plate as required to form the designs. I now have a quantity of steel plates, which are nickel-plated, and on which I wish to place my name and address in plain type; but engraving is too slow and expensive, so I should like to do the work by use of acid, as above mentioned, and shall be thankful if anyone will give me information respecting that process. Is a stencil plate used? If so, where can I best obtain it, and what acid is the best and quickest in action?—YOUNG MECHANIC.

[57528.]—**Slipping of Belts.**—I have lately had the question of boring holes in the periphery of pulleys to prevent the slipping of belts brought to my notice. On one hand, I am assured of its being only a recent discovery, while, on the other, an old engineer assures me he did it thirty years ago. Can any of your readers enlighten me on the subject?—RICHARD L. KIRLEW.

[57529].—**Cupola.**—Will any of your readers furnish me with the particulars and various dimensions of a cupola to melt six tons of cast iron per hour, so as to give the best results in economy of coke and time? The cupola is wanted to melt for heavy castings, and I should like to know if there is any real advantage of having a receiver in connection with the cupola, so as to collect a quantity of metal, or just tap the metal in the ladles as melted; whether a fan, a Root's, or Baker's blower gives the most reliable blast, and what pressure should the blast have? How much coke with such a cupola and appliances should it take to melt fifteen tons? In order to save the expense of fettling and relining the cupola, I should prefer to have a cupola with an iron jacket and surrounded by water, provided that the consumption of coke would not be greater than the ordinary brick-lined cupola. I understand that there are jacketed cupolas at work, and I should be glad to know where, and whether or not they have been a success? Any information or hints about getting the best results will oblige—CAST METAL.

[57530.]—**Bar Magnets.**—I have a couple of polished steel bars, each 12in. long by 1½in. by ¼in. Will a battery of six Grove's cells be sufficient to magnetise these, and what is the best sized wire to coil round them? Will No. 24 silk-covered copper-wire do? Perhaps someone can kindly recommend me a good book on magnets; one treating the subject more fully than textbooks can afford to do?—POTASH.

[57531.]—**Pulleys.**—I want to drive a 9in. pulley 1,000 revolutions per minute from an intermediate shaft with a 36in. pulley. What size of pulley shall I require at the other end of shaft to be driven from the engine with a 54in. driving-wheel making 140 revolutions per minute?—MILLWRIGHT.

[57532.]—**Speeding Pulleys.**—Will some brother reader tell me which is the best work on gearing and speeding wheels and pulleys?—MILLWRIGHT.

[57533.]—**Setting small Coleoptera (Beetles).**—I shall be glad if some entomologist will inform me how to set those of the coleoptera which are not sufficiently large to admit a pin through the thorax. I have tried the following methods:—Turn the insect on to its back and brush the legs out into position, then turn it back and stick it down with a mixture of clear gum. These directions are given in the Bethnal Green Museum, but are not successful, as it is impossible to keep the legs in position. Then I have tried putting it on a drop of clear cement or gum and brushing the legs out, of course using a magnifying glass, but the insect sticks to the instruments. I have also tried putting a small quantity of thick gum on a piece of card, and pulling the legs out from underneath the insect. In some cases I find this impossible, as they come out one side and not the other; then, in trying the other side, those already in position shift, and also the insect does not stick fast enough to stand the pull on its legs and antennæ. Can someone relieve me of this difficulty?—AN AMATEUR ENTOMOLOGIST.

[57534.]—**Tallow.**—Would any reader oblige by informing me what process is employed for removing the smell of tallow? What chemicals are used, &c.?—ARCHYTAS.

[57535.]—**Legal.**—If "A." finds an article upon the highway, is it right for him to keep it if he cannot hear any inquiry of the article being lost, or is it his duty to inform the town crier, or to show the article to a police officer, and then keep the article? But should inquiry be made after the article, what reward can "A." claim?—say article worth 20s.

[57536.]—**Tin Scrap.**—I should be very glad if some of your readers would advise me as to disposal of a large quantity of the above. Would it pay to adopt some patent for recovering the tin, and, if so, whose?—CONSTANT READER.

[57537.]—**Lathe Query.**—Can any fellow reader of the "E. M." help me in this matter? I have purchased a 5in. screw-cutting treadle lathe from Messrs. Bundy and Co., of Holborn Viaduct, and wish to attach a s.a. surfacing attachment working off screw; can this be done? The screw is ¼in. pitch, and the saddle is 3in in advance of screw. Messrs. Bundy inform me that s.a. surfacing off guide screw is not preferable, as it damages screw by being so continually at work, and they refuse to fit the lathe, except by independent back shaft;—are they right?—J. H. PHYL.

[57538.]—**Running Staffs and Cylinders into Watches.**—I have been looking through my last three years' ENGLISH MECHANICS for instructions how to use the graver to run staffs and cylinders into watches; this I have failed to find. Would some friend inform me how this is done? Also how to make conical pivots, and the shape of gravers and the best means to adopt to prevent the pivots falling off the centres when they are being turned?—FELLOW WORKMAN.

[57539.]—**Wimshurst's Influence Machine.**—I wish to know whether the bosses cemented to the glass plates, and through which the axle runs, if made of brass, would in any way affect the working power of the machine? I find the wooden ones very soon wear loose, and I have, therefore, to move the plates further apart to prevent their touching.—ALGERNON FORSYTH.

[57540.]—**Dynamo.**—Can "C. D. R.," or any other reader of "Ours," inform me of the cheapest sort of dynamo to light, say, four 5 c.-p. lamps of about twelve volts each? I propose to make a water-wheel like Mr. Coxeter's unless it is infringing his patent, in which case I shall be glad to know. Also the cost of the dynamo and of making the water-wheel? If it were possible to get one cheap, I would prefer getting a dynamo and water-wheel combined, like Mr. Coxeter's exhibit at the Exhibition.—CATO.

[57541.]—**Legal (Drainage).**—TO MR. WETHERFIELD, OR OTHERS.—On one side of my house are two others, and I find that their drains run into mine, the junction being in my garden and near the house, by side of which the pipe runs to join main drain, running along high-road and in front of all the houses. I am informed that it has been so ever since the houses were built, about 23 years ago. Can I compel the landlord of next houses to disconnect his drain from mine? In the event of a stoppage on my premises, although, perhaps, caused by the neighbours, must I be at expense of clearing it? Again, I wish to put proper sanitary traps in, and, of course, expense will be greater under the circumstances. I may, in the future, wish to build over where drains run, and it does not seem fair for me to have the danger and trouble of other people's drains. I may add that the houses are in a London suburb, and it would be perfectly easy to drain the other two into main drain, since they also have a side entrance. An early reply will much oblige—SANITAS.

[57542].—**Pull-up Weight.**—Please say what sh
the pull-up weight be if an inch leather belt be naile
the floor and passed over a 9in. pulley of a 2-man en
and weighted?—J. MACDONNELL.

[57543.]—**Address Luggage Labels.**—How
these made, to be so stout and nicely glazed for wri
upon? What is the composition, and how applied to
thin calico foundation?—OH! THANK YOU.

[57544.]—**Harmonium.**—I have a harmonium
one row of reeds, 8ft., broad. Will any reader kindly
which of the two will be best: to add another row of r
a mixture of 16ft. and 4ft. (the latter to commence at
C) instead of having either 16ft. or 4ft. throughou
having two rows of organ reeds, 4ft. and 8ft., with
exhaust system?—J. C.

[57545.]—**Turk's-head Knots.**—Will some c
spondent kindly give a description of how to make
knots upon a rope for climbing purposes in a gymnas
—GYMNASTIC.

[57546.]—**Dynamo.**—TO MR. EAVES.—Would
kindly give me the dimensions, with size and quanti
wire, for a dynamo of the same pattern that you
lately described to light one 10 c.-p. and two 5 c.-p.
lamps; it is to be shunt wound.—W. B. S.

[57547.]—**Gas Tank for Theatre.**—On page
Feb. 13, 1885, No. 55744, is drawing of a tank. Woul
pressure be equal until gas was all consumed? Sha
glad of advice. Would small pair of gasometers be
portable to move from place to place? I should thi
would require great pressure on gas to force the wate
of bottom into top chamber.—NEMO.

[57548.]—**Water-wheel.**—I have a model w
wheel, with a tank above it to supply the wheel, and a
under to catch the water. Could I make the wheel p
the water from bottom tank into top tank, and so h
continuous supply on the wheel, or how could it be d
The wheel would not have to work anything e
T. C. W.

[57549.]—**Chemical Calculation.**—Will som
our chemical readers oblige me with the full particula
working out the following:—What amount of 70
cent. caustic soda will be required to add 10 per ce
causticity to a ton of sodium carbonate.—ESAW.

[57550.]—**Fusion.**—I shall be extremely obliged
reply to the following:—At what temperature does f
in moist sodium chloride and in dry sodium chloride
place?—ESAW.

[57551.]—**Secondary Cells.**—TO "C. D. R."—I
I am not trespassing upon your time and patience in
ing for advice. I have just completed a small dy
(shunt) for house lighting, giving about 15 ampères
volts. I wish now to make a set of storage cells f
Will you kindly give me instructions how to proce
not asking too much? I have read your reply to
57356 with pleasure. I should like to know how the
are made (the outer edges being thicker than the inte
and how joined together and formed? I require to
twelve lamps of 20 c.-p. if possible.—ELECTRA.

[57552.]—**Dynamo.**—TO "W. H. E."—Having,
your instructions, constructed an armature of the foll
dimensions, would you kindly assist me further as to
—Dia. of armature (external), 8in.; thickness of core,
length of armature, 4in.; number of sections, 24; wir
16 d.c.c.; total weight, about 3lb.; rest. of arm
0·165 ohm. What length and dia. to give to core of
(I suppose there will be only two legs)? What a
and size of wire to wind on them? The machine is
shunt wound. What number of ampères and at
potential will the machine work best? Also num
revolutions; also what thickness to give to pole-piec
ELECTRA.

[57553.]—**Cement for Glass.**—Wanted, a ceme
sticking glass to metal and wood, which will withsta
dissolving action of petroleum, benzoline, and
mineral oils.—JIMBO.

[57554.]—**Watch Jewelling.** — Will any o
watch-making friends kindly explain the manner of
the English mandrel?—A. D.

[57555.]—**Brass and Leather Cement.**—
someone kindly tell me what kind of cement will
leather firmly adhere to polished or clean brass?
pieces of leather required to be cemented to the bra
only small, but must adhere very firmly. The leather
dressed doeskin. The same cement would do for
sheepskin.—URANIUM.

[57556.]—**Secondary or Storage Batter**
Having read in a daily paper that these batteries are
very largely and economically used in America
Brush system for lighting purposes, I should be obli
some of our electrical friends could give a descript
same. Also if they could recommend the best and
work on the subject of the secondary batteries at pr
in use.—WERDNA.

[57557.]—**Oysters.**—Can any of your readers r
mend a wire to protect oysters in the sea,
does not contain any copper or any poison whate
Galvanised wire has been tried and failed, as the galva
part comes off in a few months.—OYSTER.

[57558.]—**Dry-plate Development.**—Some
plates, when the exposure appears right, do not deve
they should do: I cannot get the image to a
although I continue the development for 15 or 20 mi
and when finished so much of the picture is clear
Will someone kindly tell me what is the cause of thi
what I can do in such cases? I use the pyro-develo
given by Marion and Co., and get on so well with it (
in such cases as above) that I like it better than the
sulphite or ferrous oxalate, both of which I have trie
find that altering the solution does no good.—E. Y.

[57559.]—**Studio.**—I intend building a studio, a
thinking of having the north side and roof all glass a
south side and roof built up with opaque material, s
protect it from the sun. Will some kind photograph
if such a one would be wisely constructed, or should
some light upon the south side? I have been think
using waterproof cloth or felt of some sort, and shou
glad to know where I could get something of the ki
would do; also price of same, or of some better p
someone could kindly suggest one. My chief objec

e that I could easily take down if I wanted with- aging it. Any information will be thankfully .—AMATEUR.

.]—**Press.**—I have a C.D.V. hot rolling press, and e glad if some one would give me a little instruc- o its use. I have tried it at different heats, but ɾt it to put the least polish on the prints. Should s of the prints be coated with something before rough the operation?—HAY HEN.

.]—**Phosphorus and Silicon in Steel.**— nalysis of steel for P and Si the nitric or aqua regia of the steel has to be evaporated to complete dry- 'he bumping which takes place during this opera- confounded nuisance, often necessitating loss of having to repeat analysis in consequence of loss ng. Can any brother reader give me a hint how to his, and thus make the estimation of P more ous?—NOVICE.

.]—**Speed of Air Particles.**—Can anyone tell average speed of air particles at pressure of 15lb. heric) according to the dynamo theory of gas ? I think people would take more definite views navigation if they would calculate the power in unds exerted by 33,000lb at rest or falling an imal space?—J. NOEL.

.]—**The Isle of Man Steamer, "Mona's .**"—This, I believe, is the name of the new steamer 'leetwood station, and is considered the largest and oat belonging to the company. Could any reader l particulars of her engines and boilers, such as d stroke of piston, number of revs. per minute, nsumption of coal per hour? Much is said in pages on locomotives, but very little on marine ring, which I am certain, if the subject is taken ld prove most interesting and instructive.—D., ster.

.]—**Leclanche Battery.**—I notice in my he's, after they have been in use a short time, a of white crystals in little groups on the zinc rods, e surface of the liquid. I should be glad to know position of these crystals, and whether they that the solution needs renewing, or that anything vrong with the battery? I don't use a saturated of salammoniac.—JOH.

.]—**Gramme.**—TO MR. BOTTONE, OR OTHERS.— small machine the following dimensions:—Four gnets, ½in. by 1⅞in; ring armature, 3in. diameter, e, with nine spaces for holes, ⅜ wide, ¼ deep. What e on fields and armature, and how much for incan- lamps? Also whether series or shunt is best, and any 10 c.-p. low-resistance lamps could light?— o.

.]—**Sawdust.**—What is the best method of remov- dust from under saw benches? Can it be done by ust tube, or an air blast under a hopper beneath bench? The sawdust is needed to be taken quite the building.—HECTOR.

7.]—**Compressed Gases.**—Will anyone who d compressed gases for limelight kindly say how nswer? Also what is the best way of com- g them, and what kind of gauge would show the e?—HECTOR.

8.]—**Problem.**—I shall feel much obliged if some- l show me in plain figures how to find the power d to keep a tank or cistern at a constant pressure of er square inch, the outlet on side at bottom being a., the inlet on side at top being 1⅞in dia., and what ce if inlet were only ⅝in. dia.—YOUNG APPRENTICE.

9.]—**Electric Light.**—Will someone please say ay Leclanché cells I should require to work an lamp for a small shop window, say 4ft. by 6ft.? to do it more as a curiosity than for use, and wish if one of the fairy lamps, at 7d., advertised, will be d? If not, what kind will, and the probable cost? S.

0.]—**Defective Flue.**—I have consulted several , and carpenters, and chimney-sweepers about a that at present exists in connection with a flue of a elonging to me. The wall in which the flue exists able-end of a dwelling-house, and is nearly, if not ntirely formed of cob, with a brick stack on the top of le-end and a chimneypot with three pans on the top stack. The flue, previously to my raising the stack ing and putting the pot with the pans on it, very badly indeed; but since I made the alteration bout eleven years ago) it has not smoked or caused noyance whatever till about between two and three go. About this time the flue had been allowed to very full of soot, and one day it caught fire and furiously, and, in fact, was like a furnace. Shortly his it was swept by one of the brush machines, and e months appeared, I believe, to be as well as usual; er a time it was noticed that if there was no fire for time in the fireplace in connection with the flue m to which the flue belonged smelt abominably strong , and, in fact, like as if it were part of the flue itself. party who last swept the flue used one of the brush es to sweep it with, I was advised, by a gentleman ad had large experience as a builder and archi- employ a mason and man to sweep it by dragging m fastened to a rope up and down the flue. This ne, but it effected no improvement whatever. Then r man, who was thought to have a very superior machine to the one I had employed previously, swept this also did no good whatever. The room remained as ever, and is simply uninhabitable, unless there is in it. When there is a fire in the room no smell is able; but let the fire go out, and in a very short time oty smell, peculiar to the inside of flues, re- and is perfectly unbearable. I cannot myself e what is the cause of this shocking state of matters, lthough I have consulted several experienced trades- find they can give no explanation of the cause of fect. One thought it would pass off in time on my g for some little time a thorough good fire in the This also has been tried for months and months. not the slightest beneficial effect. If any of the s of your valuable paper could give some reasonable ation of this, as it appears to me a very singular and could suggest anything that would remedy it, I l be exceedingly glad to be made acquainted with it. ue is straight from bottom to top, and can be seen through, and the chimney-sweepers and masons assure me that there is nothing that they can see the matter with the flue, and that it is perfect clean, and that the fire that, as I have mentioned, burnt has made no visible change in it that they can see. Whether the fire in the flue in any way occasioned the change I cannot say, but certainly there was nothing of the kind the matter with the flue previous to the occurrence of the fire. I have now furnished you with all the particulars in reference to the matter I can think of, and trust someone will be able to enlighten me on the cause of the defect, and tell me how to set matters right again.—ENQUIRER.

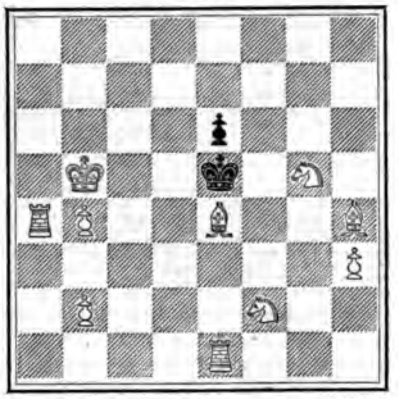
CHESS.

◆

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLVII.—CHECK.

Black.



White. [10 + 2

White to play and mate in two moves.

SOLUTION TO 955.

White.	*Black.*
1. R-K Kt 6	1. Anything
2. Q, R, or Kt mates.	

(Nine variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 954, by F. O'N. Hopkins.

TO 955, by L. T., V. S. Pochin, Rev. W. Anderson (Old Romney), E. Stanley Follwell (capital, good variety), A. A. E. Lecluse (a very able problem), R. A. Bennett.

T. C. RYE.—There is no limitation as to age; at present yours is the only name we have received for the Junior Tourney. The rules would be the same as for the other, with the exception of the amount of entrance fee.

G. W. FARROW, W. H. L. MONCK, AND REV. J. T. C. CHATTO.—We have entered your names for the new Correspondence Tourney. There are still four vacancies.

H. PRENTICE.—In 952, after 2. $\frac{\qquad}{\text{K takes B P,}}$ 3. P-Q Kt 8 becoming a Kt mate; white is allowed to call for what piece he pleases on reaching the 8th square with his P.

T. BECKETT.—Q-K Kt 4 is not mate, as R covers.

Messrs. Blake and Russell have tied for the second prize in the ENGLISH MECHANIC Game Correspondence Tourney, each having won 12½ games and lost 1. They have, therefore, divided equally the second and third prizes (£1 and 15s.) Messrs. Bourn and Nash have tied for the fourth prize, and are now playing the final game.

CHARGES FOR ADVERTISING.

	s.	d.
Thirty Words	2	6
Every additional eight words	0	6

Front Page Advertisements Five Shillings for the first 40 words, afterwards 9d. per line. Paragraph advertisements One Shilling per line. No front page or paragraph advertisement inserted for less than Five Shillings. Reduced terms for series of more than 6 insertions may be ascertained on application to the Publisher.

ADVERTISEMENTS in EXCHANGE COLUMN—for

	s.	d.
Twenty-four words	0	3
For every succeeding Eight Words	0	3

ADVERTISEMENTS in the SIXPENNY SALE COLUMN.

	s.	d.
Sixteen words	0	6
For every succeeding Eight words	0	6

*** It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions; and in cases where the amount sent exceeds One Shilling, the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O's.

The address is included as part of the advertisement, and charged for.

Advertisements *must* reach the office by 1 p.m. on Wednesday, to insure insertion in the following Friday's number.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

Holloway's Pills.—These pills purify the blood and act most powerfully on the liver, stomach, kidneys, and bowels, thus giving tone, energy, and vigour to the whole system. They are wonderfully efficacious in all ailments incidental to females, young or old, and as a general family medicine are unequalled.—[ADVT.]

Every Workman connected with the Building Trades requiring a Situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 332, Strand, London, W.C.

"THE BUILDING NEWS" is the Principal Journal representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

Every Workman should insist on seeing "THE BUILDING NEWS" every week at his Club or Coffee House. He will find more "Lists of Tenders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Intercommunication" if he wants to know anything about his trade; to write to the Editor if he has any suggestions to make, and to advertise in the paper when he wants work.

The charge for Advertisements for Situations is One Shilling for Twenty-four Words, and Sixpence for every Eight Words after.

TERMS OF SUBSCRIPTION.

PAYABLE IN ADVANCE.

5s. 6d. for Six Months and 11s. for Twelve months, Post Free to any part of the United Kingdom. For the United States, 13s., or 3 dols. 25c. gold; to France or Belgium, 13s., or 16f. 50c.; to India (via Brindisi), 15s. 2d.; to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post-office order. Back numbers cannot be sent out of the United Kingdom by the ordinary newspaper post, but must be remitted for at the rate of 4d. each to cover extra postage.

Messrs. JAMES W. QUEEN and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes, they must be paid for at the rate of 4d. each copy, to cover extra postage.

Vols. IV., VII., XXVI., XXVIII., XXX., XXXII., XXXIII., XXXIV., XXXV., XXXVI., XXXVII., XXXVIII., XXXIX., and XL., bound in cloth, 7s. each. Post free, 7s. 9d.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free, 3½d.)

Indexes for Vols. I., VI., VII., VIII., and IX., 2d. each. Post free 2½d. each. Indexes to Vol. XI and to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

ANSWERS TO CORRESPONDENTS.

◆

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 16, and unacknowledged elsewhere:—

A. HEYWOOD AND CO.—C. Birchall.—J. C. Frank.—G. J. Scurfield.—W. T. Glover and Co.—A. J. Herbert.—T. S. Tinnè.—J. Mallins.—Gerard Smith, M.R.C.S.—Verion. —J. Rand Capron.—W. B. L.—Crumby.—S. R. Bottone. —Marcus.—A Fellow of the Royal Astronomical Society. —Cornee.—Canis Minor.—E. R. P.—J. E. Gore.—A. T. —Albert H.—A New Subscriber.—Ignorant.—H. G.— Frank Cocks.—Reflex.—J. Colby.—H. L. C.—C. E. O.— Loco.—Busy Bee.—A Country Cabinetmaker.—A. T.— Surveyor.—A. H.—Theorist.—Cathode.—T. B. Boscombe. Perthshire Farmer.—H. H. B.—C. Goddard.—Tinker Jack.—T. Casson.—R. R.

BORDERER. (No reference given to former answer, and the question is not sufficiently definite to reply. We cannot possibly pretend to remember the subject matter of every letter which reaches us. 2. There is Reynolds's work, "Stationary Engine-Driving," published by Lockwood and Co., price 4s. 6d.)—A NEW SUBSCRIBER, Bargoed. (See the index published with this number under head "Cupola," "Blast," &c.; if only small quantity is required, an ordinary fire will do, provided the chimney is tall, and you block up the part over the front of the fireplace, so as to make all the air go through the fire.)—F. SPENCER. (For fixing crayon drawings, see p. 377, Vol. XXXIX. The simplest plan is to spray them over with skim milk, or float them on the same, drying carefully afterwards.)—B. R. MILLS. (Have you tried it? Why should all those extra frictional points be introduced for no purpose?)—M. P. (Cement some pieces of close-textured fabric round the pipes by means of bisulphide of carbon solution of indiarubber. 2. Apply to any of the higher-class of tobacconists' shops.)—LAPIS. (Try shellac cement for joining the stone, and then set it in Portland cement or plaster of Paris on a stout board. If not successful, try again, and look through back volumes for hints.)—A. W. J. L. (Both queries have been answered many times. How can anyone tell you how to repolish without knowing what kind of polish was put on before? 2. Cut the limes out of hard stone lime, and round them up.)—P. SHAW. (We are afraid it would cause unnecessary alarm if we gave you sufficient space to inform people that cholera is spread and caused by magnetism.)—A PATENTEE. (For Acts of Parliament, apply to the Queen's printers, East Harding-street, E.C.)—G. W. GIBBONS. (The American organ "Vox humana," or fan tremolo, was described in No. 732, p. 97.)—TELEGRAPHY. (Procure the textbooks recommended, and read them carefully, then advertise for "Lessons by post." It is awkward being in an out-of-the-way spot; but you could get to Cardiff occasionally.)—JUAN XPTOBAL. (It is now merged, we believe, in the Welch-Parker-Smith brake, which is at the Inventions.)—WILL SERGENT. (Watt's "Electro-metallurgy," published by Lockwood and Co., Stationers' Hall-court, E.C., price 3s., will probably suit you.)—INDIARUBBER CASTING. (The subject has been frequently referred to. The material, after mixing, must be subjected to pressure and heat, which is most conveniently done in a vulcaniser. See the articles on the "Indiarubber and Guttapercha Industries," mentioned last week in answer to "F. M.")—INQUIRER. (If every object is seen "surrounded with coloured rings," the glass is certainly not achromatic. Better let the optician examine it, and explain what he means by achromatic.)—W. FAIRLEY. (We cannot help you any further than the booksellers. They will no doubt hear of it when it is published.)—J. W. (Do you mean the "Complete Practical Machinist," by Joshua Rose? If so, it is published by Sampson Low and Co., Fleet-street, E.C.)—W. H. B. (We do not know of such a work, and should think it improbable that there is one. There are articles in the Encyclopædias.)—J. W. L. (We cannot spare any more space to the Rocket. See pp. 219, 302, 341, 454, 496, 519, 540, 558, Vol. XL.)—J. B. (With a little attention, you will be able to read the index. Take note that the indices move in different directions with adjoining dials, and then read that figure only which the finger or index has passed. When the index is on a figure, the adjoining dials will show whether it has to be reckoned or not. Thus, at 7998 the index of one dial would be on 8; but the preceding dial would show that 8,000 had not been reached.)—BOTANY. (The only way is to submit your specimens to an expert, or to advertise the collection and ask for offers.)—BROOKER. (Why a "storage" battery, for such a purpose? You want a primary battery, and you will find several suitable described in back numbers—chloride of silver, Skrivanow, and other cells.)—B. C. J. N. (For oxidising silver, see pp. 311, 394, Vol. XXXVIII., and the indices generally.)—AMATEUR ASTRONOMER. (How is it possible we can tell you from such a description? It is large enough to show most of the planets, but there are few in suitable position now. However, Saturn is coming along, and by trying it on him, and comparing with drawings, you will be able to form an idea of the quality of your telescope; but you must not expect too much from 2¼in.)—FICUS ELASTICA. (Propagated by cuttings placed in sandy soil and subjected to strong bottom heat. The last three words probably point to the cause of your failure.)—W. A. SMITH. (Please send.)—ENQUIRER, T. WOOD, A. S. L., W. H. EAVES. (In type.)

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Nickel Plating Vat, 12 gallons, quantity of Anodes, Nickel Salts, Batteries, &c., cost over £5. Offers.—J. GRIME, Prospect-street, Hull.

Omnicycle, nearly new, cost £26 10s., Butler's latest patent, three different powers. Offers.—J. GRIME, Prospect-street, Hull.

Hot-Air Engine, ¼ H.P., Buckett's Caloric, new, in perfect working order, cost £22 10s. Offers wanted.—JOHN GRIME, Prospect-street, Hull.

I will exchange a **Musical Box**, in perfect order, playing 8 tunes, for one broken or out of order.—HAWKINS, 122, Corporation-street, Manchester.

Wanted, **Medical Battery**, Electric Bell, Microscope, Musical Instruments, in exchange.—H. JOURNET, 43, Tottenham Court-road, W.

Wanted, first-class **Tricycle Fittings**, by mechanic, in exchange for partly finished 5in. centre screw-cutting Lathe.—R. WALSH, 1, Bank-street, Chorley.

Engineer's **Stocks, Taps, and Dies**, and other Tools, in exchange for Tandem Fittings; must be good.—R. WALSH, 1, Bank-street, Chorley.

Magnificent single-stone **Diamond Ring**, recently cost £5. What offers in exchange?—S. GORTON, Paradise-street, Coventry.

Twenty parts "**Cassell's Encyclopædic Dictionary.**" Offers wanted in Tools or Lathe Castings.—11, Princes-street, Dunstable.

Dynamo, Siemens armature, 6in. long, 2½ diameter, beautifully finished; photo. on application; also "Engineering," volume XXXVI., July to December, 1883; volume XXXVIII. ditto 1884, not bound, also numbers for January, February, June, 1884. Exchange for hand Sewing Machine, preferably "Howe" or "Prima Donna," or offers, separately or together.—H. PADGHAM, 7, Malpas-road, Brockley.

Two magnificent **Models** of an American Saloon Steamer, 46in. long, "The Bristol," and H.M.S. "Devastation," 40in. long, made to Admiralty drawings (guaranteed), both to scale, very minute, under glass cases, inspection invited, value £250; part exchange.—49, Goodhind-street, Bristol.

Will exchange my splendid large **Coil** for Micro. Objective, Lathe Heads, or Nasmyth and Carpenter on Moon.—R. G., 1, Tavistock-terrace, Holloway.

Fine Model **Yacht**, 3ft. long; exchange Lathe Heads, Drilling Machine, or offers.—S. ANDREWS, 1, Tavistock-terrace, Upper Holloway, N.

What offers for Tourist Quarter-plate **Photographic Set** complete? 10in. Vulcanite Plate Electrical Machine, Banjo, Flute Music, Hand Dynamo.—A. PERCY SMITH, Rugby.

Jeweller's **Kit of Tools**. Exchange Biunial and Views.—67, Thomas-street, Aston-road, Birmingham.

"**Knight's London and Timbs' Curiosities,**" complete in 32 numbers, cost two shillings each. What offers? Exchange.—T. GORMAN, Hawthorn-road, Kettering.

"**Scientific American,**" guinea subscription Nos. for 1884, complete and in good condition; every number superbly illustrated. What offers?—A. H., 17, Noel-road, Birmingham.

2ft. **Tank Locomotive**, with pump, pressure gauge, &c., for small Screw-cutting Lathe, or offers. Stamp for particulars.—SARGERT, 25, Holywell-street, Strand, London.

Good **Violin and Bow**, in exchange for some other musical instrument; banjo preferred.—W. TOWNSEND, 18, Butter Market, Bury, Suffolk.

36in. (Boy's) Surrey Machinist **Bicycle**, in exchange for good sound air-cane or scientific article.—W. TOWNSEND, 18, Butter Market, Bury, Suffolk.

Wanted, **Stereoscopic Camera**, complete, with extra slides for dry plates. Good exchange. Microscopic Slides, &c.—Full particulars on foreign postcard to CHURCHILL, Gibraltar.

Emery Wheels.—Will exchange three for headstock, &c.; also genuine foster mother for incubator.—T. H., Lympstone, S. Devon.

Six Smee **Cells**, Electro Magnets, Swan Lamps, two tens, two twenties, and one Edison. Bell Wire and Pushes wanted, or offers.—J. SMETHURST, Oak-street, Radcliffe, near Manchester.

Lantern Slides.—Lot views Scottish Scenery. Will take 4s. 6d. per dozen, or exchange for others.—FINLAY, 5, Wendover-crescent, Mountflorida, Glasgow.

Violin, very old, mellow, even tone. £5, for good Stereoscopic Camera, twin lenses, double backs.—HEAD MASTER, Surrey Lane Board School, Battersea, S.W.

Wanted, E-flat **Piccolo**, will give good exchange.—W. J. B., Elmslea, Kidderminster-road, Croydon.

Wanted, **Scientific Books** (electrical preferred); will give in exchange electrical apparatus or others.—Apply as above.

Exchange ¼-plate swing-back **Camera** and Inst. view Lens, Dark Tent, and case of Stock Solutions; 2 double Dark Slides, Tripod Stand, Developing Trays, Printing Frames, and Stereoscopic Camera and Lens, and 5 slides and plate box in case; 2 dozen Thomas's dry plates; 2 large gold shield show frames for window; several pairs of achromatic lenses; 4 dozen cabinet mounts, 12 by 10 outside; 4 gross of picture rings, new; 2 large portable sinks for photography; 1 dozen 16oz. stoppered bottles; 16oz. of silver nitric bath; two 2 by 16 oil paintings, by F. Foster, North Wales; one 12 by 8 painting, by Marshall; 1 dozen passe partout mounts, cabinet; 1 metal frame Didan chair, plated and engraved, for carte-de-visites; 1 leather case, holds half dozen C.D.V. coloured jockey, with Fred. Archer and T. Cannon, fitted with Talalk, new, and about 20 or 30 salts in bottles; toning bath; negative box, hold 4 dozen: in fact, a heap of things useful in photography. The lot together or separate. What offers?—K., 24, Woodbridge-street, E.C.

Electric Motor to drive sewing machine, used thrice; also gent's solid Gold Dress Ring, set with brilliants, Hall-marked, 15c.—18, Gladstone-avenue, Chester.

Six-cell **Bunsen Battery**, also Musette. See last week's advertisement. Exchange Dynamo, Lathe, Dissolving-view Lanterns. Offers.—A. LAUNDY, 112, Romford-road, Stratford, Essex.

Lathe, back-geared, part finished, 6ft. oak bed, faced with iron, double crank, 4-speed turned wheel, gut, iron standards; exchange mutual.—W. SMITH.

Perambulator Wheels, ⅝ rubbers, axles turned, complete; approval. Anvil, 2¼ cwt., lot tools, 14 gallon tank; exchange offers.—W. SMITH, Bilston-road, Wolverhampton.

Wanted, **Photographic Apparatus**. Will exchange Silver Watch, Electric Battery, Books, &c.—C. BARNETT, 82, Richmond-road, South Kensington.

"**English Mechanic,**" 7 vols., XXXIII. to XL., three numbers missing, in exchange for Silver hall-marked Watch Chain.—A. PERKS, 43, Coten-end, Warwick.

A 5-light **Dynamo**, scarcely been used, for a Wheatstone Bridge or small Launch Engine.—LOWDEN, Reform-street, Dundee.

Gas Table Lamp, Railway Reading Lamp, Vol. XXXII. "English Mechanic," unbound, complete, with index and quantity of odd numbers. Offers.—17, Wakefield-street, Warrington.

Stocks and Dies for gas; Hydraulic Jack, 4-ton, by Tangye. Exchange Lathe Heads or Slide Rest, or offer.—16, Riley-street, Bermondsey.

Wanted, small back-geared **Lathe**, cheap, in exchange for Books and cash.—W. JONES, Teal-street, Bethnal Green, E.

Wanted, complete **Set of Castings** for small Bench Lathe. Will exchange Gent's Silver Geneva Watch, in good going order.—Send full particulars to R. H. TERRY, 39, Roman-road, Old Ford, E.

Front Slide Lathe Bed, planed all over, 3ft. 6in. long, worth £3; for good Microscope Objective.—W. A. C. SMITH, 142, Ingleby Drive, Dennistoun, Glasgow.

Wanted, small **Iron Printing Press**, small Stereo-casting Box, Lancaster's Le Merveilleux or Meritoire, in exchange for well-bound Books.—HENSHALL, Folly-lane, Swinton.

Lathe, 4½in. centre, 4ft. oak bed, silk-covered Coil Wire. Medical Coil and Platinum Zinc Battery, Musical Cigar Cabinet, out of order. Offers.—Below.

"**English Mechanic,**" Vols. XXIV. to XLI. "Knowledge," first 77 Nos.; "Amateur Work," Vol. I. to IV.; "Amateur Mechanic," first vol.; "House Decorator," 2 vols.—Below.

Model Printing Press, with three lots of type, Breech-loading Gun, Silber Lamp. Offers for above.—FLOYD, 139, Portobello-road, Notting Hill, London.

Tripod Stands, Government make, mahogany and brass, and Ship Telescope, 3ft. long; take Cast-off Clothing.—HERBAGE, 1, Hedger's Grove, South Hackney.

Lady's **Silver Watch**; will take parcel of cast-off Wearing Apparel for it.—HERBAGE, 1, Hedger's Grove, South Hackney.

Grey Parrot, young, will make good talker; a parcel of Cast-off Wearing Apparel taken for it.—HERBAGE, 1, Hedger's Grove, South Hackney.

A beautiful family **Album**, very large, well bound, pretty ornament for drawing room; for Cast-off Clothing.—HERBAGE, 1, Hedger's Grove, South Hackney.

To Club Houses, Scientists, and Others.—Binocular Microscope (Beck), with all necessary appliances, with 2 Cabinets arranged for objects. This grand instrument cost £120; price £40.—CLARKSON, Bartlett's-buildings, Holborn, E.C.

7½in. **Object-Glass**, clear aperture, by Dollond. What offers?—W., 10, St. John's-road, Pitfield-street, N.

Offers are requested for 14½ **Telescope Mirror**, requires resilvering. Capital figure.—Z., 9, Ball's-pond-road, N.

TO AMATEUR TURNERS AND THE TRADE.

AFRICAN BLACKWOOD, BOXWOOD, BARWOOD, COCUSWOOD, EBONY, LIGNUM VITÆ, LANCEWOOD, MYALL WOOD, OLIVE WOOD, PURPLEWOOD, ROSEWOOD, SATINWOOD, SNAKEWOOD, TULIPWOOD, ZIRICOTI, MADAGASCAR RED WOOD, KINGWOOD, and many other Fancy Woods.

GEO. POTTIER,
Foreign Hard Wood and Fancy Wood Merchant,
115, BETHNAL GREEN ROAD, LONDON, E.
Colleges and Schools supplied. List of Woods, one stamp.

THE SIXPENNY SALE

Advertisements are inserted in th rate of 6d. for the first 16 words, a succeeding 8 words.

Motor Castings, materials fo Batteries, Galvanometers, Intensity Coils. MENDHAM, and Co., Bristol.

Insulated Wire Table, show resistance per foot, feet per ohm, &c., price 3d and Co., Bristol.

Standard Ohm, in box, copper correct to ten thousandth of ohm, 21s.—KING, Bristol.

Wimshurst **Influence Machine** turers of Improved Pattern. Numerous testim efficiency.—KING, MENDHAM, and Co., Bristol

Galvanometer Cards, improved ordinary combined, 2½in., 8d.; 4in., 10d.; 6in above.

Write for **King, Mendham, and** and reduced Price List, post free 4 stamps.

Electric Depot, 10, Deansgate, Ma Breast Pins, 25s. Electric Bells, 4s. Inductio Proprietor.

New Illustrated Price List of **Scre** NUTS for Model Work, drawn to actual stamp.—MORRIS COHEN, 132, Kirkgate, Leeds

Lathes. Lathes. Cheap and g guaranteed. List two stamps. Best make.—E street, Sheffield.

Fretwork.—Catalogue of every r illustrations, free for 6 stamps.—HARGER BR

Planing, not exceeding 10in. by 1 CLEGG, 18, Belinda-street, Hunslet, Leeds.

For **Model Work** (wheel-cutting i Boring, Turning, and Screwcutting.—CLEGG,

Hammond's Patent Mitre F the best, cheapest, and quickest Cramp for all it cramps the four mitres in one action, and can be nailed at the same time; price 23s.; sen orders payable to G. R. HAMMOND, Snodland, on application.

Optical Glass of finest quality, cr sizes in stock to 14 inches diameter, discs and al Blenheim-grove, Peckham.

Lathe Castings, &c.—See T. ment in ENGLISH MECHANIC every other we

Gold and Silver Fish, 12 for Plants, Snails, Shingle included. Stamped ad inquiries, or illustrated price list of Fish, Re from every part of the globe.—Zoological Ex road, N.W.

Crouch's **Binocular Microscop** changes for sale, perfect condition.—66, Barbic

Water Waste Preventers, especially made for strength, 24s.—KNIGHT, stoke.

Living Microscopic Object Polyzoa Plumatella and Cristatella, tube eithe Alvechurch, Redditch.

Engine, double oscillating horiz horse, £6, a bargain.—JOURNET, 194, Great Po

Oxygen Gas, compressed in cylin safest for limelight.—CLARKSON, Compresse lett's-buildings, E.C.

Oxygen Gas, compressed into nitrous oxide and carbonic acid.—CLARKS Chemist.

Oxygen Gas, compressed into ir on application.—CLARKSON, 28, Bartlett's-bui

Astronomical **Telescopes** of all ki or Fittings made by A. CLARKSON, 28, Bartlet

Eyepieces.—Huyghenian of any telescope, 15s. each. Sun Diagonals, £1. Star

Astronomical **Telescopes**, seco makers.—CLARKSON, 28, Bartlett's-buildings,

"**Warne's Sheet Metal Wor** cheap, covers soiled.—94, St. Augustine's-road,

Mechanical Tools (various). dozen, wood 6d. foot, machines and frames.— Cullum-street, E.C.

Mica or Talc cut for all purposes New Oxford-street, London, W.C.

Cast Steel.—Practical process of w tools, springs. Manual, 12 stamps.—J. F. B row, Aberdeen.

Birmingham Goods.—(All Clocks, Watches, Jewellery, Furniture, Wanted. Wholesale Book free.—HENRY MA

Magic Cube.—"A marvel of i *Monthly*. 3½d.—JAMES CRAM, Euclid-crescent,

Piles.—Worst cases cured first app Ointment," 13 stamps.—THOMAS PALMER, land, Durham.

"**See-Saw,**" "**Fairy Voices,**" po music sold at one-third marked price, Stroud.

The Cheapest House in Eng instruments.—DAUNCEY, Stroud.

A good, sound, well-made **Piano** warranted. 12 guineas.—DAUNCEY and SON,

Patents, Designs, and Trade JAMES STEVENSON, The People's Patent born, W.C.

Diagrams.—Lecturers, Teachers, ing letter-diagrams should send stamp.— Chemist, Aspley, Huddersfield.

Batteries.—Pint Bunsen's, Daniell each, post free 1s. 6d.—GEO. HAILEY, Nov Liverpool.

Sets of **Planing Machine Cas** by 12in. by 12in.; price, rough, 72s.: planed, £1

The **Amateur's Milling Att** horizontal, vertical, and lateral traverses of ALLSOP.

Castings for above—re weight, 100lb. Particulars.—G. AL

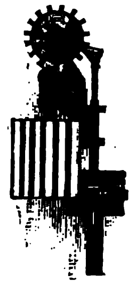
The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, SEPTEMBER 25, 1885.

LIGHTHOUSE ILLUMINANTS.

THE report of the Trinity House Committee on Lighthouse Illuminants does not seem to meet with that universal commendation which was expected, although the experiments have been carried on for twelve months at much expense, and with considerable unnecessary elaborateness. The origin of the experiments may be briefly described as an attempt to arrive at some uniformity between the French authorities, the Trinity House, and the Board of Irish Lights. The French authorities had it in contemplation to make a radical change, in lighting their coasts by electricity (they have already several electric lighthouses); the Irish Board had already adopted gas for many of their more important lights, while the English and Scotch coasts were marked out mainly by oil lamps. To make a general change from oil to gas would involve a heavy cost, which was naturally objected to by the Elder Brethren and the Board of Trade, and the question then arose whether if any change were made it should not rather be in favour of electricity. There is no question that the electric light is very beautiful as a lighthouse illuminant, but practical mariners are not enthusiastic about it, while not a few positively object to it, its dazzling brilliancy tending to mislead them in calculating distances. No light has ever equalled it for distinctiveness of character, and in that respect the electric beam is welcomed by the navigator; but in spite of the "report," he is not yet satisfied that the electric arc can penetrate further through fog, or rather haze, than one of the older-fashioned lights of the first order. The year in which the experiments were carried out was marked, as the committee themselves state, "by a singular prevalence of clear weather," and yet they report that the electric light exhibited in the A experimental tower at the South Foreland, was the most powerful under all conditions of weather, and had the greatest penetrative power in fog, as compared with the gas and oil lights in the other towers. They also say that the gas and oil lamps, for practical purposes, are equal; but that when shown through fixed lenses, the superiority of the superposed gas-light is unquestionable. The general conclusion, a sort of recommendation which will be followed, is that oil-lights are good enough for ordinary purposes, but that where a very powerful light is required electricity offers the greatest advantages. Part II. of the Report, which will be published shortly, contains the detailed reports on the electric light and photometry, diagrams, drawings, &c., and we hope the evidence of pilots and masters of vessels, who are the persons more directly interested. As a matter of fact, at many of the lighthouses around our coasts oil is the only possible illuminant, for the simple reason that there is no room to make gas or to put down the plant necessary for obtaining current; but the committee say that oil is much the cheapest illuminant both as respects first cost and annual maintenance. The figures and the conclusion drawn from them have been challenged, and it has been asserted that so far from the quadriform gaslight costing more for maintenance than the triform oil-light, it costs actually less, while the committee themselves report that the superposed gaslight shown through fixed lenses is unquestionably superior. It is obvious that gas is the least trouble, can be raised to its maximum power i[illegible]nds, and requires no attentior [illegible] lighthouse oil flame needs about twenty minutes' nursing before it can be brought up to full power. The importance of this point is seen when we reflect that in the case of sudden fogs three superposed lights can be added in a moment to the ordinary-weather light, if gas is used, while valuable time is lost if oil-lamps are employed. It is, however, noteworthy that while the majority of the lights around our coasts are "fixed" and "intermittent" (occulting), both having precisely the same optical apparatus, there is only one spot in the whole coast-line of Great Britain where gas is used—viz., the two lights at Haisborough in Norfolk. In Ireland gas is used at Howth Bailey, Dublin Bay; Wicklow Head; Hook Tower, entrance to Waterford; Mine Head, near Dungarvan; Galley Head, co. Cork; St. John's Point, co. Down; Rockabill, co. Dublin; Mew Island; and Tory Island. The electric light was first tried in this country at the South Foreland experimentally during 1857, '58, and '59, when it was agreed to use it as the permanent light at Dungeness. On Feb. 1, 1862, the electric beam shone out for the first time from any lighthouse from the tower on that dangerous point of the coast of Kent. The light was not exactly a success, on account of the imperfections in the apparatus, and in 1874 the old oil lamps were again brought into use, because Dungeness had grown out so far into the sea that the electric light, from its low elevation, was found to bewilder navigators, and prevent them making an accurate estimate of their distance. Meantime, however, improved apparatus having been invented, an electric light was installed at Souter Point, near Wearmouth, and the spot being suitable, mariners entering the Tyne have frequently expressed their opinion of its value. The next year, 1872, the electric light was also established at the South Foreland in two houses, and experiments being made there in 1877 with the improved dynamos of Siemens, it was resolved to use the electric light in the two towers at the Lizard. That completes the list of electric lighthouses in the United Kingdom, and notwithstanding the report of the committee, it is doubtful whether the number will be materially increased, except in the case of important points where a powerful distinctive light is required. The lights employed in the experiments were regulators having carbons of 20, 30, or 40mm. diameter, supplied with current by De Meritens magneto-electric machines. The nominal candle-power of the arc lights is given as 10,000 and 15,000, while the illuminating power through the lens in clear atmosphere was respectively 1,250,000 and 1,500,000. It would seem from these figures that the large increase in power of the naked light does not give a correspondingly augmented illuminating power through the lens; but there is no room to doubt their relative accuracy, as they are given on the authority of Mr. Harold Dixon, M.A., a gentleman who has had much experience in photometric testing. In foggy and hazy weather, Mr. Dixon says the multiform arrangement of gas and oil lights is extremely useful for distances beyond half a mile; but in the case of the electric light the greatest visibility is secured at short distances by sending the current from one or more machines through a single arc. He also concludes that in all weathers and at all distances the electric light, whether revolving or fixed, has proved superior to the highest powers of gas and oil. It is, however, contended that the experiments with the electric light are untrustworthy, for the beam was focussed directly upon the observers, and not, as in the case of all lighthouse lights, upon the horizon and the intervening space. To make the test fair between gas and electricity the two lights should be tested under the usual lighthouse conditions—that is, they should be visible at th[illegible]izon, and at all points between the [illegible] and the lighthouse. The evidence of pilots and masters of vessels, who have practical experience of the value of the lights in all weathers, will be deemed by the public of more value than the opinions of the special observers, and it is to be hoped that it will be published. It appears that altogether upwards of 6,000 observations were recorded of the different lights; but, for various reasons, it was found necessary to reject nearly 2,000, and an analysis of 754, taken for the purpose of comparing the electric light with the highest powers of gas and oil, give a superiority to the arc of 35 per cent. over the quadriform gas with 108 jets, and about 40 per cent. over the triform oil, with six wicks. That is, taking all kinds of weather and various distances. Upwards of 3,000 other observations were made to compare lower powers of gas and oil with different-sized arcs; but it is considered sufficient to give the result with the higher powers. As to the comparison between gas and oil, the former is only slightly better than the latter in the case of revolving lights, but is decidedly superior in all kinds of weather with fixed lights. The oil used is a paraffin, with a flashing point of 154° Fahr., and it is forced up to the wick by the pressure of a weighted plunger. The gas used is the best that can be made from cannel, and has an average illuminating power of 35 candles. The cost of making gas on the small scale necessarily renders it more expensive than mineral oil; but it has undoubted advantages, as pointed out above. The experiments have served a useful purpose; but, so far as discovering a really useful light for foggy weather is concerned, they have served to demonstrate that the most powerful light is useless in a thick fog; that the difference in visibility is measured by a few hundred feet, and that within a distance of less than 3 000ft. from the lighthouse. It seems certain, then, that for foggy weather the only approximately safe method of navigation is a code of signals indicating the direction in which vessels are steering.

GENT AND CO.'S NEW PATENT PNEUMATIC PENDULUM INDICATORS.

A RELIABLE direct-acting pneumatic pendulum has long been the aim of inventors, and Messrs. J. T. Gent and Co., of Leicester, have now supplied the want, as will be seen by the illustration. A toothed wheel is fixed over a swinging pendulum, and when the indiarubber bag is expanded by the pressure of air from the push, the V piece on the vertical spindle is lifted and moves the wheel round, in doing which another tooth catches the pendulum and causes it to swing. When the pressure is removed the V piece returns to its original position ready for another signal.



The bell is rung by the same action which swings the pendulum, by releasing an escapement in the usual way: it requires winding once a day or once a week by means of a lever and cord.

There are no battery, wires, or complications. Everything is strong and durable, and the whole is so simple that any ordinary workman can do the fixing.

ASTRONOMICAL NOTES FOR OCTOBER, 1885.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination South.	Sidereal Time.
	h. m. s. a.m.	h. m. s.	° ′ ″	h. m. s.
1	11 49 33·01 ..	12 31 5	3 21 22	12 41 31·66
6	11 48 2·37 ..	12 49 17	5 17 17	13 1 14·42
11	11 46 41·85 ..	13 7 39	7 11 33	13 20 57·18
16	11 45 33·44 ..	13 26 13	9 3 20	13 40 39·94
21	11 44 39·20 ..	13 45 2	10 51 51	14 0 22·71
26	11 44 1·41 ..	14 4 7	12 36 18	14 20 5·47
31	11 43 42·30 ..	14 23 31	14 15 52	14 39 48·24

The method of finding the Sidereal Time at Local Mean Noon at any other Station will be found on p. 355 of Vol. XL.

Spots and faculæ continue to appear upon the Sun's face.

The Zodiacal light is still visible in the East before sunrise.

The Moon

Enters her Last Quarter at 11h. 29·1m. a.m. on October 1st, and is New at 7h. 31·4m. in the morning of the 8th. She will enter her First Quarter at 1h. 20·7m. a.m. on the 16th, be Full at 9h. 22·6m. at night on the 23rd, and finally, for the second time this month, enter her Last Quarter at 5h. 57·8m. in the evening of October 30th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	22·6	5 40·5 a.m.
6	27·6	10 17·5 ,,
11	3·2	2 28·5 p.m.
16	8·2	6 28·6 ,,
21	13·2	10 16·1 ,,
26	18·2	1 40·7 a.m.
31	23·2	6 26·3 ,,

The Moon will be in conjunction with Mars at 7 p.m. on the 3rd; with Jupiter at 5 p.m. on the 6th; with Mercury at 8 o'clock the next evening (the 7th); with Venus at Noon on the 11th; and, lastly, with Saturn at 5 p.m. on the 28th.

Mercury

Is a Morning Star during the first half of the month, but comes into superior conjunction with the Sun at 10 a.m. on the 16th, after which he, of course, becomes an Evening Star. He is but poorly placed for the observer at any time in October, and during a considerable part of it is invisible. His angular diameter decreases from 5·4″ at the beginning of the month to 4·8 by the end of it.

Day of Month.	Right Ascension.	Declination.	Souths.
	h. m.	° ′	h. m.
1	11 52·1	2 55·3 N.	11 10·7 a.m.
6	12 24·4	0 47·1 S.	11 23·3 ,,
11	12 56·3	4 35·1 ,,	11 35·4 ,,
16	Behind the Sun.		11 47·0 ,,
21	13 58·4	11 46·7 S.	0 00·0 ,,
26	14 28·9	14 59·5 ,,	0 8·8 p.m.
31	14 59·5	17 52·7 ,,	0 19·7 ,,

The path indicated by this ephemeris extends over nearly the whole of the constellation Virgo and a good deal of Libra. Mercury will be a little to the South of η Virginis on the 4th, but behind the Sun when at his nearest Spica. He will also be not far to the South of α Libræ on the evening of the 28th. He will, further, be in conjunction with Uranus at 2 a.m. on the 5th.

Venus

Occultations of (and a near approach to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from
			h. m.		°	°	h. m.		°	°
1	λ Geminorum	3½	12 38 p.m.	Bright.	70	30	1 32 a.m.	Dark	289	24
25	B.A.C. 987	6½	3 0 a.m.	Bright.	110	137	4 10 ,,	Dark	277	31
26	B.A.C. 1526	6	†10 3 p.m.	N. by W.	191	151				
27	B.A.C. 1930	6½	12 0 ,,	Bright.	89	51	1 6 ,,	Dark	281	24
29	1 Cancri	6	10 5 ,,	Bright.	152	115	10 26 p.m.	Dark	201	16

† A near approach.

Is an Evening Star during the whole of October; but from her great and rapidly increasing South Declination, is very badly placed for the observer. She is now very perceptibly gibbous, her angular diameter increasing from 14·2″ on the 1st to 17·4″ by the end of the month.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	14 56·5	17 54·6	2 14·6 p.m.
6	15 20·3	19 47·4	2 18·7 ,,
11	15 44·6	21 28·1	2 23·3 ,,
16	16 9·3	22 55·4	2 28·2 ,,
21	16 34·4	24 7·8	2 33·6 ,,
26	16 59·7	25 4·4	2 39·1 ,,
31	17 25·1	25 44·2	2 44·9 ,,

So that Venus will travel through Libra and Scorpio into the Southern part of Ophiuchus.

Mars

Is now coming into view again in the morning before sunrise; but, subtending an angular diameter of only 6″ at the beginning of October (increasing to 6·8″ by the end of it), he merely presents the appearance of an enormous gibbous red star.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	8 45·8	19 13·4	8 5·0 a.m.
6	8 57·9	18 29·7	7 57·3 ,,
11	9 9·7	17 44·2	7 49·4 ,,
16	9 21·2	16 57·2	7 41·2 ,,
21	9 32·4	16 9·0	7 32·7 ,,
26	9 43·3	15 19·4	7 24·0 ,,
31	9 54·0	14 30·3	7 14·9 ,,

This path carries Mars from about the middle of Cancer to a point to the N.W. of Regulus.

Jupiter,

For the purpose of the observer, will scarcely come into a position for telescopic scrutiny until December; but

Neptune,

Although he does not South until after midnight, is practically visible during the whole of the working hours of the night. He requires a telescope of some size and power to exhibit him as anything but a 7-8th mag. star.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 33·6	17 22·7	2 53·6 a.m.
6	3 33·3	17 21·2	2 33·6 ,,
11	3 32·8	17 19·5	2 13·5 ,,
16	3 32·4	17 17·8	1 53·3 ,,
21	3 31·9	17 16·0	1 33·2 ,,
26	3 31·4	17 14·1	1 13·1 ,,
31	3 30·8	17 11·7	12 48·8 p.m.

Whence it will be seen that Neptune is in an utterly blank region in Taurus.

Uranus

Is much too close to the Sun to be visible.

Saturn,

Although he is a Morning Star in the s
that his meridian passage occurs a little be
6 a.m. on October 1st, and about 3h. 57m.
on the 30th, rises about 20 minutes to 10 o'cl
at night at the former date, and at about 7h.
on the last night of the month. He
towards the latter date, he may be very
seen by midnight. His ring-system is
about as open as it can be, and he is, as alw
an object of the highest interest to the stud
The angular equatorial diameter of his g
increases quite imperceptibly from 16·8″
17·6″ during the month.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	6 34·8	22 18·6	5 54·3 a.
6	6 35·5	22 18·0	5 35·3
11	6 36·0	22 17·6	5 16·2
16	6 36·3	22 17·3	4 56·7
21	6 36·3	22 17·2	4 37·2
26	6 36·2	22 17·3	4 17·4
31	6 35·9	22 17·6	3 57·4

Hence Saturn will be seen to remain sens
stationary at the obtuse angle of a trian
formed with ε and ζ Geminorum.

Shooting Stars

May be looked for between the 18th and 21st. Indications also exist of a shower, showers, between the 1st and the 6th.

Greenwich Mean Time of Southing Fourteen of the Principal Fixed S on the Night of October 1st, 1885.

Star.	Souths. h.	m.	s.
Altair	7	2	31·74
α² Capricorni	7	28	57·77
α Cygni...	7	54	43·69
α Cephei	8	32	57·60
α Aquarii	9	16	52·57
ζ Pegasi	9	52	37·85
Fomalhaut	10	8	9·39
Markab...	10	15	52·55
γ Cephei	10	51	28·86
δ Sculptoris	10	59	39·36
α Andromedæ	11	19	7·31
α Cassiopeiæ	11	50	36·17
β Ceti	11	54	23·20
Polaris	12	34	33·96

The Method of finding the Greenwich
Time of Southing of either of the Stars in
above list for any other Night in Octobe
also that of determining the Local Instant o
Transit at any other Station, will be found
p. 356 of Vol. XL. It must, however, be no
that the first of these rules is not rig
accurate when applied to Polaris and o
close circumpolar stars (nor, in fact even
star like γ Cephei), although it will be fou
perhaps, sufficiently so in practice.

DR. PERCY FRANKLAND'S recent experime
point to spongy iron as the best filtering ag
Powdered coke comes next, and is very g
Animal charcoal, although excellent at first, s
becomes worse than useless, and can in no case
recommended: but Dr. Guthrie's "penny wa
cleaner," with its broken stock brick as the fil
ing medium, is as good as anything.

BRITISH ASSOCIATION.

THE ADDRESS IN GEOGRAPHY.

THE address in Section E was delivered by General J. T. Walker, C.B., F.R.S., the president of the section, who gave his audience a general account of the Survey of India. We extract the following preliminary remarks:—My predecessors in this chair have claimed for geography a range of science which may be said to be practically unlimited; for it comprehends the history of the earth itself, and of all the life to be met with on the surface of the earth, from the first beginning of things, and through their subsequent development onwards to their present conditional status; it is associated in a greater or less degree with every other department of knowledge, and is a remarkable exemplification of the mutual interdependence and correlation of the physical sciences, for while all other branches of science are incomplete without some knowledge of geography, it is incomplete without some knowledge of each and all of them. Such claims on behalf of geography would, not many years ago, have been considered extravagant and exaggerated; a popular encyclopædia which is still of some note defines geography to be simply the science which describes the surface of the earth, and somewhat querulously complains that geographical treatises contain matter not unfrequently taken from statistics, natural philosophy, and history, which it declares to be irrelevant and not properly admissible into such treatises. And in a popular sense geography is still commonly suggestive only of such a knowledge of locality as may be acquired from maps and charts, with their graphical delineations of whatever exists on the surface of the earth, and of the various natural or artificial boundary lines of the peoples and States between whom the surface is divided. But the British Association and the Royal Geographical Society have successfully maintained that scientific geography is not restricted in its scope to a mere knowledge of locality—though that in itself is a very important factor in whatever appertains to the intercourse and mutual relations of mankind—but embraces all that relates to the structure and existing configuration of the earth, and takes cognisance of the varied conditions of all the life, both animal and vegetable, which is nurtured and supported by the earth; it studies the side lights which the general configuration of surface throws on the character of each locality as a home and support of life, and it examines with special interest the influence which that character has exerted on the social and political conditions of different races and peoples. And geography does not merely devote its attention to the existing order of things as now displayed to our gaze; in alliance with geology it studies the history of a distant past, when the features of the earth's surface were not precisely as now, and lands which we see high above our horizon lay deep beneath the ocean, and life existed in other forms, whose mute records we possess in the fossils —the *likha-káni* or written stones as they are significantly called by the people of Afghanistan—which, after long lying entombed among the rocks, are presented to modern sight as revelations of life's early dawn; it investigates what Baron Richtofen describes as the reciprocal causal relations of the three kingdoms—land, water, and atmosphere; it seeks to determine the processes by which in some parts of the globe continents were built up with their varied sculpture of mountain and valley, of highly-elevated plateau and low-lying plain, of lakes and inland seas, and great river systems—while in other parts land was depressed below the sea-level, or broken up into the islands which are now dotting the surface of the ocean; and it endeavours to trace a process of continuous evolution of life from the primary and simplest types which perished in the early ages of the earth's history, to the latest and most highly-developed types which are now flourishing around us. Going back still further it searches for evidence for the first beginnings of the material universe; it looks beyond the orbit of the most distant planet of the solar system, and scrutinises regions of stella space to find, in the widely scattered particles of the nebulæ, the beginnings of new solar systems and new worlds such as ours; there it may be said to behold as in a mirror the formation of our own planet as a fluid igneous mass thrown off with great velocity from its sun, and rapidly revolving, and then becoming spheroidal, and slowly cooling and solidifying, and finally acquiring the crust which was to become an abode for life, the stage whereon man was to play out the drama of his planetary existence, and be held all the while fast imprisoned and out of touch with the surrounding universe.

THE ADDRESS IN ECONOMIC SCIENCE AND STATISTICS.

The address in Section F was delivered by Prof. H. Sidgwick, M.A., president of the section, and consisted mainly of a defence of political economy and a refutation of the charges brought against political economists. The following is an abstract:—In commencing, the president said his address might be regarded as a discussion of the relative views of British and Continental economists, or, amongst other topics, Free Trade and Protection. He disclaimed all connection with the kind of political economy called "orthodox," which undertook to settle all practical problems of Governmental interference, or private philanthropy, by simple deduction from one or two general assumptions—of which the chief is the assumption of the universally beneficent and harmonious operation of self-interest. Since, however, this kind of political economy was still somewhat current in the market-place, it seemed worth while to try and make clear the relation between the economic science and the principles of Governmental interference. He then proceeded to examine some of the tenets of Adam Smith, the founder of political economy as an independent science. The element which made most impression on the ordinary reader was Smith's advocacy of the "system of natural liberty"; his exposition of the natural "division of labour"—tending, if left alone, to become an internal division of employments—as the main cause of the "universal opulence" of "well-governed" societies; and of the manner in which, in this distribution of employments, individual capitalists seeking their own advantage are led "by an invisible hand" to "prefer that employment of their capital which is most advantageous to society." At the same time, Adam Smith was too cool and too shrewd an observer of facts to be carried, even by the force and persuasiveness of his own arguments, into a sweeping and unqualified assertion of the universality of the tendency that he described. His advocacy of natural liberty in no way blinded him to the perpetual and complex opposition and conflict of economic interests involved in the unfettered efforts of individuals to get rich. He even went the length of saying that "the interest of the dealers in any particular branch of trade or manufacture is always in some respects different from, and even opposed to, that of the public." In short, however fascinating the picture that Adam Smith presented of the continual and complex play of individual interests constituting and regulating the vast fabric of social industry, the summary conclusion drawn by some of his disciples that the social production of wealth will always be best promoted by leaving it altogether alone found no support in a fair survey of Adam Smith's reasonings. It was natural that in the heat of a political movement absolute and unqualified statements of principle should come into vogue, since the ease and simplicity with which they could be enunciated and apprehended made them more effective instruments of popular agitation; hence it is not surprising to find the Anti-Corn Law petitions declaring the "inalienable right of every man freely to exchange the result of his labour for the productions of other people" to be "one of the principles of eternal justice." But under the more philosophic guidance of J. S. Mill, English political economy shook off all connections with these antiquated metaphysics, and during the last generation has been generally united with a view of political principles more balanced, qualified, and empirical, and therefore more in harmony with the general tendencies of modern scientific thought. If, he said, *laisser-faire* were the one main doctrine of modern political economy, there could be no doubt that the decisive step forward that founded the science ought to be attributed not to Adam Smith, but to his French predecessors the "Physiocrats." It was to them—to Quesnay, De Dournay, De la Rivière, Turgot—that the credit was due of having first proclaimed to the world with the utmost generality and without qualification that what a statesman had to do was not to make laws for industry, but merely to ascertain and protect from encroachment the simple, eternal, and immutable laws of nature. Referring to some remark on free trade and trade-unions in a monthly, Prof. Sidgwick said it was erroneous to maintain, on the ordinary economic grounds, that temporary protection must always be detrimental to the protecting country, even if it were carried out by a perfectly wise and strong Government, able to resist all influences of sinister and sectarian interests, and to act solely for the good of the nation. The decisive argument against it was rather the political consideration that no actual Government was competent for this difficult and delicate task; that protection, as actually applied under the play of political forces, was sure to foster many weak industries that had no chance of living without artificial support, and to hamper industries that might thrive independently by the artificial dearness of some of their materials and instruments. So far he had been speaking of the function of economic science in determining principles of Governmental intervention in matters of industry. This was not the view that English economists generally had taken as to their primary business. It was the additional light that Adam Smith threw on the general determination of such economic quantities—and not his advocacy of natural liberty—which constituted his chief claim to his place in the historical development of economic science.

THE ADDRESS IN ANTHROPOLOGY.

The address in Section H was delivered by Mr. F. Galton, F.R.S., president of the section, who took for his subject "Heredity in Man." The object of the anthropologist, he said, was to learn what mankind are in body and mind, how they came to be what they are, and whither their races are tending. He had been working with fresh data, consisting of family records of persons living in all parts of the country. The subject of his remarks would be types and their inheritance. He would discuss the conditions of the stability and instability of types, and hoped in doing so to place beyond doubt the existence of a simple and far-reaching law that governs hereditary transmission. Some years ago he had made experiments on the produce of seeds of different size but of the same species, with the result that the offspring did not tend to resemble their parent seeds in size, but to be always more mediocre than they—to be smaller than the parents if the parents were large; to be larger than the parents if the parents were very small. He had used the seeds as a means of throwing light on heredity in man; and an analysis of the family records furnished to him last year fully confirmed and went far beyond the conclusions he had obtained from the seeds. The subject of inquiry on which he was to speak was hereditary stature, and his data consisted of the heights of 930 adult children and of their respective parentages, 205 in number. The multiplicity of elements, some derived from one progenitor, some from another, must be the cause of the fact that the stature of the children depended closely on the average stature of the two parents. His inquiries had brought out the fact that the height of the children of both sexes, but especially that of the daughters, took after the height of the father more than that of the mother. Marriage selection took no account of shortness or tallness, and tall men and short women and short women and tall men were as frequently married as men and women of similar heights. It was easily to be shown that we ought to expect filial regression, for, speaking generally, the further one's genealogy went back the more numerous and varied would his ancestry become, until they ceased to differ from any equally numerous sample taken at haphazard from the race at large. Their mean stature would then be the same as that of the race; it would be mediocre. He asked how it was that in each successive generation there was the same number of men per thousand who ranged between any limits of stature we might specify, although the tall men were rarely descended from equally tall parents or the short men from equally short parents? The answer was that the process comprised two separate sets of actions, one concentrative, and the other dispersive, and of such a character that they naturally neutralised one another and fell into a state of stable equilibrium. There could be no doubt that heredity proceeded to a considerable extent, perhaps principally in a piecemeal or piebald fashion, causing the person of the child to be to that extent a mosaic of independent ancestral heritages, one part, coming with more or less variation, from this progenitor, and another from that. In conclusion, he said:—When heredity shall have become much better and more generally understood than now, I can believe that we shall look upon a neglect to conserve any valuable form of family type as a wrongful waste of opportunity. The appearance of each new natural peculiarity is a faltering step in the upward journey of evolution, over which, in outward appearance, the whole living world is blindly blundering and stumbling, but whose general direction man has the intelligence dimly to discern, and whose progress he has power to facilitate.

ABSTRACTS OF REPORTS PAPERS, &c.

Report on the Migration of Birds.

Mr. J. A. Harvie-Brown read an abstract of the report. Altogether 118 returns had been received. The report showed that on the east coast of England a great movement was carried on for six months in the autumn and winter of 1884-5. The southerly movement of migrants was well established in July, and from this time to the end of the third week in January, 1885, there was a steady flow, with slight intermissions, of birds either passing along the coast to the south or moving directly inland, the vast majority coming from the east across the North Sea, and moving westward or in westerly directions. Occasionally there had been heavy rushes or persistent bird waves, continuous for days and even weeks. The periods of migration occupied by different species vary greatly, from four weeks to as many months; no general rule can be laid down in this respect. There was an immense and continuous rush on to the coast from the middle of October (15th) to the end of the month, migrants arriving continuously night and day. This rush was continued at some of the stations, with but slight intermissions, to the middle of November. On the east coast of Scotland, whilst desultory movements continued during September and October, the heaviest rushes are recorded in the middle of November. The last fortnight in October is the average annual period of what may be called the "great rush" of immigrants on to the east coast of England. An unusually extensive migration of gulls to the Scotch coast was remarked in 1881, in connection with the vast swarms of sprats or "garvies" (*Clupea sprattus*), themselves following and feeding on countless myriads of minute marine creatures. This aggregation has been attributed, and perhaps with reason (though it is a point on which the committee has not sufficient information to decide), to the vast accumulation of ice west of Spitzbergen in the summer of 1881, and the consequent lowering of the temperature of the sea, which cause has impelled and driven southward the fish food along the course of the milder Gulf Stream to the uttermost limits of its possible extension, the firths and inlets of the east coast of Scotland. As a rule very few of our rarer immigrants are recorded from the east coast of Scotland.

Strength of Telegraph Poles.

Mr. W. H. Preece, electrician to the General Post Office, read a paper on "The Strength of Telegraph Poles." He stated that no accurate experiments having been made on the strength of native-grown Scandinavian red fir trees, which were now exclusively used for telegraph poles, and there being great reason to doubt the accuracy of the coefficient given in books, very careful measurements were made with specially-constructed apparatus on a number of old and new creosoted and plain poles. No difference could be detected in the different sorts of poles, whether preserved or not; but the coefficient came in 765 instead of 1341, as usually given—in other words, for the last thirty years they had imagined that the strength of the poles was double what it really was, and consequently they were now using stronger trees. On the question of stress, careful experiments had been made, and the maximum pressure of the wind on the wires was taken at 18·75lb.

Living and Dead Protoplasm.

Dr. Oscar Loewe read an important paper on "A Chemical Difference between Living and Dead Protoplasm." Protoplasm, it was found, contains certain aldehyde groups, which account for the extreme mobility and readiness of change in living protoplasm. These aldehyde groups can be reduced by alkaline silver solution. Spirogyra, one of the lower algæ, acts on this solution in a peculiar way. Living protoplasm reduces the salt, while dead protoplasm does not. The specific gravity of the protoplasm of Spirogyra was increased, and was found to contain silver deposited in its interior. Argyria, or the effect of nitrate of silver on the human subject in certain diseases, was found in these algæ. Thus was shown a specific chemical difference between living and dead protoplasm. Ordinary poisons, such as prussic acid and strychnine, seem to have no particular effect on lower organisms, while the poison irresistible by all protoplasm is hydroxylamyl.—Prof. Burdon-Sanderson said that this investigation had more importance than might at first appear, for it had arisen out of the epoch-making paper of Pflüger. Pflüger concluded that there must be a chemical change in the transition from living to dead protoplasm, and Dr. Loew took up the question as to what exactly this change was. His investigations are an important step in deciding this most important question.—Prof. Stirling said this gave a new test for living protoplasm. The chief thing to settle was what exactly causes reduction of the silver.

The St. Andrews Marine Laboratory.

Prof. M'Intosh described briefly the structure and arrangement of the marine laboratory at St. Andrews, and made some general remarks on the work done there during the last nine months. A great many of our food fishes, he said, were carefully examined in regard to the development of the eggs and the growth of the young fishes. About twenty species were examined in this way. They experienced some difficulty with some of the forms, on account of their voracity, particularly with the cod. They found that a cod of 5in. long would swallow a cod of 3in., and if it could not get it all down at once, it would keep it in its throat till the head part was digested, and then draw in the tail. Mollusca were studied chiefly in connection with the development of the mussel; but he might say that very hazy notions were held in regard to it. Some larger forms were also examined, including porpoises and sharks. One porpoise was extremely interesting. He had noticed it for some time in the bay, and that its motions were very peculiar. He could not make out what it was doing there so constantly in shallow water. But some days afterwards a large female was caught in the salmon nets, and they found that it was a female giving milk. Its milk was of a most interesting kind, and formed the subject of examination and analysis by Prof. Purdy. It was as dense as cream, and of a deep yellow colour.

Remarkable Occurrence during a Thunderstorm.

Mr. W. H. Preece made an interesting communication under this heading, the purport of which was as follows:—A house at St. Cuthbert's, ten miles from Wolverhampton, is connected by telephone with that town, and is also lighted by electricity. At half-past eight o'clock on the night of the 6th of August, when a single lamp only was alight in the dining-room, and three or four other lamps on the same circuit, a thunderstorm occurred, and suddenly a report like a rifle-shot was heard in the house, and the lamp in the dining-room flashed up and immediately went out. On investigation being made, it was discovered that the telephone wire had been attached to a lightning conductor which protected the house (attached in order to "make earth"), and it was conjectured that a lightning flash had struck the protector, entered the telephone circuit (the wire of which was fused in three places), and then flashed across into the electric light circuit, producing a very curious and beautiful result, a mirror of platinum being formed in the electric lamp. The scientific result was that lightning does not obey the ordinary law of the transmission of currents—it does not divide itself, but (as in this case) selected one current and discharged its full force in it. A practical outcome of the incident was the necessity shown for occasionally testing lightning conductors.

Antarctic Discovery.

Admiral Sir Erasmus Ommanney read a paper on "Antarctic Discovery." The object of the paper, he said, was to draw attention to the neglect of the Antarctic region as a field for exploration. He gave a summary of the work which has already been done, and referred to a paper by Dr. Neumayer on the subject, concluding by saying:—I have thus laid before you but a very imperfect description of these voyages; to give the details of the scientific results would occupy a separate paper. But I have endeavoured to demonstrate how large a field remains open for discovery. I think, from all we now know, we may infer that the South Pole is capped by an eternal glacier; and, from the nature of the soundings obtained by Ross, it would appear that the great ice-wall along which the ships navigated was the termination of the glacier—the source from which the inexhaustible supply of icebergs and ice-islands are launched into the Southern Ocean, many of which drift to the low latitude of 42 degrees. The fact of finding the volcanoes of equal proportions to Etna or Mont Blanc creates a zest for further research regarding that awful region on which neither man nor quadruped ever existed. No man has ever wintered in the Antarctic zone. The great desideratum now before us requires that an expedition should pass a winter there, in order to compare the conditions and phenomena with our Arctic knowledge. The observations and data to be collected there throughout one year could not fail to produce matter of the deepest importance to all branches of science.—Mr. Murray, of the *Challenger* Expedition, said he had listened with much interest to Admiral Ommanney's summary of Antarctic voyages. He did not think that there was any difficulty whatever for a great nation like ourselves to undertake successfully further explorations in this most interesting part of the world. That part of the world was cut off more or less from all the land of the globe. It was exceedingly interesting to find out the connection of this land with the great continents which were more or less situated in the northern hemisphere. They knew that along the edge of the Antarctic ice barrier—that in that region there was continental land. And the gallant Admiral was perhaps a little too strong when he said that no quadruped or other animal ever lived there.—Dr. W. B. Carpenter thought that further explorations should be made in Antarctic regions; but General Walker, the president of the section, thought it quite possible that when our Antarctic explorers reached the open fields and pastures new which Sir E. Ommanney had indicated, they might find themselves in very similar difficulties to those which had been encountered in the North Polar regions.

Arctic Expeditions.

Dr. John Rae read a paper on "Overland Expeditions to the Arctic Coast of America." He began by referring to the expedition of Hearne in 1771; of M'Kenzie in 1789; of Franklin, Richardson, Back, and Hood in 1821; of Franklin, and Richardson, Back, and Kendall in 1826; of Back in 1833 and 1834; and of the Hudson's Bay Company's Expedition under Dease and Simpson in 1837, 1838, and 1839; and then described at great length his own expeditions in 1846-47, 1850-51, and 1853-54.

The Best Route to the North Pole.

Dr. Rae also read a paper on "The Best and Safest Route by which to attain a High Northern Latitude." The plan proposed is that the route by the west shore of Spitzbergen should be taken by one, or perhaps two, steamers similiar to the fine vessels used in sealing and whaling at the present time. That after forcing the ice "pack" at the north-west end of Spitzbergen, a north-east course towards Francis Joseph Land should be followed That a depot of coals should be placed at a convenient harbour in North Spitzbergen. He gave extracts from Parry's "Narrative," 1827, showing how open and small the ice was in latitude 82° 45′ N. The southern drift of the ice that so obstructed the advance of Parry's boats will be n great impediment to a powerful steamer, whilst i she gets helplessly fixed in the pack she will drif homewards with it. No well-equipped and powerful steamer has tried this route.

The Coast Terraces of Norway.

Mr. Topley read a paper from Mr. Hugh Mille (son of the celebrated geologist) on "The Coas Terraces of Norway." In order to solve this vexed question, Mr. Miller had made a careful survey of few square miles of coast in the neighbourhood of Trondhjem, and among the conclusions he ha come to was that these terraces were all post-glacia —that is, formed since the rock-glaciation of the district. This was confirmed by the condition of the high coast-cliff, which had been cut in ice rounded rock, but is not itself glaciated. All the evidence obtained discountenances Saxe's view tha these rock-terraces were cut out by glaciers, as wel as Carl Petersen's that they were rasped out by floating ice coasting the shores. Coast-ice has lef no more sign of its presence on the clay terrace than the winter freezing of our British river leaves upon our river terraces. The preservatio or excision of the terraces seems to depend as mucl upon local circumstances—exposure to storms, resistance of coast-line, &c.—as upon anything else It is impossible at present to predicate which o them shall in any given place remain. Whethe elevation by jerks, therefore, be postulated or not all hope of correlating these terraces throughout th country must be deferred until their heights hav been accurately determined by level.—Prof. Jud said it must be matter of congratulation to see th name of Hugh Miller on the list of contributors t the British Association. Mr. Miller was followin worthily in the steps of his father, and had alread distinguished himself by a number of most carefully-written works. The paper now read from him was evidently preliminary, and they were al glad that Mr. Miller had visited the district, an hoped he would get still further information on th exact movements now going on in the Scandinavia Peninsula.

The Parallel Roads of Lochaber.

Mr. Topley read a paper by Mr. James Melvi Bonnington, on "The Parallel Roads of Lochaber. Mr. Melvin considered that the theories hithert submitted to account for the origin of these road were open to grave objections, and all of then save that of their being the margins of lakes hel in by the ice of glaciers which flowed down th corries from the mountains, had generally bee given up. But even this last one was open t serious objection. In the first place, it necessitate the existence of great glaciers in the lower po tions of the glens with the water of lakes in th higher. It further necessitates the cessation o certain of these glaciers in Glen Spean, over, pe haps, nine-tenths of the district formerly producin them, and their retention in one-ninth of th surface from which they had previously flowe Those corries and opener glens, such as the Gu bein, the Treig, and the Laire, which they say su plied the ice-barriers when the upper roads in Gle Roy were being formed, issuing, as they do, fro 100 square miles of mountain country, the peaks o which rise to 3,658ft., according to the requir ments of the ice-dam supporters, must becom barren. These glaciers must shrink up, withou any other reason being assigned than the necessit of their doing so to enable the supporters of th ice-dam to prove their case. While this large e tent of previously ice-producing country ceases t furnish any more ice to the Spean Valley, on solitary corry, Coirchron, drawing a supply fro about eleven square miles, is allowed to maintai all its original ice-producing power, and to for the great dam stretching more than four mil across the valley of the Spean, though aided o the other side by the ice from the great glen. Th country which fed this glacier of Coirchron con sists of about eleven square miles of surface, wi a peak 4,000ft. high.—Prof. Judd said he r gretted that Mr. Melvin had not taken account o the perfect horizontality of these parallel road which was thought of so much importance by oth writers.

The Geology of East Central Africa.

Prof. Henry Drummond read notes on a recent examination of the geology of East Central Africa from the Zambesi to the Nyassa Tanganyika plateau. He stated that the region he traversed when he made these notes included the littoral belt at Zanzibar, Mozambique, and the mouths of the Zambesi and the Quilimane rivers; the region watered by the Shire river from its source in Lake Nyassa to its termination in the Zambesi, the country discovered by Livingstone known as the Highlands, the western shore of Lake Shirwa, the great rock basins of Lake Nyassa throughout its 200 miles of length, to the southern part of the Marsa-Tanganyika plateau. From the work of the various explorers who had penetrated Africa, it is now certain that the interior of Africa is occupied by one vast plateau, in height from 2,000 to 5,000 feet above the level of the sea. This plateau attains a height of considerably over 5,000ft., while towards the coast throughout the entire length, both east and west, it falls with great uniformity to a lower plateau, with an elevation of from 1,600 to 2,000 feet. This lower plateau is succeeded also with much uniformity along both coast lines by littoral and delittoral plains with an average breadth from the sea of about 150 miles. The section he was about to describe traversed each of these regions in turn. In the coast belt the only thing to break the monotony of mangrove swamp was the débris of an ancient coral reef studded with sponges and other organisms. Some twenty miles further inland, and still only a few yards above sea level, an inconspicuous elevation appears, consisting of sedimentary rocks. No organic remains had been found in this series north of Natal, but the fossils of the Cape beds may yet shed some light on its true horizon. Proceeding, Prof. Drummond said that two or three days' journey north and west of Movumballay, among the distant hills lining the valley of the Shire, Livingstone marks a spot where coal was to be found. After careful examinations he (Prof. Drummond) had come to the conclusion that Livingstone had been either mistaken or misinformed. A black rock certainly occurred in the locality named, but after securing specimens of all the dark-coloured rocks in the vicinity, he found them to be, without exception, members of the igneous class. Coal, however, does certainly occur further inland on the Zambesi, while further south, the Natal and Transvaal coal-fields are now well known. Reference was then made to the existence of coal in the far interior of the country, and on the western shore of Lake Nyassa, where it was found by a solitary explorer who penetrated that region in the wake of Livingstone. The importance of such a discovery—a coal seam on the borders of one of the great inland seas of Africa—could not be over-estimated. Having examined this section with care, he differed from the conclusions come to by Mr. James Stewart in his report on the coal to the Royal Geographical Society. The 7ft. seam described by Stewart was certainly a deception, the seam being really composed of a series of thin beds of alternately carbonaceous and argillaceous matter, few of the layers being good coal. He lit a fire with it, and was disappointed with the results. Combustion was extremely slow and without flame, and there were only what could be called small films of really good coal here and there. Prof. Drummond next proceeded to the great plateau, the geology of which was very simple, consisting for the most part of granite and gneiss. The gneiss-granite deposit probably occupies by far the greater part of the interior of the African Continent, and must become of great future interest in connection with the phenomena of metamorphism. Whether in this case the granite is the ultimate stage in the metamorphism of the gneiss, or the gneiss the compressed and rearranged constituents of earlier granite, it is impossible to determine; but the singular succession of the two rocks and other indications seem at least to point in the direction of a metamorphic origin for the whole. As to the origin of Lake Nyassa, no follower of Ramsay in his theory of the glacial origin of lakes could desire a more perfect example of a rock basin than that of Lake Nyassa. The only other point he would allude to was that of glaciation. He had been unable to detect anywhere throughout his route in the interior of Africa a solitary indication of glaciation. The whole region he traversed was another proof of the uniformity of nature.

Oceanic Islands and Shoals.

A paper was read by Mr. J. Y. Buchanan on "Oceanic Islands and Shoals." Mr. Murray, of the *Challenger*, described Mr. Buchanan's paper as the record of very laborious work, and said it dealt with questions of great importance in all the general questions of oceano-graphical research. One of the great matters of discussion at the present day was whether these great oceans were permanent features of the world or not. There could be no doubt that if they got information such as Mr. Buchanan had given—close soundings with the latest apparatus—they would be in a position to judge whether their theories with respect to these questions were sound or not. Especially it was in the case of the oceanic islands that they desired information, and the mapping out and placing upon charts observations made with so much care was the only means by which they could have data to which they could refer when they were trying to generalise on great subjects of this kind.

Casualties at Sea.

A paper which gave rise to an important discussion was read by Don Arturo de Marcoartu. His Excellency urged that vessels should be supplied with apparatus to communicate with and telegraph to each other and to the nearest coast the weather and sea passed over by them, and that reports given by vessels should be given as "warnings" more extensively. He wished the mid-Atlantic stations connected by telegraph for the same purpose. In regard to the use of oil in rough seas, he said that Dr. Badeley in 1857, Mr. John Shield five years ago at Peterhead, and last year at Folkestone, the Board of Trade in 1883, and a Committee on Life-Saving Appliances of the United States, had made experiments. The conclusions of the committee were that in deep water oil had a calming effect upon a rough sea; but there was nothing in either source of information which yet answered the question whether or not there is in the force exerted by the wind a point beyond which oil cannot counteract its influence in causing the sea to break.—The Lord Advocate alluded to his holophote course-indicator, an electric light controlled by the rudder in such a manner that when the helm is put up or down the light would flash at some distance in front of either bow of the vessel, and thus indicate the direction in which it is going.—Sir James Douglass said this idea of a lantern did very well for a short distance, but for a long distance it utterly failed. It was very difficult to realise a movement from a distance of over a mile out at sea, and signals were required to be visible for from two to three miles.—The Lord Advocate said his idea depended not upon the object light, but upon the sweep of the light on the water.—Sir James Douglass said all those questions were of the utmost importance to a maritime country. In regard to experiments with oil on troubled water, he had witnessed them, and he had carefully studied all the reports, and had come to the conclusion that they were all very well in a tub of water or a pond, but on the ocean they were utterly hopeless. He would stake his reputation on that. It was utterly hopeless to think that a quantity of oil had the power of laying a storm—all the world could not produce oil enough to bring about that result. There might be something in marine telegraphy, and he hoped the experiments of Mr. Graham Bell in transmitting through two or three mile distances would come to something. He did not believe in powerful lights. Increase the lights to any very great extent and a dazzling effect was the result. In regard to sound, he wondered that no more effective alarm was used than the whistle. It was well known that as the whistle instrument was enlarged the sound became more and more a roar. He would have ships use all their boiler power in sounding a siren, so that the sound could be heard at a distance of not less than two or three miles in any weather. With such a signal as that there ought to be—not absolute safety, but collisions would be more easily prevented. He was glad to say that a universal system of buoys had been practically arranged, so that, as soon as an old system can be changed to a new, all the buoys would bear one universal language.—Admiral Pim pointed out that a red light would show four miles, while a green light was only visible for two miles and a half, so that if a green light were seen it indicated that the two vessels were within two miles and a half of each other.—Sir James Douglass said there was undoubtedly a weakness in regard to these lights, and he held that in the manufacture of lights, effect should be given to the difference that existed in the various lights, so that by making the green light more powerful it could penetrate as far as the red.—Senor Marcoartu, in reply, referred more particularly to a parabolic reflector for sound.—Sir James Douglass said he had seen this tried, but, unfortunately, the reflector so intensified and focussed all the sounds about the vessel that, with the noise of the sea, the operator could hear nothing but a chaos of sound.

The Solar Corona.

Prof. Stokes read a paper by Dr. Huggins on the Corona. After a short history of the question, Dr. Huggins said:—The evidence seems to be conclusive that the corona which comes into view at a total eclipse corresponds to an objective reality of some kind existing about the sun. It is difficult to explain satisfactorily (1) the observed and photographed spectra which vary at different parts of the corona; (2) the visibility of the planets Venus and Mercury as dark bodies when near the sun; (3) the filamentous and especially the peculiar structure seen in photographs of the corona; (4) the close of agreement of photograph taken at different times during an eclipse, and especially between photographs taken during the same eclipse at places many hundred miles apart. The corona is not a true solar atmosphere. It must consist of a fog in which the particles are incandescent and do not form a continuous atmosphere. The matter of the corona is supplied, not by comet tails, but by the sun. Allied to the corona are some of the appearances in comet-heads; and both are now attributed to electrical disturbances, and especially to a repulsive force acting from the sun, probably electrical, which varies as the surface, and not, like gravity, as the mass. Such a force can easily master the force of gravity; and, as we see in the tails of comets, blow away this thin kind of matter to enormous distances in the very teeth of gravity. Such a force would imply that the sun's surface possesses permanently an electrical potential of the same name as in the matter ejected. This explains all peculiarities, and is the same as the theory of comet-tails expounded by Prof. Stokes at Aberdeen in November 1883.—Prof. Osborne Reynolds, in the course of the discussion, expressed his belief that there is an electrical disturbance between the sun and the surrounding planets, and dilated on the importance of that view if it could be established as a fact. He also was inclined to attribute an electrical origin to comets; but disclaimed being the first to advance this view. He brought forward this theory at the British Association meeting in 1871, showing by experiments how the corona, tails of comets, and aurora were producible. —Prof. Johnstone Stoney spoke of the outrushes that must result from the extremely rapid expansion and consequent dissociation inwards and outwards of gases at the sun's surface. The velocity of these out-rushes was more than 120 miles per second, and should be estimated.—Prof. Schuster thought, from his own observations and calculations, that the appearances of the corona were due rather to the readjustment of electrical disturbances on the sun's surface than to the presence of an enormously high electrical potential. He thought the general statements should be checked by definite calculations.

Barium Sulphate in Sandstone.

Prof. Clowes read a paper on "Barium Sulphate as a Cementing Material for Sandstone." He pointed out that Bisschof mentioned instances of foreign sandstone in which the material cementing the sand grains together was barium sulphate, but it appeared that up to the present time no such sandstone had been met with in the United Kingdom. Having learned that opinions differed regarding the calcareous nature of certain new red sandstone beds in the neighbourhood of Nottingham, he undertook to examine the chemical composition of these sandstones. He procured specimens of the sandstone from different levels. On being analysed the sandstone was found to contain barium sulphate in varying proportions, at present being determined, whilst some of the lower beds also contained calcium carbonate. In some of the sandstone beds the barium sulphate was very unequally distributed, forming a network or a series of small masses more or less spherical in shape; in such sandstone the sand grains between the sulphate streaks and patches was quite loose; the result being that the weathered surface presented a honeycombed or mammillated appearance. He had attempted to detect some evidence of the way in which this barium sulphate had been introduced into the original bed. It might possibly have been deposited along with the sand; but if this was its origin it had certainly undergone physical change, as it existed now in a firm, compact, and crystalline condition. It seemed certain, therefore, that it had been either originally deposited from aqueous solution, or had been rendered crystalline by the slow percolation of a solvent liquid through the sedimentary deposit, or else it had been formed by the action of water containing calcium sulphate percolating through sandstone originally cemented with barium carbonate.

Action of Water on Lead Pipes.

Mr. A. H. Allen, Sheffield, submitted an interesting communication on this subject. He said he did not wish to raise a scare, yet it could not be denied that there had been several cases of lead-poisoning through people drinking water conveyed in lead pipes. But though only one person in a thousand might be affected from this cause, it was quite clear that the matter deserved the attention of chemists, and he hoped by raising the subject that some chemists present would be able to help him in his attempt to arrive at a satisfactory explanation of the case. The most discordant statements were made as to the cause of lead-poisoning; some saying that soft and others that hard water was most likely to produce it, but he thought that it might depend, not only on the presence of salt in water, but on the character of the salt. He referred to a remarkable case of poisoning which occurred some years ago in one of the districts of Huddersfield, by lead suddenly appearing in the water; and on investigation it was found that it arose from the water coming from a ferruginous spring containing a free mineral acid, which acid could be detected in the water in the reservoir and the mains, and caused the water to act on the lead. By filtering the water through limestone the tendency to act on lead was got rid of, but not before a very serious case of lead-poisoning had occurred. In another case which came under Mr. Allen's observation, and in which the water for many years had shown little tendency to act on the lead, it suddenly took a "fit" and corroded the lead, with the result that the lead was present in serious quantity in the water of certain districts of the town. Prof. Brazier, of Aberdeen, had, in a communication to him, pointed out that water acted on lead, particularly when it was mixed with snow water, and Mr. Allen stated that his own experience fully bore out that observation. Lead being a cumulative poison, frequent doses were liable to cause very serious and even fatal effects. Some people were more susceptible to the action of lead than others. The late Dr. Angus Smith considered that even so minute a trace as one-fiftieth of a grain of lead per gallon of water should not be allowed; but if that standard were adopted few waters would pass the test. It might be admitted that one-tenth of a grain of the metal per gallon of water was objectionable, and when the quantity rose to half a grain it was very dangerous. He pointed out that sulphate of lead, which had sometimes been regarded as an insoluble salt, was soluble in water to the extent of about three grains per gallon, and hence, for the purpose in question, was capable of producing highly poisonous effects. Carbonate of lead was soluble in water to the extent of about two grains per gallon; but basic carbonate was highly insoluble, 60 gallons of water being required for the solution of one grain. In conclusion, Mr. Allen said that the mysterious "fits" water occasionally took in acting upon lead rendered the subject a matter of great practical importance, and he had brought the matter before the section in the hope that some of the members might give him assistance in arriving at the right explanation of the causes of poisoning by lead, as he had not yet got to the bottom of them.—Prof. Frankland, speaking of nitrates and nitrites in water, said the fact that there was salt in water did not affect the action of water on lead, as experiments had shown him that the salts were absolutely inert. Two essential conditions to water acting on lead were the presence of dissolved oxygen and the absence of free carbonic acid. He agreed with Mr. Allen that it was all but impossible, if not quite impossible, to get a solution of carbonate of lead in water, the idea that carbonate would dissolve in water being erroneous. There were two kinds of actions which water had upon lead which ought to be distinguished—viz., that the action of water on lead deposited salts of lead in the water, and that it also produced dissolved salts. Speaking of the danger of snow water acting on lead pipes, he said this was a statement with which he quite agreed, and for this reason—that snow water was rich in dissolved oxygen and free from carbonic acid.—Prof. Dewar said the lead-poisoning at Huddersfield might have been caused by the carbonate of lead or other salts being carried away. He thought the amount of peroxide of hydrogen in water was so small that he questioned whether it could have any effect at all. The question of the water supply in America was a burning one, and had caused a great deal of trouble. In Philadelphia a process was adopted of pumping into the town's supply atmospheric air at a pressure of fifteen atmospheres. Referring to another point, Prof. Dewar said it had been found that if they got distilled water and put a trace of peat in it, the water would have no action on the lead whatever; so that here they had a case in which a very slight amount of organic matter prevented action on lead. It seemed to him that the question under discussion—as to the action of water on lead—was surrounded by so many complications that they need not be surprised that cases of this kind occurred.—Prof. Frankland said the public should be warned against the use of tin-lined lead pipes unless they knew how they were manufactured. In some cases the way in which they were manufactured produced an alloy of lead and tin, which acted more on the water than lead pipes alone. He had suggested a plan to some of the manufacturers by which pipes could be made which were not in the slightest degree affected by water, but whether all the pipes were of that kind or not he could not say; but, certainly, where this alloy was produced there was great danger. Speaking of American water, he said that probably in most cases it would be sufficiently free from carbonic acid to prevent any action of the water, even though the water was surcharged with oxygen.

Grants.

The recommendations involving grants of money were the following:—Electrical Standards, £40; Solar Radiation, £20; Meteorological Observations at Chepstow, £25; Instructions for Tidal Observations, £50; Comparing and reducing Magnetic Observations, £40; Standards of Light, £20; Ben Nevis Observatory, £100; Physical and Chemical bearings of Electrolysis, £20; Silent discharge of Electricity into Atmosphere, £20; Chemical Nomenclature, £5; Fossil Plants of the Tertiary and Secondary Beds, £20; Caves of North Wales, £25; Volcanic Phenomena in Japan, £50; Erosion of Sea Coasts, £20; Volcanic Phenomena of Vesuvius, £30; Geological Record, £100; Fossil Phyllopoda, £15; Zoological Record, £100; Marine Biological Station at Granton, £75; Zoological Station at Naples, £50; Researches in Food Fishes and Invertebrata at St. Andrews, £75; Migration of Birds, £30; Mechanism of Secretion of Urine, £10; New Guinea Exploration, £150; Investigation into depth of permanently frozen soil in Polar Regions, £5; Regulation of wages under sliding scales, £10; Effect of varying stresses on metals, £10; Investigation into a prehistoric Race in the Greek Islands, £20; Investigation into North-Western Tribes of Canada, £50; Facial characteristics in British Isles, £10. Total, £1,195.

Report on Underground Waters.

The eleventh report of the Committee on Underground Waters was submitted by M. De Rance, who pointed out that the quantity of water to be derived from the deep-seated springs, and by means of the artesian wells and borings, intercepting artificially such underground supplies, is limited by the area of the porous material absorbing the rainfall; by the nature of the permeable rocks, the porous character of which varies with the amount of their compactness; and by the amount of the annual rainfall of the district examined. It was pointed out that with an average rainfall of 30in., there is an annual absorption of 10in., which gives an average volume of 400,000 gallons per square inch in the red sandstone, and about 6in. in the chalk, giving an average of 24,000 gallons for each square inch of absorption area. The great importance of underground water supplies for the requirements of large centres of population was commented on, owing to their persistence after long droughts, and the purity of their supply. Some wells were pointed out as yielding nearly two million gallons a day.

The Brains of Extinct Animals.

Prof. Marsh, of Yale College, said that for 15 years he had directed his attention to the subject of the size of the brain in extinct animals. In every instance he found that the mammals from the lower tertiary had very small brains. He carried out his investigation into the upper tertiary, and found that the brain was much larger in the pliocene than in the miocene. All the tertiary mammals had small brains; there was a gradual increase in the size of the brain during this period; and this increase in the size was generally in the cerebral hemisphere or higher portions of the brain. In some groups the convolution of the brain had gradually become more complex. In some the cerebellum and the olfactory lobes had even diminished in size. There was now evidence that the same general law of brain growth holds good for birds and reptiles from the Jurassic period to the present time. The brain of an animal belonging to a vigorous race fitted for a long survival, was larger than the average brain of that period in the same group, and the brain of a mammal of a declining race was smaller than the average brain of its contemporaries of the same group. The small animals now existing had proportionally larger brains than the larger animals, and young animals had proportionally larger brains than adult animals. They found some interesting examples which threw light on this question. For instance, in the Eocene they had an animal, the oldest known ancestor of the rhinoceros, and it had an exceptionally large brain. Taking all the facts together, it seemed as though this brain growth was an important element in the survival of animals. If the animal became large and unwieldy with a small brain, it would be liable to suffer from any change of climate. In other words, in early times the big brain conquered, as it is the big brain that conquers in civilisation to-day.—Prof. Flower said it was satisfactory to find a case where the facts worked out coincided with previously formed theories, because that was not always the case, and sometimes the facts or the theories had to go to the wall. In this case they had no such difficulty, and they had to thank the American Government for the way in which it had taken up Prof. Marsh's work and were disseminating it.

THE largest profit by a German railroad in 1883 was 9·59 per cent. by the Right Bank of Oder Railroad. Four German roads earned more than 8 per cent., two more than 7 per cent., but no other earned as much as 6 per cent., while 14 earned less than 3 per cent.

CHEMISTRY OF PIGMENTS.—II.[*]

By J. M. THOMSON, F.R.S.E., F.C.S.,

Demonstrator of Chemistry at King's College, London.

Red Pigments.

I PASS now to the consideration of certain o these pigments, firstly, on account of one o the most important of them—namely, red lead containing the metal lead which we have alread found in other pigments; and, secondly, because will consider the remaining colours according t the order in which they are arranged in the sola spectrum. Red lead consists of an oxide of lead the chemical formula of which is approximatel Pb_3O_4. It is largely used for out-door painting o a coarser kind, but is very little employed by artist as it has no permanency, and is particularly easil affected by noxious gases. It is prepared by heating "litharge," another oxide of lead, to the required temperature in reverberatory furnaces, grea care being taken that the litharge is pure, and th temperature well regulated, so as to obtain th richest colour, the presence of other metal greatly deteriorating the brilliancy. Red lead i probably a mixture of two oxides, PbO and PbO as we find that treating it with warm nitric aci produces at once a change in the colour, by di solving out the first, or protoxide, and leaving th brown peroxide. You will perceive this chang on the sample I have in this tube, which rapidl becomes brown on my adding to it a little warn nitric acid.

Vermilions. — Common Vermilion, Mercur Sulphide; and Antimony Vermilion, Antimos Sulphide. — The first of these colours I hav already alluded to in the commencement of m lecture, in connection with change of colo without change of composition. We hav now to consider more particularly its man facture as a pigment. The mercury vermilion ma be obtained either by the sublimation of a blac compound of mercury and sulphur at a high ter perature, or by the wet method, which is the o supposed to be adopted by the Chinese in th preparation of the peculiarly rich colour whic they obtain. For the first method, the sublim tion of the black powder, or "Ethiops," as it called, is carried out in specially formed earth pots, heated at the bottom, and carefully cooled the top, so that the sublimed sulphide may deposited on the cooled parts of the vessel. Th best portions of the sublimate are then picked o washed, and crushed for sale. In Idria the mercu and sulphur are placed in barrels, which are caus to revolve rapidly, until the entire combination the bodies has taken place. This forms the bla sulphide, which is then placed in iron cylinde heated to dull redness, and fitted with earth covers and tubes, in which the red variety deposited. After finely grinding the pigment water, it is boiled with caustic alkali to remove t excess of sulphur, subsequently being washed a dried. In the so-called Chinese or moist meth the mercury and sulphur are ground togeth when moistened with a small quantity of caus potash; having been well mixed, more solution caustic potash is added, and the whole heated o sand bath, with constant stirring, the heat be gradually and carefully increased, the temperat which seems to yield the best results being a lit below 50° C. At a certain point the mixture atta its most brilliant colour, becoming gelatinous consistency; the operation is then stopped, vermilion washed with caustic soda and water, finally dried. In both operations the succ depends chiefly on the management of the tempe ture in the sublimation of the Ethiops, and in heating of the caustic ley with the mercury sulphur. Vermilion may be found adultera with several substances, chief among which brickdust and the chromate and peroxide of le Samples of the pigment may be tested for bri dust by simply volatilising some, as I do now, o piece of porcelain, when the pigment passes leaving the brickdust behind. To detect chrom or peroxide of lead, the pigment should be diges with hydrochloric acid, when the smell of chlo will at once be felt; and should further proof required, the mixture may be filtered hot, w the lead salt will most probably be deposited in filtrate on cooling. Should vermilion be adultera only with lead chromate, very often friction i mortar is sufficient to show its presence, a deterioration in the brilliancy of the pigment ta place. There seems to be no doubt that vermil unless exceptionally pure, undergoes a cha through time, gradually losing its original br red colour, and becoming converted into a bro This may be explained when we reflect that great brilliancy of the colour can only be obtai by carrying out its preparation within cer temperatures, and that heating above or coo below these points does not yield a good col pointing to the fact that the pigment cannot be regarded as a perfectly stable body, but is liable to molecular changes which may take place through time or changes of temperature.

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[*] The substance of the Cantor Lectures delivered b the Society of Arts.

Antimony Vermilion, Antimony Sulphide.—This colour may be prepared by passing a current of sulphuretted hydrogen gas through a solution of some antimony salt acidulated with hydrochloric acid, when you see the orange precipitate of antimony sulphide forming. To prepare the precipitate of a good scarlet hue, pure antimony chloride should be dissolved in water, when at first a white precipitate of antimony oxychloride will be found; on adding a saturated solution of sodium hyposulphite, or calcium hyposulphite, to this mixture, however, the precipitate will quickly dissolve, and on heating the vessel gently to about 30° C. a precipitate will be formed at first of an orange colour, but gradually changing to a brilliant scarlet. The best result is obtained when the temperature is gradually raised to 55° C., when the reaction should be finished if a sufficient quantity of the hyposulphite has been used. After preparation, the pigment should be thoroughly washed, when it will be found to stand well, and, already containing sulphur, is not affected by noxious gases. A red of an extremely brilliant colour, named "iodine scarlet," may be obtained from another compound of mercury, namely, the biniodide. Its formation can easily be shown to you on the lecture table by adding together solutions of potassium iodide and mercury bichloride, when a brilliant scarlet colour is produced. This substance is soluble in excess of either reagent, and the addition of these must be carefully carried out; the best result being obtained by taking eight parts of mercury bichloride to ten parts of the potassium iodide. Although a colour of great brilliancy, it cannot be recommended, as the mercury biniodide undergoes transformation by heat, as already shown to you, and the colour does not withstand the action of sulphuretted hydrogen gas. Two other compounds furnish pigments of a rich colour termed "purple red." They are the chromates of mercury and silver, and are formed by the decomposition of the nitrates of silver and mercury by potassium bichromate. The cost of such pigments, however, and the fact that they gradually lose their brilliancy in time, have prevented their extensive employment. The silver chromate was at one time much used in miniature painting.

"*Colcothar or English Rouge*" is a residue of iron peroxide produced in the manufacture of Nordhausen sulphuric acid, and resulting from the decomposition of the iron protosulphate therein employed. If required in a finer condition, it may be prepared either by carefully heating pure anhydrous ferrous sulphate, or by roasting precipitated ferric oxide. This pigment is not unfrequently adulterated with barium sulphate, which may be readily recognised by treating with hydrochloric acid, which entirely dissolves the colcothar, leaving the sulphate unacted upon.

Yellow Pigments.—Ochres.—These pigments consist essentially of clay, coloured with different quantities of ferric oxide, with more or less water attached to it. They comprehend also the colours "raw" and "burnt sienna," and the pigments known under the names of "Antwerp" and "Venice reds." The darker shades of ochre are readily prepared by heating the bodies of a lighter colour, and contain lesser quantities of water in their composition. I have here some yellow ochre in this tube, and you perceive that at once, on the application of heat, it becomes brownish-red in colour, losing water, which collects on the colder portions of the tube. The ochres, as a class, are of no definite chemical composition, but they are extremely stable colours, both under the action of air and noxious gases, and are well suited for outdoor painting.

(*To be continued.*)

LAYING OUT SHEET IRON AND BOILER WORK.—III.*

The Steam Dome.

THIS follows the cone in the regular order of progression. Ascertain first how much of your dome is to be cut away in order to conform to shape of shell; this is done by striking a segment of a circle equal to the shell of boiler. Erect a perpendicular from centre, then measure off on each side of perpendicular one half diameter of dome. Draw a line from points of intersection as shown in Fig. 5, and the height of arc C D equals the piece to be cut out. Allowing for flange, select the sheet to be used, and proceed as in the case of an ordinary cylinder, but dividing the circumference into eight (8) equal parts. Having measured off the height of dome from centre of top holes to point D, next draw a line representing the height at sides A B, Fig. 5, then get a line exactly between these two, as E, Fig. 6.

Then on lines 1, 1, Fig. 2, set compass or trammels to strike part of circle required to intersect at lines 1, 2 E and 8, 9 E as shown. On line 5, set trammels without changing and strike part of circle as shown on lines 4, 5, 6, C, and E, Fig. 6. Reverse trammels to opposite side, strike circles as shown on Fig. 6, then draw flange line, divide on ends and side for rivet holes, and the figure is complete.

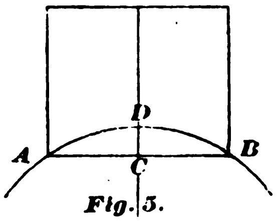
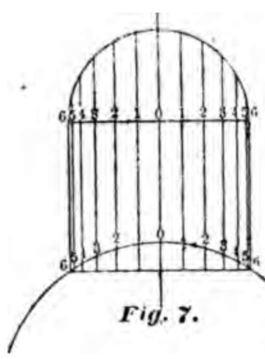


Fig. 5.



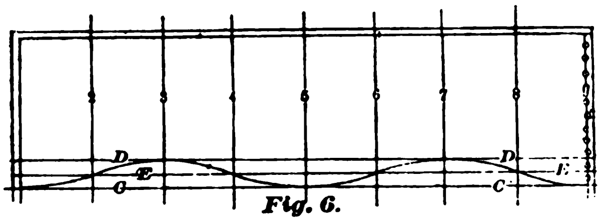
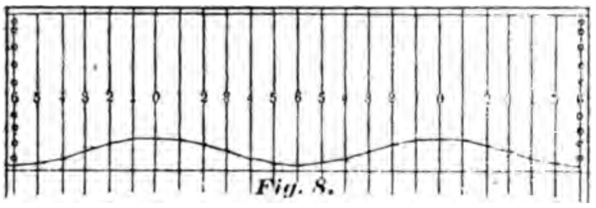


Fig. 6.



This method, commonly used in nearly all boiler shops, only applies when there is considerable difference between the diameters of dome and boiler, but will not give accurate results when the diameters are equal or nearly so. The only correct and proper method for this kind of work is by lines drawn on the straight sheet to represent them if drawn on the circular piece; and as the line system applies to very many of the pieces usually laid out by boiler-makers, their study is earnestly recommended. In laying out a dome by lines, a sketch of boiler and dome is required the same as in Fig. 5; in addition, a half circle is drawn on top of dome equal to one-half the diameter of dome rolled up; this is divided into as many equal parts as may be desired, and the lines carried down to intersect with shell, as shown in Fig. 7. These lines may be marked by letters or numbers. In preparing the straight sheet from which it is proposed to construct the dome, having calculated the circumference and measured off the same, divide the distance into twice the number of spaces shown on half circle, and carry the lines straight across the width of sheet; then set compass or trammels at 1 1 Fig. 7, transfer these distances to same numbers on Fig. 8; follow same proceeding with all the other numbers, and you can rely on having a well-fitting dome, if your flanger keep the same to a true circle in the turning of flange. It will be noticed that there are five numbers 1, 2, 3, 4, and 5, and but two numbers 6 and 0; the necessity for this is apparent, when it is understood that only one-half the circumference of dome is seen in Fig. 7, and the full circumference in Fig. 8. It also follows that the points 1, 1, 2, 2, &c., are identical with those on opposite side; hence the distances when transferred must be to all of the points with like numbers. Domes laid out by this method can be placed on the centre or side of boiler, or the dome and boiler may be of same diameter and accurate results will follow.

This method also applies to laying-out of connections between boilers, or a nozzle to connect a horizontal dome with a shell; in fact, the line system, if applied correctly, will apply almost to any figure, but requires slight modifications to suit each case. In future numbers I will show the application of this principle to other figures than the plain cylinder. In these sketches the seam has been placed on long side of dome, as is the custom. There are cases where a departure from this custom is necessary; a careful study of the rule governing this class of work will enable anyone to place the seam at whatever point is desired. In laying-out cylinder work, whether domes or shells, it is recommended that the circumference be divided into four equal parts and a hole punched on the quarter; then, when laying-out a head, square the same and centre at flange line the four points. In fitting up work this will be found valuable, as holes can be punched in flange at indicated points, and the head can be fitted in and marked off with very little trouble.

The Largest and Cheapest Penny Weekly Newspaper.—The *Weekly Times*—one of the oldest London weekly papers—has just been enlarged, and now consists of sixty-four lengthened columns. The *Weekly Echo*, a paper of large circulation, has been incorporated with the *Weekly Times*, and the two journals now merged into one form the largest, best, and cheapest penny weekly paper ever produced. Several new and interesting features are added. Mr. B. L. Farjeon, the well-known and favourite novelist, is contributing a new and most interesting story entitled "Aunt Parker"; Chess, Gardening, Volunteer matters, Sport, Law, Medicine, and Domestic topics are each in charge of competent authorities, and with these attractions and the immense mass of additional matter offered to its readers, there is no doubt of a speedy and large addition to the readers of this widely-circulated and favourite paper. Five editions are published weekly—the latest on Sunday mornings. The office is at 332, Strand, London, W.C., and the paper can be obtained at any newsagent's or bookstall in the kingdom.

Science Classes and Technical Education.—Those who are desirous of joining science classes should determine on their course without delay. We make a few notes of those specially deserving attention.

King's College, Strand, W.C.—Besides the evening classes in workshop Engineering, there are now a series of lectures on Metallurgy, by Prof. A. K. Huntington, assisted by Mr. W. G. McMillan as demonstrator, on Monday evenings. Mr. McMillan also gives a course of lectures on Fuel on Monday evenings. The class of Practical Metallurgy is held on Friday evenings, and students can prepare for the Science and Art Department examination in that subject. Special attention will be paid in the Monday evening lectures, to the metallurgical requirements of the City and Guilds Institute examination.

City of London College.—The Engineering Department of this college is under Mr. Henry Adams, M.Inst.C.E., assisted by Mr. R. J. Hatton. The syllabus of lectures includes Technical Drawing, Building Construction, Machine Construction, Carpentry and Joinery, Civil Engineering, Mechanical Engineering, Surveying, &c.

Anderson's College, Glasgow.—The popular evening classes at this college will commence on September 29. The subjects of the lectures will be Natural Philosophy, Anatomy and Physiology, Music, Chemistry, and Geology. The fee for each course of twenty-eight lectures, with use of library, is 2s. 6d.

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* By G. MARSHALL, in the *American Machinist.*

SCIENTIFIC NEWS.

THE death is announced of Mr. John Gay, F.R.C.S., in his 73rd year. The deceased was the author of a number of important works on surgery.

The number of members, associates, ladies, and foreign members attending the British Associatiation meeting was 2,203; the total amount received being £2,256. The council are to consider the propriety of admitting ladies as officers of the Association.

Dr. Copeland read a paper on "The New Star in Andromeda," in which he expressed the opinion that the star is not new, but is only the temporary brightening of an old star. Prof. Stokes also read a communication by Dr. Huggins on the Spectrum of the Star. As observed on Sept. 9th, there were found three to five white lines between D and *d* in the spectrum—a continuous spectrum being visible from D to F.

A "correspondent" of the *Times*, in an article on the "Birth of Worlds," says: "Neither this star, nor any other new, variable, or temporary star ever observed, can be said to have thrown the least light on the birth of worlds. Certainly, if the nebular hypothesis of Laplace represents the real way in which solar systems are formed, no new star has thrown light upon that process, or possibly can. For the process imagined by Laplace involved no catastrophes."

Probably the same "correspondent" also writing on "Swiftly Moving Meteors," says: "The inquiry is one of singular interest, because if there are such swiftly travelling meteors, we have to adopt strange ideas as to their origin and the cause of their tremendous velocities. If there are not, we must cease to rely so confidently as hertofore on the estimates which Messrs. Greg, Denning, Alex. Herschel, and others have formed respecting the directions of the various meteor streams. In either case, the meteoric field of inquiry requires many new labourers."

At the meeting of the British Association, Mr. J. J. Coleman gave an account of experiments with a modification of Daniell's battery, in which he used iron as the electro-positive element, and found it the more permanent arrangement, the cell remaining intact for a much longer period. A slight deposit of sulphate of copper forms on the iron; but it is easily rubbed off.

The Institution of Civil Engineers has issued a list of forty-two subjects on which original communications are invited. For papers read during the past session, the Watt medal was awarded to Prof. H. S. Hele-Shaw; the George Stephenson medal to Mr. W. Stroudley; Telford medals to Messrs. P. W. Willans and W. G. Brounger; besides twelve Telford premiums and eight Miller prizes to students.

The Gilchrist (Entrance) Engineering Scholarship is open for public competition at University College, London, on September 28 and following days. The scholarship is of the value of £35 per annum for two years, and candidates must be under nineteen years of age on October 1st. The subjects are mathematics, mechanical drawing, use of tools, &c.

The special committee appointed by the Franklin Institute has reported "On the Efficiency and Duration of Incandescent Electric Lamps," as tested at the Philadelphia exhibition. The report is issued by authority of the board of managers, and is published separately and as a supplement to the *Journal* of the Institute. This report, which fills 127 pages, eighty of which consist of tabular matter, is the most complete and satisfactory examination of the subject which has yet appeared.

The story about telephoning from America to Europe is in place of the usual tales about the sea-serpent; but we believe it is true that Mr. Edison has allied himself with Mr. Gilliland, and is going to set up his laboratory in Florida, and proceed to investigate all that is known and all that is unknown concerning electricity.

The Blackpool electric tramway will probably be opened by the Mayor of Manchester on September 29. Boston, Mass., is to have an electric street railway. Probably by this time the Daft electric motor has been publicly tried on a portion of the New York elevated railway. The private trials had been made at the date of our advices, and had given satisfaction.

The natural-history collections made by the late Dr. Nachtigal, in the course of his tour of annexation on the West Coast of Africa, have arrived at Berlin in 20 cases, and the greater part of their contents will be assigned to the new Ethnological Museum.

Attention has been called to two races of men that must soon become extinct. At the present rate of decrease the Maoris of New Zealand—now reduced to less than 45,000 men from 100,000 in Captain Cook's day—must have disappeared by the year 2000. The Laplanders are estimated not to exceed 30,000 in numbers, and are gradually becoming fewer.

Prof. Verrill, of New Haven, has discovered that oysters live longest when they are packed with the front edge downwards, as the mantle is then closely pressed against the inner edges, and prevents the escape of water.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects; For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

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THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENTIFIC MENDICANCY—A MUCH-NEEDED REFORM IN TEXTBOOKS—THE NEW STAR IN THE NEBULA IN ANDROMEDA—THE INTELLIGENCE OF DOGS—AN HONOUR: OR MERELY AN ODD TRICK?—WHAT IS "CREATION"?—HYGINUS N.

[24792.]—WHILE admitting that Sir Lyon Playfair (as reported on pp. 25-28) was moderate in the presentation of science in its mendicant aspect, in his recent Presidential address at Aberdeen, it can only be deplored that he wasted a golden opportunity for imparting instruction to those who heard him, and devoted himself to the repetition of the South Kensington shibboleth. The conspicuous unfairness of those who are eternally clamouring that research should be endowed, lies mainly in their careful suppression of the fact that practically every scientific discovery of value has been made by men who are not, and never have been, indebted to the State for one single halfpenny, while the enormous sum annually lavished on the Science and Art Department has, so far, only had the effect of producing a clique of scientific Professor Holloways, who flatter one another openly on the platform, and surreptitiously in articles in the (mis)leading journal, and in other publications to which they have access, until the ignorant outside public actually begin to take them at something like their own valuation! Why, moreover, as has been previously remarked, the chemist, the astronomer, the geologist, or the biologist should be "endowed," and the man whose poems remain on his bookseller's shelves, or whose paintings are rejected at the Royal Academy, should be left out in the cold, has never been explained.

In pleasant contrast to Sir Lyon Playfair's address appears that of Prof. Chrystal in Section A, whose remarks on the need of sound scientific teaching and textbooks deserve all the publicity that can be given to them. "Might not," asks Prof. Chrystal, "the British Association, now and then, request some one fitted for the task to write a treatise on such and such a subject, and offer him reasonable remuneration for the time, labour, and skill required?" It is much to be hoped that this idea will bear fruit, and that we shall so obtain the supersession of (text?) books such as the one in which it is alleged that longitude is determined at sea by finding local noon when the sun is at the highest part of his diurnal path! I wonder wha any American astronomer who has ever crossed th Atlantic—or, in fact, gone out of sight of land- would say to such stuff as this emanating from person who is supposed, by those who only kno him through puffs, to be a teacher of astronomy (Heaven save the mark!) The British Associatio at all events, would never give its imprimatur t this sort of trash. That Prof. Chrystal himsel can right well separate the chaff from the wheat- our intellectual giants and pioneers of science fro our mere advertising quacks—is evidenced by th list of names which he gives as those of men fro whom he craves occasional courses of lecture Not one single Brompton one appears in it.

Since writing letter 24729 (p. 31) I have o several nights examined the great nebula in Andr meda and the recent marvellous addition to it. confess that I cannot agree either with Mr. Tarra (letter 24733, p. 32) or with Mr. Peek (letter 2473 same page) as to the new star being orange-colour or red: for, notably on the night of the 4th, shone with a bluish light, like a tiny electric (ar light. Besides, it has a very short spectrum, c off, as far as I can see, at both ends; but most at the least refrangible one. I should have though that the familiar effect of reflection from silver reddening all objects was the operative cause the production of the colour in Mr. Tarrant case, but for the fact that Mr. Peek seems to hav seen the same thing in a refractor. The effect (necessity a purely optical one) to my eye is th the star is between us and the nebula. By the by having spoken of its spectrum, I may add, as encouragement to the possessors of moderate optic means, that with McClean's star spectroscope my 4⅛in. achromatic, I saw it very well indeed. was assuredly not gaseous, so that we are not her dealing with such a phenomenon as was exhibite in the case of T Coronæ in 1866, and again by th Nova Cygni in 1876, but are regarding an incande cent solid or liquid body. In fact, had the birth this latest addition to the celestial vault bee announced in the *Morning Post*, it should have a peared as "The Universe—of a Sun."

Amid a desert of disquisitions, compose chiefly of cacophonous technicalities and r markable for their extreme dryness, Sir Joh Lubbock's paper at the British Association intelligence in dogs stands out as a pleasant oas There is great wisdom in his suggestion that should endeavour ourselves rather to understa dogs than to teach them tricks. As the result familiar intercourse with two or three dear frien among them, I am convinced that any attempt enter into their mental processes must be produ tive of results as valuable in their application they are pleasant and interesting in their acqui tion. No one who has mixed much with dogs anything like intimate terms can fail to have notice how they pick up the meaning of spoken words, a how identical in kind their mode of learning langua is with that of a child. The formation of t canine larynx is, of course, opposed to speech its ordinarily-accepted sense (albeit I seem to r member two French dogs which were exhibited London years ago which did utter a few articula words); but a dog is, in this respect, only on par with a dumb man, and can often translate i suppressed utterances into perfectly intelligib signs. One of my own dogs, a little fox terri can and does perpetually ask me, by means of c tain conventional gesticulations, to give her som thing, or to do certain things, at least as intelligib as a savage could. She seems to me to be abo on an intellectual level with a child of two yea old or so. Students of science at a loss for a su ject for research might experimentally investiga comparative psychology with a distinctly benefic result.

They say that "A straw shows which way th wind blows." I am, I confess, a little amus in looking through Symons's "Rainfall in 1884 to note how, among a voluminous li of rainfall observers, the solitary recogniti of the fellowship of a learned society that occu is that of the Royal Society, all the Fellows which figure in Mr. Symons's list as "F. R. S Do we owe this to the fact that the compiler of t work is himself a tolerably recent addition to t society in the east wing of Burlington House— what? This parade of one solitary distincti would almost lead one to imagine that Mr. thinks this particular fellowship some sort of *honour!* If this be his notion, the soon he dismisses it the better. There are men the Royal Society who would confer dignity a lustre upon any assemblage of savants whateve but they are in reality "rari nantes in gurgi vasto," and are surrounded by second, third, a so on to *n*th-rate men, pushing doctors, me bers of the South Kensington ring and the li who manage to obtain the right to inscribe t magic letters after their names, for trade purpos and for trade purposes only. Outsiders in gener and Americans in particular, may note that exact the same amount of honour—neither more nor le —attaches to the Fellowship of the Royal Socie *per se*, as does to the occupancy of a seat in a first-class carriage on the Metropolitan Railway.

With reference to letter 24768 (p. 59), I will just remark that *when* "some new *energy*" appears "without having been transformed from any of the energies known to us" it will be quite time to discuss the precise term to be employed to designate it. The phrase "first appearances of new and previously non-existent characters," involves a simple petitio principii. To be consistent, "H. B. F." should say that table salt is "created," when anyone mixes carbonate of soda and hydrochloric acid; because assurodly the resulting sodium-chloride presents characters which are "new and (seemingly) non-existent" in its components. I wholly demur to the assertion of your correspondent that "We have every reason to believe that during the progressive history of our planet, new and previously non-existent forms have constantly appeared, and are appearing, in a manner inexplicable by 'Natural Selection.'" "H. B. F." seems to think that the geological record is as perfect as the diagrams which one sees hung up behind a lecture-table, instead of being, as it in reality is, imperfect and fragmentary to the very last degree. It is seldom, indeed, that we are able to trace the successive steps in the evolution of any given form of animal life, as has been done in the case of the horse; the successive links connecting which with the hipparion have been so happily preserved. My objection to the use of this word, "Creation," as employed by "H. B. F.," is that it is in reality only employed as a cloak for our ignorance, and explains nothing whatever. To render his argument perfectly valid, your very able correspondent, "Sigma" (letter 24787, p. 63), must postulate the eternity of matter.

Many thanks to Mr. Sadler (letter 24778, p. 61) for sending me back to the *Astronomical Register* for September, 1879, apropos of Mr. Rand Capron's supposed discovery in connection with Hyginus N. Of course, if that turtle did (like an Irishman) put himself outside of "The Crater," that will account for anything.

A Fellow of the Royal Astronomical Society.

THE NEW STAR IN THE ANDROMEDA NEBULA—ENCKE'S DIVISION IN SATURN'S RING—SOLAR PROMINENCES—DOUBLE STARS: 25 CANUM, ζ BOÖTIS, ε BOÖTIS, ξ BOÖTIS, 44 (i) BOÖTIS, η CORONÆ, μ^2 BOÖTIS, σ CORONÆ, λ OPHIUCHI, ζ HERCULIS, Σ 2107, Σ 2173, μ^1 HERCULIS, 70 OPHIUCHI, δ CYGNI, ε EQUULEI, Σ 3062.

[24793.]—THE appearance of a new star in the great Andromeda nebula is an event of rare importance in the astronomical world. On the receipt of the Dun Echt Circular, No. 97, on Sept. 2, I took the first opportunity afterwards of looking up the stranger. This occurred on the night of Sept. 3, and I found it to be even so, that a new star had certainly appeared in the very heart of the nebula. I could still see the old nucleus, and on the next clear night, Sept. 6, I measured the Nova as compared with the place of the old nucleus, and found that the former was about 12″ preceding and 8·5″ south of the latter. Comparing its place with the measure given in the Dun Echt Circular, No. 98, in which on Sept. 3rd Lord Crawford and Dr. Copeland found it to be some 1·6″ preceding and 5″ south of the old nucleus, I suspected motion, and I referred the question to the Dun Echt observers; but Dr. Copeland informed me that their measures were too uncertain to admit of any precise deductions, having been obtained with difficulty in cloudy weather. To settle this important question, I measured the position of the Nova as compared with a small star of about the 10th mag., which Mr. Common informs us is shown in the photograph he took of the nebula last year, which lies south preceding the Nova, and obtained the following results on Sept. 9th:—

(1) P = 261·5°
D = 120·2″
(2) P = 261·5°
D = 117·0″

The mean of which measures gives:—

P = 261·5°
D = 118·6″

On Sept. 13th I again took a measure, which was as follows:—

P = 261·5°
D = 119·5″.

I therefore conclude that my suspicion of rapid motion on the part of the Nova is unfounded; but it may be as well to place on record these measures for the further determination of the question.

There appeared a very interesting article on the great Andromeda Nebula in *Nature* of Feb. 9th, 1882, by the late Prebendary Webb, one of the drawings given by him of that object having been made by myself, and from my recollection of it, I should certainly agree with your correspondent, Mr. Herbert Ingall, in letter 24730, that the nucleus is not now as bright as it formerly was. Whether it is really less bright, or only apparently so, in consequence of the near proximity of the Nova, I cannot say positively; but I certainly incline to the former opinion. There remains the important question whether the stranger has been developed out of the nebula, and is in connection with it, or whether it is merely the appearance of a new star situated between us and the nebula, and projected upon it in the same line of sight. On this point we should hope to learn some information from the respective spectra of the two objects. The spectrum of the nebula is a very peculiar one, being continuous, but cut off at the red end. And when we find, according to Mr. Maunder, in a letter to the *Times*, that the Greenwich observations show the spectrum of the nebula and the spectrum of the Nova to be identically the same, that spectrum being, as we have seen, most peculiar, I presume that it is a fair inference to say that the two bodies *are* physically connected; but on this point I should like the opinion of those who are better able to judge than myself. What does "F.R.A.S." say?

In May and June I was on the Continent, and had the opportunity of visiting the Observatories of Munich, Geneva, and Paris, at each of which places I was received with the greatest courtesy and kindness. The principal instrument at the Geneva Observatory is a fine 9in. refractor, and they told me that they had made a special study of Saturn, and frequently observed Encke's division in the outer rings. Of its existence there can, I think, be little doubt. It may be variable; but so many observers in different parts of the world can hardly be mistaken as to their having seen it over and over again.

Since my return from the Continent, I have taken every favourable opportunity of looking for solar prominences with the very fine spectroscope which I purchased some time ago from Mr. Hilger. I have hardly ever examined the sun on a clear day without seeing prominences of some sort, but very bright ones are comparatively rare. They vary very much, and your readers who are possessed of but small instrumental means must not despair of seeing a prominence if they only have the good fortune to light upon a very bright one. The form of such a one could be seen with ease, where a fainter one would be totally invisible. The opportunities of examining the sun have not been very frequent lately; but, judging from those I have had, I should say that prominences have not been so frequent or so bright latterly as they were during last autumn and winter.

The nights have been very unfavourable for double-star work, good definition being a great rarity; but I give below a few double star measurements taken recently by me.

(1) 25 Canum. R.A. 13·32. Mags. 5, 7·6.
P = 147·5°. D = 0·5″. Ep. 1885·49.

(2) ζ Boötis. R.A. 14·35. Mags. 3·3, 3·9.
P = 111·5°. D = 0·6″. Ep. 1885·48.

(3) ε Boötis. R.A. 14·39. Mags. 3, 6·3.
P = 328·2°. D = 2·8″. Ep. 1885·48.

(4) ξ Boötis. R.A. 14·45. Mags. 4·7, 6·6.
A.B. P = 260·0°. D = 3·4″. Ep. 1885·48.

(5) 44 (i) Boötis. R.A. 14·59. Mags. 5·2, 6·1.
P = 242·5°. D = 4·8″. Ep. 1885·49.

(6) η Coronæ. R.A. 15·19. Mags. 5·2, 5·7.
P = 165·5°. D = 0·5″. Ep. 1885·48.

(7) μ^2 Boötis. R.A. 15·20. Mags. 6·7, 7·3.
P = 104·5°. D = 0·8″. Ep. 1885·52.

(8) δ Coronæ. R.A. 16·10. Mags. 5, 6·1.
A.B. P = 203·0°. D = 4·0″. Ep. 1885·49.

(9) λ Ophiuchi. R.A. 16·24. Mags. 4, 6·1.
P = 42·0°. D = 1·9″. Ep. 1885·51.

(10) ζ Herculis. R.A. 16·36. Mags. 3, 6·5.
P = 90·5°. D = 1·8″. Ep. 1885·5.

(11) Σ 2107. R.A. 16·47. Mags. 6·5, 8.
P = 240·5°. D = 0·75″. Ep. 1885·52.

(12) Σ 2173. R.A. 17·24. Mags. 5·8, 6·1.
P = 199·0°. D = 0·5″. Ep. 1885·52.

(13) μ^1 Herculis. R.A. 17·41. Mags. 9·5, 10·5.
B.C. P = 284·0°. D = 0·4″. Ep. 1885·57.

(14) 70 Ophiuchi. R.A. 17·59. Mags. 4·5, 7.
P = 32·2°. D = 2·5″. Ep. 1885·58.

(15) δ Cygni. R.A. 19·41, Mags. 3, 7·9.
P = 332·5° D = 1·6.″ Ep. 1885·56.

(16) ε Equulei. R.A. 20·53. Mags. 5, 6·3.
A.B. P = 285·0. D = 1·1″. Ep. 1885·66.

(17) Σ 3062. R.A. 23·59. Mags. 6·9, 8.
P = 311·0°. D = 1·3″. Ep. 1885·66.

Of the above, perhaps the most interesting are Nos. 6, 7, 10, 11, 12, 13, and 14. η Coronæ is a rapid binary, with a period of about 43 years, and, according to my measures, I find it has traversed an angular distance of some 56° since 1881.

In the same period μ^2 Boötis has decreased in angular distance some 22°, and ζ Herculis about 15°. The latest measure I have of Σ 2107 is one by Duner in 1875, which is P = 212·3°. D = 0·99″. In ten years, therefore, this binary has run through an angle of 28·2°. In 1878 the Cincinnati observers measured Σ 2173, and found the angle and distance to be P = 141·6°; D = 0·55″. My measures show a change in angle since that date of 57·4°. No. 13, μ^1 Herculis, is a celebrated binary, discovered in 1856 by Alvan Clark. Burnham measured it in 1880, and found the angle to be 245·9°. Now it is 284·0°, an increase of 38·1° in five years. In 1882 I measured 70 Ophiuchi, with the result that the angle is now 20° less than it was then. In this way it is exceedingly interesting to watch the revolution of sun about sun in these binary systems, situated from us at "distances which are reckoned only in Heaven," and, many of them being coloured suns, it may, as Sir John Herschel pointed out, be "easier suggested in words than conceived in imagination, what variety of illumination *two suns*—a red and a green, or a yellow and a blue one—must afford to a planet circulating about either; and what charming contrasts and 'grateful vicissitudes,' a red and a green day, for instance, alternating with a white one and with darkness, might arise from the presence or absence of one or other, or both, above the horizon."

Jevon J. Muschamp Perry.

St. Paul's Vicarage, Alnwick, Sept. 15.

P.S.—Since writing the above, I see by a letter in the *Times* of Sept. 15th, by Mr. R. A. Proctor, that, in his opinion, the identity of spectra between the new star and the nebula proves conclusively that they are physically connected.—J. J. M. P.

[24794.]—I TURNED the 9in. reflector of this observatory on this wonderful object on the evening the cablegram was received by me (Sept. 2nd), announcing its discovery by Hartwig.

The great Nebula has become so familiar to me, having examined it hundreds of times in my cometary sweeps, that I was completely astounded as I beheld the marvellous spectacle of a new sun. My latest observations make it of the 6th magnitude, hard and well defined with high and low magnifying powers. It is easily seen here with the naked eye.

In the telescope, with a moderate power, it is beautiful in the extreme. Future developments will be watched with intense interest.

William R. Brooks.

Red House Observatory, Phelps, N.Y., U.S.A.,
September 5th.

[24795.]—ON looking at this object last night with a 3in. it seemed to me that it no longer assumed the elongated form which has distinguished it, but is greatly spread out with long wisps of light, putting one much in mind of the Great Neb. in Orion. Can any of your readers who have larger instruments inform me if such is really the case? The central condensation, or new star, whichever it be, was plainly visible. **A. B. B.**

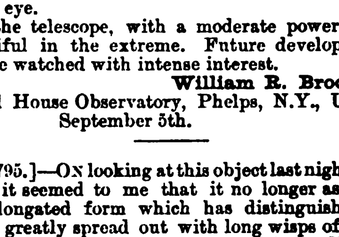
P. II. 61 ANDROMEDÆ.

[24796.]—BY "61 Andromedæ" (letter 24699) I presume Mr. Dowsett means P. II. 61 Andromedæ ("Cel. Objects," p. 215). I regret to say I have no observations of this star. The companion is certainly not a "known" variable; but the recorded observations certainly seem to give grounds for suspecting variation. It is always a difficult matter, however, to *prove* variability in these faint companions to brighter stars.

Sept. 14. **J. E. Gore.**

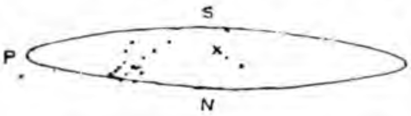
KLEIN'S OBJECT—NEBULA IN ANDROMEDA.

[24797.]—IN reference to the remarks of "F.R.A.S." (24729), I now inclose a tracing showing in outline the object and neighbourhood as



delineated in Beer and Mädler's map. In the original the effect is given by a number of very fine short lines. These Mr. Wesley has reproduced in this month's number of the *Observatory*, in which a full history of the matter is given.

"F.R.A.S." tells me that the detached map there spoken of, which led to the finding of the object in Beer and Mädler's map, is from Arago's English version of his "Astronomie Populaire" (1858, Longman), but partly relettered. It is odd



that the object, which is fairly conspicuous in the maps, should have apparently escaped notice, pending the searching investigation the matter had some years ago.

In reply to Mr. Herbert Ingall's letter (24731), Guillemin, in *Le Ciel*, gives a drawing of the Andromeda Nebula as a fusiforium object with some central condensation. Smyth's Bedford Catalogue shows the object as oval, with stars outside it, shown as within in Guillemin's drawing. I send a diagram of the stars as given by Guillemin, who does not give his authority for the drawing. The faint one marked with a × seems in the position of the Nova, or near it. The nebula was examined here on the 5th and 9th, and the star was very conspicuous. Two observers thought it blueish in tint. We all thought it slightly brighter on the latter occasion. The nebula and star having similar spectra is suggestive of the latter being a condensation of the nebulous matter, and not of independent character.

Guildown, Sept. 14th. **J. Rand Capron.**

ASTRONOMICAL.

[24798.]—"S. S.," letter 24775, says that stars at such a remote distance as 31 M. as yet defy resolvability. As this implies some knowledge of the distance of the nebula, I shall be glad if he will refer me to any evidence we have of its great comparative distance. Is it known that it is more distant than the mass of the stars? To me the new star appears behind the nebula. If so, the inference is that the nebula is not "infinitely" remote; but rather that it is near. Is there any evidence that the nebula consists of stars or anything resolvable at all? Is he correct in asserting that "in no instance has any star been seen in their midst of a size that will at all compare with any standard of magnitude that has yet been adopted?" I am afraid there is more sound than definite meaning here. There are a number of stars in the same line of sight as this very 31 M. There are quite a number of 6th, 7th, and 8th magnitudes in same line of sight as 42 M., and also a number with 27 M, and one apparently in centre of ℍ IV. 37. Is there any evidence that all these stars are unconnected with the nebula? If not, "S. S." assumes his conclusion and argues in a circle. I think he will see that his conclusion that the star is *infinitely nearer* than the nebula is based on insufficient grounds. Even if we suppose it within the nebula, it will not prove it a "globe of more gigantic proportions than any yet conceived," unless evidence is forthcoming that the nebula is extremely distant compared even with the fainter stars.

But when a star rapidly blazes up, and as rapidly fades, does this not furnish evidence of comparative smallness and nearness, since the vaster the body the longer certainly it would require to degrade, and, if it be possible to prove connection with nebula as well, that would prove the comparative proximity to us of both. If the Andromeda nebula is at an "infinite" distance, or even at a distance as great as the vast majority of the stars, then it must necessarily be of "more gigantic proportions than any yet conceived," since it fills a space in the sky of great extent compared to the mere point occupied by a star. There are places in the heavens where many thousands of stars are seen in a fraction of the space occupied by 31 M, and if this is at an equal or greater distance, it must fill more space than these thousands of stars, and the immense intervals betwixt them. Can we conceive this, or is it not more reasonable to conclude that bodies possessed of apparent magnitude, and which can be magnified, are really nearer to us than those which resist all scrutiny, and remain mathematical points however examined?

Edwin Holmes.

OBSERVATIONS OF THE MILKY WAY AT HIGH ALTITUDES—CHANGE OF ADDRESS.

[24799.]—Dr. Gould, from Heis's delineation, together with his own observations, finds that the Milky Way consists of two great circles of stars slightly inclined one towards the other, the two circles joining in the Northern heavens near γ Cygni. Besides these he finds there is a third circle of stars, chiefly bright ones, from the first down to the fourth magnitude. The "Atlas Cœlestis" of Heis, and the "Uranometria Argentina" contain beautiful delineations of the Galaxy, the one of the Northern, the other of the Southern heavens. Writing from memory, I believe that Dr. Gould infers that these three circles are independent one of another. This summer I have been spending a few weeks at Mürren in the Bernese Oberland at a height of about 5,500. The nights were extremely beautiful, and the Galaxy surpassing anything I have ever seen elsewhere. One or two fine nights were devoted to studying the brightness and structure of the Galaxy.

My late and deeply-lamented friend Prebendary Webb, in an unpublished observation under the date of 1880, Sept. 2nd and Sept. 3rd, has the following notes:—

(1) "Galaxy.—I thought I could detect a very feeble stream running off from below Lyra to α Ophiuchi. This, I find, is otherwise than Heis."

(2) "Galaxy (previous observation) confirmed. It is faintly triple, a distinctly separate stream running off from β Cygni to or towards α Ophiuchi."

On August 6th I saw this new branch very distinctly. It leaves the main stream of the Galaxy at XIX. 20 + 27° 30′, and runs by 106, 105, 95, 96, α, 19, 21, κ, ι Herculis to δ, ε, Ophiuchi.

On July 31st I was much struck by another branch of the Galaxy, which I at first mistook for Webb's branch. The following are my observations of it:—

July 31st. A distinct branch seemed to run from β Lyræ to δ Herculis.

August 5th. The new branch very plain. It starts from the Galaxy and passes through β, γ, Lyræ, and so to ξ, μ, λ, δ Herculis, where it is broken; but appears again at β, γ, Herculis, and ends in the fine region near β Serpentis. It starts = 6·0, gradually diminishing to 7·0.

On Aug. 10 I noticed another branch while trying to see if the one detected on July 31 crossed the Galaxy. It leaves the Galaxy at Lacerta, and is marked by the stars 8, λ, ρ, σ, π, δ, η Andromedæ and ψ Piscium.

The separation of the two great branches took place, as I thought from memory, a little south of γ Cygni; but I was much surprised to find this was clearly not the case. I have the following observations:—

Aug. 5th.—The rupture in the Galaxy seems to occur at α Cygni, and not at γ Cygni.

Aug. 6th.—I was greatly astonished to find that the real intersection of the Galactic branches does not occur in Cygnus; but a little south of δ Cephei.

The Intensity of Light.—Heis divides the Galactic light into six magnitudes. Following his plan, I have the following determinations:—

	July 31.	Aug. 2.	Aug. 9.
Sagittarius near γ ..	0·5 =	Star 4½ mg. =	0·5
Scutum	1·5		1·5
12 Aquilæ to δ Aquilæ			4·5
ζ Aquilæ to 67 Ophiuchi	5·5 to 5·0		5·0 to 4·5
γ Aquilæ to Sagitta	4·0		4·0
Sagitta to ε Cygni..	5·5		5·5
Near ζ Aquilæ......	5·0		5·0
Below β Cygni......	6·5		6·0
North of β Cygni, XIX. 40 + 33·35..	3·0		
Below γ Cygni......	2·0		2·5
Between α and γ Cygni			6·0
North of α and S. of 63 Cygni............	2·0	2·0	2·0
π Cygni to δ Cephei			4·0
XXII. 10 + 54° ...		2·0	
δ Cephei to Cassiopeiæ			4·5
Perseus cluster......		1.0	2·0

The portion of the Galaxy near γ Sagittari is excessively bright. There are one or two remarkable points in the Galactic structure which have not received the attention they deserve, I think. Firstly, *the gaps.* These interruptions are numerous, the most remarkable being the disappearance of the following branch below 68, 70, 67 Ophiuchi. The break, however, is not complete. On August 5 I noticed it could be traced all the way till it brightened near ο, ν, Serpentis, the magnitude being 6·5.

Other gaps occur—

(1) Round β and γ Aquilæ; August 6th.

(2) Within the circlet of λ Aquilæ; Aug. 6th.

(3) South of 1 and 2 Aquilæ; Aug. 5th, Aug. 6th.

(4) North of ξ Cygni, and having that star at its S. margin, elliptical, and prolonged north; Aug. 2nd.

(5) Near 63 and 59 Cygni; Aug. 2.

(6) 57, 56 Cygni are situated in an elliptical black hole, stretching up to α Cygni; Aug. 2nd.

(7) A most remarkable rift, running right across the Galaxy at right angles to the stream. The centre of it passes through XXI. 12 + 48. It runs as far south as ρ Cygni, and is crossed by a stream of stars, which end in ρ; Aug. 2nd. This curious gap can be traced nearly 10° across the Galaxy, and is broadest at the *n.f.* end; Aug. 5th.

(8) Near ζ Cephei; moon rising prevented furth description.

August 2nd. Secondly, *Patches, sprays, &c.*

Patches (1) μ Sagittarii...... August 6.
(2) XVIII. 5 — 16·0 August 6.
(3) Scutum .... August 6.
(4) Perseus cluster ... August 6.

Remarkable star spray from λ Cephei through 1 and μ Cephei (not the Garnet Sidus), and ends broad star dust somewhere about XXII. + 52°. is separated from the surrounding Galaxy by tw dark channels, one at each side of it: one makes bend and is lost near π^2 Cygni, ending in a ri between π^2 and π^1 Cygni; August 2nd.

XXII. 20 + 55°, XXIII. 3 + 68° 30′, 0 + 62·15, marks a narrow band of great condens tion. August 5th.

The Galaxy between Cassiopeia and Cepheus h a streamy appearance; August 6.

In the region marked by ν, ζ, 30, XXIIh. + 6 Cephei are many bright stars forming a large op cluster, and singularly contrasted with the co densed part of the main Galactic stream. There a relation between the two streams of the Galaxy where one is faint the other seems bright; Aug. 6

If Dr. Gould's theory of the two rings is correc the Galaxy should brighten at Cepheus and co tinue bright all the way to the horizon at Aurig but when the stream was visible near both horizo such was found not to be the case; the part in Sagi tarius, although so low, was the brightest part the Galaxy, while the part in Auriga was b faintly visible. This appearance would take pla if we were situated in space much nearer t Sagittarius Galaxy than the Auriga one; or we ma hold the theory of a cloven ring, which seems, think, from the peculiar gaps and patches, the mo probable.

Would my correspondents kindly note the chang of address? **T. E. Espin.**

High-street, Wolsingham, Darlington.

THE NEBULA IN THE PLEIADES.

[24800.]—Of the existence of this nebula think there can be no reasonable doubt. Discovere in 1859 by Temple, it was also observed by Schmid in 1861. Prebendary Webb, in his account in th *Intellectual Observer*, Vol. IV. p. 448, I believ states that he has seen it more than once; an Mr. Matthews, in a letter to the *Astronomic Register*, Vol. IV. p. 168, says that in the autum of 1864 he had some excellent views with an 8i reflector.

He describes it as having somewhat the shape a fan branching out from one of the bright star and gradually increasing in breadth as it leaves th star. During the autumn of 1865 he was, howeve unable to see it with a 9½in. reflector.

On referring to my note-books, I find I saw th nebula on Jan. 28, 1868, with a 3¾in. refractor. I was then a very faint object, and a low power w required. On Jan. 26, 1870, I searched for it wi a 6½in. silvered glass reflector, but could find trace of it, Merope appearing quite clear and shar I have not since looked for it.

This nebula requires a very low power, as it very large and faint, and fills the whole field whe a high power is employed, thus being rendere invisible.

The question of its variability is a most interes ing one, and the Pleiades will repay a careful surve during the ensuing winter.

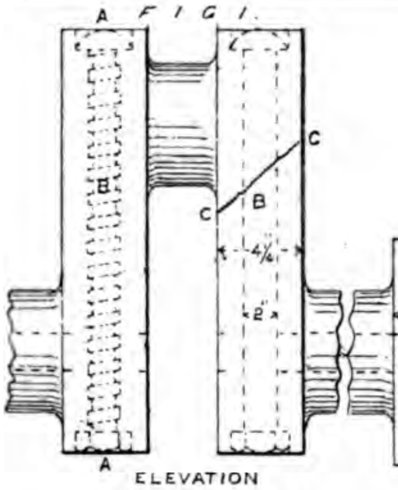
Sept. 19. **H. Michell Whitley.**

THE BREAKING OF LOCOMOTIVE CRANK AXLES.

[24801.]—Your readers are aware that for long time, but more especially since the Peniston accident, I have given considerable attention t the very important question of the breaking locomotive crank axles. The value of hoops place round the webs is a subject upon which great di ference of opinion exists. The writer having obtaine all available details from the various compani had some experiments made, and also witness others, the result being that it appeared that whe a crank-web breaks nearly or quite straight acro the hoops are of the greatest use in holding th crank together; but, on the other hand, when th fracture occurs in a slanting direction the hoop not only rendered of no value, but it even tends b its tightness to force the broken parts out of th required position. The hooping of a crank pra tically lengthens it about 2in., and there are ve many engines running in which hoops cannot b employed, in consequence of there being no avai able space between the crank and the under side the boiler.

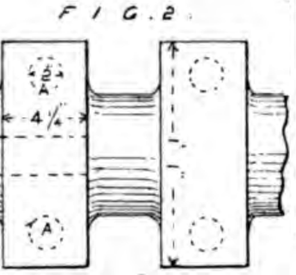
To overcome the above-mentioned difficulti the writer designed and applied for a patent for improved method of strengthening the webs throws of cranks. The crank having been manu factured in the usual manner, the improveme consists in drilling two holes of about 2in. diamet through the length of the webs A A. A bolt, p

FIG. 1.



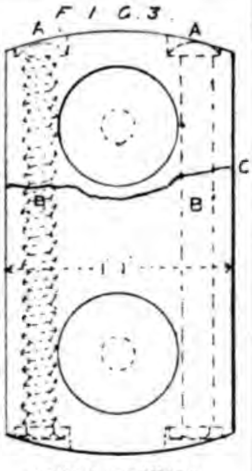
ELEVATION

FIG. 2.



END VIEW

FIG. 3.



CROSS SECTION

or screw (B) is then passed through the said holes.

Each bolt should be made of steel, having a tensile strength of not less than 40 tons per square inch, and can be either screwed into the web or made a driving fit and forced in by any desired hydraulic pressure, and afterwards secured by a nut.

C C shows the position of a slanting fracture, and the manner in which the bolts would strengthen the crank when working, and in case of breakage; they would hold the web in place in such manner that the wheels of a locomotive engine would be prevented from leaving the rails, and thus give time for the enginedriver to bring his train to rest and prevent a disaster.

I may mention that some experiments have been conducted by, and for me which show that the advantages anticipated are actually obtainable in practice, and a similar bolt through the straight portions of the axle also gives good results.

Clement E. Stretton,
Hon. Mem. A.S. Ry. Servants.
Saxe Coburg-street, Leicester, Sept. 17th.

G.E.R. COMPOUNDS.

[24802.]—IN reply to letter No. 24753, owing to an error in calculating the time of my journey on July 11th, I stated last week in 50 minutes. It ought to have been 56 minutes. The printer is responsible for the error in the number of miles, as I wrote 49 in my letter. The number of the single engine was 607.

A Friend of the "Bone Shakers."

THE MIDLAND 19in. CYLINDER ENGINES; THE L. AND N.W. COMPOUNDS, AND THE G.N. 8ft. SINGLES.

[24803.]—DURING my visit to Great Britain last year and this, and my extensive inspection of its railways (the results of which I hope to publish shortly), one thing that struck me most forcibly was the fact that, whenever any locomotive engineer introduced some important novelty, it seemed as if "every man's hand was against him," or, at all events, against his invention. That is to say, it was invariably hailed with a chorus of disparaging criticisms and allegations of failure. I do not mean to say that all of these latter have been baseless; but it is certainly within my own personal knowledge and experience that some are not supported by fact.

I will take the three great lines running from London to the North of England as illustrations of my meaning. These also furnish instances of noteworthy and strongly-differing new departures in locomotive practice. On the Great Northern railway Mr. Stirling uses an extreme diameter of "single" driving-wheel, 8ft. 1in., and length of piston stroke 28in., with an 18in. "outside" cylinder. On the Midland, Mr. Johnson uses an "inside" cylinder 1in. more in diameter (19in.), but with a stroke 2in. shorter (26in.), and he couples 7ft. driving-wheels to 7ft. trailing-wheels. On the L. and N.-W. Mr. Webb uses three cylinders on the compound principle, two "outside" high pressure, and one "inside" low pressure, equivalent to two cylinders of 17in. diameter and 24in. stroke under the ordinary system, while he drives two separate pairs of "single" driving-wheels 6ft. 6in. diameter. Greater diversity of treatment could hardly be conceived.

All these three different methods have been successively denounced as failures—I think quite unjustly. As regards the Midland 19in. engines, I have already given my reasons for questioning their reported incapacity, and have quoted my own experience of them, which spoke for itself. I should like now, with your permission [illegible] for the other two classes of [illegible] to. Your readers will, I am sure, admit that I am an impartial critic, seeing that I have no connection whatever with any English railways, and live at the other side of the world. My only interest in the matter is that of fair play. I have independently inspected all these engines and their work, and have formed my own judgment from my own personal experiences during nearly a year's almost constant travelling over the British lines.

Mr. Webb's compound engines have been vigorously and very ably assailed in many quarters. Compounding has been declared to be an unnecessary complication, because all its advantages could be secured by expansive working. It would occupy too much space to deal with this point now, my object being rather to record facts than to discuss theories; but I may remark that the new Midland engines were designed for expansive working, and that when they have failed, it admittedly has been owing to the impossibility of insuring this fully expansive working at all times unless a supernaturally perfect race of drivers could be invented. The compound system *compels* expansive use of the steam *nolens volens*. But it has been alleged that the compound engines fail to keep time with their trains, that they cannot run at a high speed downhill, and that the result of a competitive trial on the L. and South-Western line, between one of these and Mr. Adams's fine engines, was decisively against the compound. I will take this last allegation first. What were the conditions of the trial? Both engines had two pairs of 6ft. 6in. driving-wheels, and a 24in. piston stroke; but Mr. Webb's engine had cylinder-power equivalent to two 17in. cylinders of the ordinary type; whereas Mr. Adams's had 18in. cylinders—an inch larger. I have not the respective weights before me, but I believe that the L. and S.W. engine weighed fully eight or ten tons heavier than the other, and had a proportionately greater adhesive weight. There can be no equal comparison between these two on the score of power. It has, in fact, been a special feature in the L. and N.W. engineering policy to use as light engines as possible, even at some loss of power, and only very recently in the case of the newer and larger class of compounds has this policy been departed from. Thus there were no equal conditions of comparison *in limine*. Nevertheless, the compound engine did excellent work, as will be seen when the full particulars are published, and she surprised many who had been previously sceptical. I believe Mr. Adams would bear me out in this statement.

Next I come to my own observation, not in special trials, but in the ordinary everyday working of the engines. I will take several instances haphazard from my notebook, and we will see how they bear out the charge brought against the compound engines of always losing time with express trains.

1. No. 66, Experiment, with 7.15 a.m. down Irish mail, Euston to Crewe, started 1 minute late, arrived 2 minutes early, thus gaining 3 minutes; weather wet, with cross wind and greasy rail.
2. No. 300, Compound, with twelve coaches, on same Irish mail, lost 2 minutes from Euston to Bletchley, having to slacken through fog; but ran from Bletchley to Rugby in exact time allowed.
3. No. 302, Velocipede, with twelve coaches, in same train, lost 1 minute to Bletchley; the loss being made between Euston and Willesden.
4. No. 305, Trentham, with nine coaches, on Irish up day mail, while that was timed to run from Northampton to Euston in 1 hour 25 minutes, gained 1 minute in spite of losing 2 minutes through being checked by signal just north of Tring, and of staying a minute extra at Willesden; weather wet.
5. No. 323, Britannic, an Irish down day mail, ran from Crewe to Chester (21¼ miles) in 25 minutes, gaining 3 minutes, and thence to Holyhead (84½ miles) in 1 hour 42 minutes, thus gaining 5 minutes, or 8 minutes in all. Weather, strong N.W. gale, with showers of rain and snow.
6. No. 306, Knowsley, with 12 coaches on up Scotch express, gained half a minute between Crewe and Euston.
7. No. 372, Empress, with up express, Holyhead to Crewe, 12 coaches, in rough weather, gained 13½ minutes.
8. No. 520, Express, an up Scotch express, 13 coaches, gained 2 minutes on the fast-timed run between Crewe and Nuneaton, but lost 10 minutes on the slower length, between Nuneaton and Euston, owing to a slight mishap to the engine. This, therefore, ought not fairly to count; but I simply give it as it stands.

All these were with the ordinary Experiment class of compounds. With one of the newer and heavier Dreadnought type, No. 508, Titan, on the down Scotch express of 11 coaches, 5¼ minutes were gained between Euston and Crewe, and with No. 503, Dreadnought, on a trial trip, a speed of 55 miles an hour was run on the level with 25 coaches. Such work may speak for itself. I am no fanatical advocate of the Compounds any more than I am of the new Midland engines, but I may place on record the facts as observed by myself. As regards extreme velocities down hill, it is true that I do not find in my records—on a hasty glance through them—any higher speed than 65 miles an hour with these engines, but I have not yet had time to work out all my figures in detail, and it is possible I may find some higher speeds overlooked. I understand, however, that it is a special desideratum with the L. and N.W. Railway to avoid extreme speeds *down* hill, and to keep up the average by going faster *up* hill. I may add that I have recorded no other instances of time being lost by these engines than those quoted above, which are explained.

Next, as to the G.N. engines. These, of course, are now no novelties, and I am aware that they were the subject of some years' controversy in these columns, to which indeed I contributed my share. But as they are still decried by some critics, I should like to mention a few performances which came under my personal notice during the past year. My detailed observations were chiefly made in 30 or 40 runs with Nos. 1, 5, 8, 34, 47, 53, 62, 69, 93, 94, 546, 662, 665, 666, 667, 668, and 671. In *not one instance* was any time lost in the running. In nearly every case time was gained, notwithstanding the very fast timing and the heaviness of the loads and gradients.

I must not trespass on your space now by quoting many instances, although these would, I believe, be of considerable interest; but I may mention, as peculiarly fine work, runs with the Manchester special expresses from King's Cross to Grantham (No. 93) in 1 hour 57½ minutes, and Grantham to King's Cross (No. 665) in 1 hour 52 minutes. In each case a distance of 62 miles was actually covered in the hour, and in the latter a speed of 75 miles an hour was maintained for 12 miles; the loads, however, were in those instances light—six coaches. The 76¼ miles from London to Peterborough were done in 81 minutes, and the 29 miles from Grantham to Peterborough in 28¾ minutes, both including getting up speed at starting, and slackening to 10 miles an hour through Peterborough. On the 1.30 p.m. down express, No. 666, with 14 coaches, ran from King's Cross to Peterborough in 86 minutes, starting and stopping, covering 61¼ miles in an hour, and attaining a maximum of nearly 74, down 1 in 200. On the 3.15 down train, No. 662 took 15 coaches from Peterborough to Grantham in 39½ minutes, gaining 1½ minute, and ascending the 15¼ miles from Tallington to Stoke Box in 21 minutes; No. 53 performing a like feat. On the up train due in London at 8.30 p.m., No. 668, with 15 coaches, ran from Grantham to Peterborough (29 miles), starting and stopping, in 32½ minutes, and the same run, with 16 on, was done by No. 34 in 34½ minutes. No. 47, on the 1.30 p.m. down, with 13 on, passed Grantham (slackening) in 37 minutes from Peterborough, and ran the 15¼ miles, up hill from Tallington to Stoke, in 20 minutes. On the down Scotch express, No. 665 did the 83 miles from Grantham to York in 1 hour 37 minutes, gaining three minutes. No. 665 took 16 coaches from Peterborough to Hitchin in 53 minutes, and No. 662 ran from Doncaster to Grantham, 50¾ miles, with eight coaches, in 54¾ minutes. I could instance many other admirable runs; but perhaps the best of all was on the 5 p.m. Sunday express, consisting of 15 coaches, which No. 666 took from Hitchin to Peterborough, 44¼ miles, starting and stopping, in 47¾ minutes, thus gaining 2¼ minutes on the very fast time (50 minutes) allowed, and showing an average speed of 55·6 miles an hour. The eight-mile continuous bank of 1 in 200 was always ascended, with loads of 14 to 16 coaches, in 11¾ to 12¼ minutes, the latter being the maximum time taken. The lighter trains ran up it in 10 minutes, or a little less.

I could go on; but I fear to weary you. I hope, however, that I have succeeded in showing that all these three classes of much-criticised engines are able to do, at any rate, as good work as any other types at present in use. I may take another opportunity of illustrating the work done on the other great lines, if this would be acceptable to your readers.

Charles Rous-Marten, F.R.G.S.
Wellington, N.Z.

SNARES AND PITFALLS OF AMATEUR CARPENTRY.

[24804.]—I WAS so pleased to read the admirable article under the above title in your issue of the 4th inst. by "O. J. L.," that it seems ungracious to criticise it; nevertheless, I should like to point out a small pitfall into which "O. J. L." has, inadvertently I presume, led his readers. On page 2, we find, referring to squaring up table legs, &c., "The third and fourth [sides] are to be similarly treated, each being tested by the square *from the one previously finished*."

Now, this is just what we were always instructed *not* to do when I was an apprentice, for the simple reason that it perpetuated any slight error. If all workmen and their tools were perfect, it would be all right; but very frequently there is a slight error which, if continued round, will become very appreciable in the end. Anyone may easily test this by squaring up a piece thus: Side 2 from side 1, 3 from 2, 4 from 3, and then try No. 4 from No. 1, the opposite edge, and nine times out of ten I should think it will not be perfectly square. The proper way is to get No. 1 side true, then No. 2 straight and square from that, and mark them as true sides to work from; then square No. 3 from No. 2, and No. 4 from No. 1, and error will be counteracted.

The same rule applies in squaring a rail, &c., over, say for a tenon shoulder. Mark the front side and bottom edge, and then square both sides from bottom, and both edges over from front.

Country Cabinet-maker.

HINTS ON SILVERING: TO MR. KERSHAW, MR. BRADBURY, AND "PRISMATIQUE."

[24805.]—I TAKE pleasure in replying to the query of Mr. Kershaw (letter 24458, page 413) as to paraffin-coated vessels for silvering mirrors in, and I would often like to answer queries I see in "Ours," but I am so far away that I think someone will have answered them even before I read them. However, I hope this letter will not be too late to be of use.

From my experience, I think paraffin-coated vessels are much superior to anything else for the purpose, as they last almost indefinitely, and much less silver is deposited on the paraffin than on glass, earthen, or pitch-coated vessels. Mr. Brashear uses them exclusively. Tin vessels are the handiest, but wood may be used with equally good results, and the coating of paraffin may be applied as follows: Melt in the vessel a sufficient quantity of paraffin to cover its bottom thinly, and allow this to harden; then melt more in a small dish, and, with a camel's hair brush, apply to the sides of the vessel. This will always insure a proper coating.

As to silvering, I regard Mr. Brashear's process as the simplest, cheapest, and best, and I have never yet failed to secure good, hard, and thick films by its use. And here I wish to give a hint or two. First, to those who find considerable sediment in the solution from the addition of the ammonia, I would say, filter the solution before adding the reserve silver, instead of afterwards, as usually done. This will enable the true colour of the solution to be seen, which is impossible when there is much sediment. I usually, after mixing the silver and potash, add sufficient ammonia to almost clear the solution; but if it is entirely cleared up (that is, colourless) it will do no harm, only more reserve silver will be needed. After filtering, the reserve silver is dropped in until the solution assumes a brownish-yellow colour, and this colour, indicating an excess of silver in the solution, must be obtained, for if the ammonia is in excess (which may be known by the light yellow or straw-coloured appearance of the solution), no deposit will take place. The proper colour being obtained, stir briskly for about three minutes, and if the solution does not lighten up, all right; if it does, add a little more silver. Filtering again is not necessary. I hope some of "Ours" will try this idea and tell us how they like it. For dropping in the ammonia and reserve silver (which I have never been able to do very successfully from a bottle), I use a "filler," such as is used to fill stylographic pens with ink. It is simply a glass tube with a rubber bulb attached to one end, and it answers the purpose admirably.

Second, in regard to cleaning mirrors. The importance of this matter is likely to be overlooked by most of us, but as imperfectly cleaned mirrors are the cause of many failures to secure good and uniform deposits, too much attention cannot be given to it. The optical surface of the mirror should never be touched unnecessarily with the fingers, as they leave an oil difficult to remove. After washing with the nitric acid, a second wash with a solution of pure potash in water is very beneficial. Then wash in clean water, and the mirror being laid on its back, if the water remaining on its surface is seen to "run away" at any place, that place is not clean. The continued application of the nitric acid and potash will, however, bring it out all right. To apply the nitric acid, take a bottle, say 3in. or 4in. long and ½in. diameter, and tie plenty of absorbent cotton around the bottom end; saturate the cotton with the acid and rub the mirror thoroughly. I I like this way better than stuffing the cotton into a glass tube, as there is no liability to scratch the mirror.

To Mr. Bradbury.—Is there not some error in Littrow's formula as given on p. 94, Vol. XXXIX? In the example following the table, the focus of the flint lens, as computed from the radii and refractive index given, is 0·6554, whereas, to satisfy the dispersive ratio, it should be 1·000. The same error occurs in the other examples given. Will you kindly state where the error is, and give the correct formula?

To "Prismatique."—Intending to work a 5¼in. flint to match a crown I have, will you kindly tell me if there is no way of determining the dispersive ratio of the two glasses (where the indices of the alphabetical lines are not known), except by an approximate determination from their specific gravities and actual trial by Herschel's method? When the lenses are separated to secure achromatism (the focus of the flint in this case being made slightly shorter for trial), how is this separation to be measured? From the centre of one to the centre of the other is the rule; but what do you call the centre—laterally, longitudinally, or both? Do you cement a piece of cork to the lenses while grinding and polishing, and what is the advantage of a small hole in the centre of tool and polisher? This is a new line of work for me, as most of my work has been confined to reflectors. Your replies to the above questions, with such hints as you may be pleased to give, will be gratefully received. I have no back numbers previous to Sept. 1st, 1884. **Chas. L. Woodside.**

Boston, Mass., Sept. 7.

THE LION IN THE PATH.—TO "FIDDLER."

[24806.]—"FIDDLER'S" last letter appears to have received no notice from anyone else, so I venture to deal with some of his peculiar arguments.

He is, I conclude, a Swedenborgian, from his fancy for mystic circles and so forth; but, be that as it may, his old friend the Lion stops the road that he wants to go. One can't measure the distance to the stars with a carpenter's rule, nor reckon eternity by a Dutch clock, because the instruments are not suitable for such purposes; neither can the human brain solve the problem of existence outside of itself: it is not adapted for it. There is a limit to mental conception—a barrier that can't be passed—even though the precise position of the limit may itself be impossible of definition.

People may quarrel about creation and evolution; but no one can tell whence comes, or whither goes, the *vis vitæ*, that inexplicable principle, that something which can't be isolated, but which so solidly separates the lowest form of living cell from the most complex form of crystallised matter. Neither, on the other hand, can the mind conceive the formation of matter from nothing. This much we may say, that just as the spirit of life comes and goes from a material particle, so perhaps that particle may come and go, may exist or cease to exist; but if we try to *realise* the conception, we are brought face to face with the same impenetrable barrier: we have reached the limit of the working of the human brain. There stands the lion, and there he seems destined to stand while humanity exists.

Again, "Fiddler's" argument about self-contained opposition is a mere play on words. If you are half-way up a hill, it is downhill behind you and uphill in front of you; but there is no "opposition" between downhill and uphill, nor any central point of the hill itself where it changes its character from down to up. **A. S. L.**

GRAMME ARMATURES.

[24807.]—UNDER the above heading Mr. Dorman (letter 24748) makes some remarks, to which I should like to reply. When I was describing the armature of the 30-lighter, my consideration was not given to making an armature as cheaply as possible; but was more especially directed to making an armature that should stand any amount of rough usage in unskilled hands. In fact, an armature that should be mechanically and electrically, as near perfection as possible.

Mr. Dorman, after observing that he does not agree with my condemnation of the original Gramme armature with its wooden mounting, p ceeds at once to eat his own words by describing armature in which the ring has a metallic mou ing. When I advocated sheet-iron rings in li of iron wires, I did not base my judgment theory alone; but on theory combined with pra tice. During experiments undertaken with t object, and with the result, of bringing out th dynamo, I carefully tested the efficiency of shee iron rings versus iron wire, for the cores of Gramn armatures. The experiment was made on "Volta" No. 1 (a) shunt-wound dynamo, givi 50 volts and 13 ampères. At the time of th experiment the speed was maintained consta at 1,500 per minute, ten lamps were switch on, the E.M.F. and current in the exte nal circuit being respectively 50 volts a 11 ampères. The armature of this machi was made exactly as the one described in lett 24267. The armature was then taken out, a another exactly similar, except that it had an ir wire core, was put in its place. The 10 lamps we switched on and the speed brought up to 1,500 p minute; but the lamps did not shine forth wi their accustomed brilliancy, and on applying t voltmeter, I found the E.M.F. had dropped to volts. I was at the time rather suprised at th result, so I set to work to find out the cause. first weighed the two armatures, with the pulle and commutators removed, and found that althou each armature was wound with an equal number turns and an equal weight of wire, the armatu with the iron wire core, weighed some 2lb. less th the one with the sheet-iron ring core. Here, the was one cause of the E.M.F. dropping; but the is another cause for the loss of E.M.F. It must remembered that the lines of force entering t core from the N. pole divide, and, running do each side of the ring, enter the S. pole. In th course they should encounter no obstacle, and, fact, when traversing an armature core of sheet-ir rings, do not; but when the lines of force attem to pass through an armature core wound with i sulated iron wire, they find that the continuity the iron is partly broken in a radial direction, that they have to jump from layer to layer till t bottom layer is reached. Thus the magnetic sistance of the armature core is considerab increased.

Mr. Dorman, in describing his armature, do not say how the wire is fixed for starting windi or how it is fastened when the winding is finishe also how he would manage any unevenness th may occur during the process of winding. In core made of sheet-iron rings the armature may so true and evenly balanced that not the slight vibration occurs, even at 2,000 per min. I dou very much if such a result could be obtained wi an iron wire core.

As regards the cheapness of the two methods, l us take an example: A ten-light machine costs £ or £2 per lamp; the same size dynamo with an ir wire core will cost 15s. less, and will only lig nine lamps, so to save 15s. on the core we lose lamp (equivalent to £2).

I hope Mr. Dorman will not think I intend to discourteous to him, or that I wish to disparage l evident good intentions in sending the sketches a description to the "E. M.," my only object bei to prove to him and readers generally that I d not condemn iron-wire cores through any speci fad of my own, but because of the results obtain in carefully-conducted experiments.

Coventry. **W. H. Eaves.**

ERRATUM.—The equation at the end of lett 24674 for determining the amount of current a wi can safely carry should read thus—

$$109^2 \times \cdot7854 = \cdot0093 \text{ sq. in. area}$$

$$\frac{1 \text{ sq. in.}}{\cdot0093} = 107\frac{3500}{107} \times 2 = 65\cdot4 \text{ ampères.}$$

ENGINE-MAKING AT HOME.

[24808.]—IN reply to "Orderic Vital" (lett 24756, p. 86), there is no special difficulty in maki a pair of engines such as you suggest. The o evil I see is that of overcrowding, and putting in them so much work as few would care to und take. The splitting of the eccentric would not very troublesome. But a more elaborate bed—fo eccentrics in halves, with their straps, two s links, drag links, weigh shaft, and lever, in ad tion to the other ordinary work, will try t patience of any save a model maker. I will, ho ever, bear what you say in mind, and try and p duce a respectable design on the lines which y suggest, for a supplementary article. **J. H.**

COMPARISON OF TIDES.

[24809.]—THE weather at the commencement the month of August was unsettled, and on the a proach of the high tides, which arrived on c coasts from the 9th to the 14th, it became exce ingly boisterous, a succession of cyclonic ga following each other continuously during th interval. The tide-generating influences were m favourable, and tides of extraordinary dimensi

COMPARISON OF TIDES AT LIVERPOOL AND FLEETWOOD FOR THE MONTH OF AUGUST, 1885

Date.	Calculation.		Observation.		Error.	Barometer	Wind.	Remarks.
1885.	ft.	in.	ft.	in.	in.			
Aug. 1	25	8	25	5	− 8	30·2	E.N.E.	Slight.
	24	0	24	2	+ 2	30·1	E.N.E.	Slight.
2	25	0	24	8	− 4	30·1	E.N.E.	Slight.
	23	3	23	6	+ 3	30·1	N.W.	Fresh.
3	23	11	24	1	+ 2	30·1	N.N.W.	Slight.
	22	2	22	8	+ 6	30·0	W.S.W.	Strong.
4	23	0	22	11	− 1	30·0	W. to E.S.E.	Fresh.
	21	4	21	5	+ 1	29·9	E.	Moderate.
5	21	11	22	1	+ 2	29·9	E.N.E.	Slight.
	21	3	21	8	+ 5	29·9	S.	Fresh.
6	21	10	22	6	+ 8	29·9	S.S.W.	Strong.
	22	0	22	7	+ 7	29·8	S.S.W.	
7	22	9	23	5	+ 8	29·8	S.	Strong.
	23	8	24	6	+10	29·7	S.	Strong to gale.
8	24	5	25	1	+ 8	29·7	S.W.	Strong; cyclonic.
	25	8	25	10	+ 2	29·8	S.S.W.	Slight.
9	26	3	26	8	+ 5	29·8	S.W.	Increasing.
	27	2	28	10	+20	29·6	S.W.	Strong to gale.
10	27	5	28	9	+16	29·5	S.W.	Gale continuing.
	28	6	29	8	+14	29·4	S.W.	Gale continuing.
11	28	3	29	1	+10	29·4	S.S.W.	Very strong.
	29	3	30	2	+11	29·4	S.S.W.	Very strong.
12	—		—		—	—	—	—
	28	9	30	4	+19	29·5	W.S.W.	Strong to gale.
13	29	2	30	5	+15	29·5	S.W.	Gale.
	28	2	28	2	+ 0	29·8	Gale abated.	
14	28	5	28	2	− 3	30·2	N.N.W.	Slight.
	27	2	27	2	0	30·3	E. to S.E.	Moderate.
15	27	0	26	10	− 2	30·3	S.S.E.	Slight.
	25	7	25	7	0	30·3	S.S.E.	Slight.
16	25	3	25	3	0	30·2	Calm.	
	23	11	23	11	0	30·2	Calm.	
17	23	5	23	5	0	30·2	Calm.	
	21	11	22	3	+ 4	30·1	N.N.W.	Slight.
18	21	4	21	8	+ 4	30·1	N.W.	Fresh.
	20	6	20	11	+ 5	30·1	N.W.	Fresh.
19	20	0	20	1	+ 1	30·2	W.N.W.	Moderate.
	20	1	20	4	+ 3	30·0	W.N.W.	Moderate.
20	19	9	19	7	− 2	30·0	N.E.	Slight.
	20	6	20	6	0	29·9	N.E.	Slight.
21	20	3	20	8	+ 5	29·9	N.N.W.	Moderate.
	21	8	21	9	+ 1	29·9	N.N.E.	Slight.
22	21	3	21	10	+ 7	29·9	N.W.	Strong.
	22	11	23	6	+ 7	29·8		Pressure cyclonic.
23	22	9	22	10	+ 1	29·8	W.N.W.	Slight.
	24	1	24	4	+ 3	29·8	W.N.W.	Slight.
24	23	8	23	11	+ 3	29·9	S.W.	Slight.
	25	3	25	6	+ 3	29·9	S.W.	Slight.
25	24	8	24	8	0	30·0	N.W.	Very slight.
	26	3	26	0	− 3	30·0		Pressure anti-cyclonic.
26	25	4	25	3	− 1	30·0	E.	Fresh.
	27	1	26	6	− 7	30·1	E.	Strong.
27	—		—		—	—	—	—
	26	1	25	7	− 6	30·0	E.N.E.	Strong.
28	27	5	26	8	− 9	29·9	E.N.E.	Very strong.
	26	3	25	8	− 7	30·0		Anti-cyclonic pressure continues.
29	27	3	26	8	− 7	30·0	N.E.	
	25	9	25	6	− 3	30·0	N.E.	
30	26	7	26	3	− 4	30·0	N.N.E.	Strong.
	25	0	25	2	+ 2	30·0	N.N.E.	Strong.
31	25	7	25	8	+ 1	30·0	S.E.	Slight.
	23	10	24	5	+ 7	30·0	S.W.	Fresh to strong.

for the month of August followed in consequence. Moderate and settled weather succeeded, and the sea-level was normal and stationary. From the 25th to the end of the month the pressure became anti-cyclonic, with steep gradients at times, and the sea-level became a good deal reduced. Throughout all these changes, however, the law of the *diurnal inequality* continued to assert itself; and inasmuch as in the matter of docking a ship all that is required is to know from the height of any tide as a datum what the height of the following tide may be predicted to be, the diurnal inequality becomes a most important factor in the prediction. Sir John Lubbock gave rules for its determination, which have now to be superseded, and the *British Almanac*—a periodical (I take it) somewhat akin to the ENGLISH MECHANIC—was the vehicle of his calculations.

James Pearson, M.A., F.R.A.S.

Fleetwood, Sept. 7.

VENTILATION AND LIGHTING OF COAL MINES.

[24810.]—MANY thanks for your article on the Ventilation and Lighting of Coal Mines. Every original and practical suggestion upon the subject is of the utmost value.

It was in 1883 that Mr. Ellis Lever offered a premium for a miner's lamp to fulfil the agreed conditions.

I sent one; the outside of it was like the "Clanny" previously in use, but the arrangements for the light were quite different. When my lamp was returned to me it seemed untried. I placed a small substance (white carbon) on the asbestos wick, and it was returned untarnished. I know it was a rough specimen, but I had no time to prepare a better one, and one of our best lamp makers asked me £6 6s. to make one on purpose. Of course, I could not afford it.

Now, the reason I thought the lamp might be acceptable was this: it burns full twelve hours without touching. It was self-contained, it could be conveniently carried about, it gave full 4-candle power, a brilliant, white light. The rays, if reflected by a 6in. Young's silvered glass reflector, will dash the intense light full 100 yards on many square yards of surface. Such a light, I thought, would not require to be placed too close to the work. Then again, the reservoir is absolutely airtight; the outside pressure ought not to interfere with it.

The light, unaided by a reflector, is seen by a middle-age man in his bedroom as a bright star *one mile* away. At 300 yards away it lights up a coach road of some yards in length, so that an old man of 78 years can see his way home in the darkest night.

The lamp can be thrown down, or even turned bottom upwards, without alteration. I thought that these several advantages at least was a step forward; but I have not yet received a single line of approval.

I appeal to your many *practical* readers, and I ask them at least an opinion upon these acquisitions, Are they worth anything or no?

Benzoline is burnt in the lamps. The lamps can be made as strong as you like. The benzoline rises through a long wick that does not wear out, it then is met by a short asbestos wick, which heats the gas: it then strikes the hot metal cap, and issues from the needle holes in five jets.

It has occurred to me that a cone of Asbestos millboard, ⅛in. thick, perforated with five holes, placed on the outside of the miner's lamp, would be an advantage in these respects: 1st. It should give warning to a miner that the mine is unsafe long before the wire gauze is red hot or white hot. 2nd. Asbestos pure will not inflame. 3rd. The outside can be painted with luminous paint, which, after the miner has extinguished his lamp, would be invaluable. 4th. The luminosity of the paint could be charged from the lamps standing near each other.

Is there no substance, chemical or natural, that will render the air pure before it reaches the lantern? Chemists should know by this time. Practical men, kindly advise. **T. Wood.**

PHOSPHORESCENCE OF THE SEA.

[24811.]—I AM obliged to our fellow correspondents for their information and remarks relative to this. The point of my original question was as to its being only produced by motion of the water. I was under the impression that it only occurred as a surface luminosity, irrespective of the water being put into movement, and also that it was a phenomenon seen almost exclusively in hot latitudes, and then rarely, and I think it is often put so in books. I know that the usual explanation was that it was caused by animal organisms; but seeing that it was only caused in this instance by the vessel's movement, that it must have filled the Channel pretty extensively, and so near shore in the harbour, and not being aware that it is so familiar as it proves to be near its own shores, I was hardly prepared to think it was living organisms entirely, and so looked for some other explanation.

It is an interesting point which I hope will be further elucidated, as to whether there is any kind of evolution of electricity during the luminous state. It does not necessarily follow that there is an actual oxidation of phosphorus in the case of the living animals as "Os" suggests. I think the common instance of dead fish, in which commencing decomposition is taking place, is not quite comparable. Phosphorescence is not always due to phosphorus, although the name has this derivation. It is analogous to it, but probably here is a vital process, and not one purely due to decomposition; that this is the case is borne out by the interesting observations of Mr. Shrubsole.

On looking further into the matter (which I might as well have done at first, only then this interesting correspondence would have been lost to the pages of the "E. M."), I find that Noctiluca miliaris is not the only organism concerned in it, and that members of higher invertebrate sub-kingdoms are responsible for it at times—e.g., Medusæ and other Cœlenterates, and even some molluscs, &c.; therefore probably the different appearances may be associated with different species. Doubtless the weather has something to do with it in influencing these creatures. It was a very hot and most glorious day to which I refer.

May I ask Mr. Shrubsole as to how common the phenomenon is? Is it frequently or only occasionally seen? I should also like to know whether the *diffused* luminosity is ever seen in a perfectly smooth or only a troubled sea; it is always motion of some sort that excites it—motion of the waves if not motion of a ship, or whatever else may be in the water. In other words, has Noctiluca the power of producing the phosphorescent appearance without an external stimulus? **Landbird.**

THE SOARING BIRD.

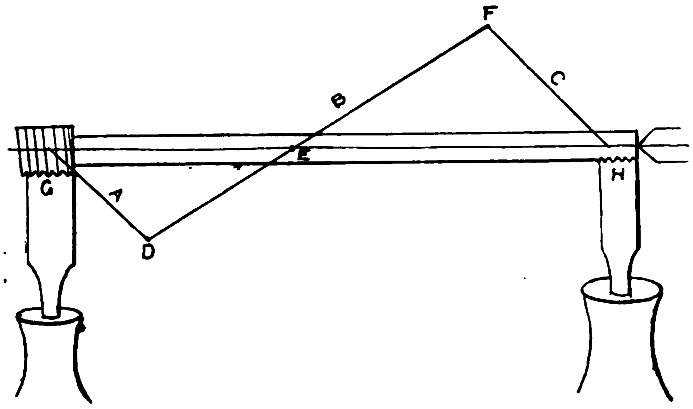
[24812.]—IN your issue of Aug. 21st Mr. Moy quotes from your leader in regard to my statement in the tractate on the soaring bird, that the mathematics of the case goes to destruction in its conflict with what was called the common-sense view. He should have continued to where it is shown that such conflict is seeming only, perfect harmony between them being the final outcome.

It seems to me that there are but two methods of bird-flight pertinent to this inquiry—one with active, the other with passive wings; and, so far as I know, they both require the same motive power to force a given bulk with a given velocity through the air.

The flapping birds obtain this force by muscular effort. The soaring birds find it in the gravitation of their bodies. It is equally indispensable to both. I submit that it is a superfluous task to provide any sort of motive power to effect translation in air when the gravitating force of the device is entirely competent to the task of giving the utmost that can be demanded of it. Hence I do not wonder that the exhibition in the East Avenue was a failure. The chimney-climbing machine, sandwiched into the section, was the only effective invention for going aloft it had to show.

My treatment at the hands of the English mechanical journals has been so very fair, and indeed generous, that I can hardly realise that a residence in London would be provocative of "kicks," as Mr. Moy fears. My English correspondents also exhibit a comprehension of the subject, and an interest in it, which might be sought for in vain in America.

Chicago, Sept. 7. **I. Lancaster.**



SCREW-CUTTING.

[24813.]—THE inclosed rough sketch will give our readers an idea of a screw-cutting arrangement devised by myself some four years ago. The bar upon which the screw is to be cut is mounted in the lathe by screwing one end into the nose, and bringing up the back centre against the other. The lefthand end is shouldered down to take a brass ferrule cut with a screw of twelve threads to the inch. Over the comb G, in a line with lathe centres, a bar (A) is linked. This bar extends to D. From D to F another bar is centred upon E, a similar bar (C) connects the screw-chaser (H) with the end of F. At F a suitable arrangement is made, so that the distance between E and F and between P and H may be varied at will. As this distance varies, so will the rate of traverse of chaser vary, and thereby the pitch of screw. In this arrangement a right-handed screw upon ferrule will cut a left-handed screw upon bar, and vice versâ. I have drawn the chaser with several teeth, but a single point would do, to be afterwards followed with chaser. The sketch is not drawn to scale, and the centring of bar at E is not shown. These details can be easily supplied by our ingenious subscribers. **Cornu.**

TOBACCO-SMOKING AND THE SPHYGMOGRAPH.

[24814.]—IN connection with the matter extracted from *Lancet* on tobacco, the inclosed pulse tracings of my own pulse with the sphygmograph may be interesting; they were made without removing the sphygmograph, so as to insure the same pressure and position. The blackened part of the paper passes through my sphygmograph in ten seconds, so you will see that before smoking (Fig. 1) my pulse was 60, with a first-rate impulse on the artery to produce so good an up stroke, and plenty of tone in the arterial system, as shown by the slope and recoil in the down stroke, and that after smoking three big pipes of honeydew pulse was 84, up stroke diminished very much, and the different markings of the down stroke slurred and poorly indicated (see Fig. 2).

Gerard Smith, M.R.C.S.

FIG. 1.

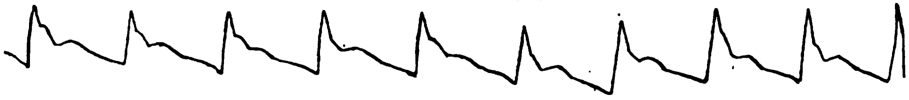
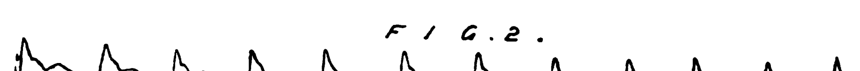


FIG. 2.



A HOME-MADE 15in. REFLECTOR.

[24815.]—I HAVE had the pleasure of spending a few evenings with Mr. Vallance, and together examining the new arrival in the Andromeda nebula. In his 15in. reflector, with various powers, the conclusion we came to was that the visitant had all the appearance of a star, being round, clear, and well defined. There is likewise a very minute star, about one-sixth of the former, which we have closely watched at each opportunity: it is directly below it. On Saturday evening we observed the companion M 32, and were inclined to think that it was unusually bright towards the centre. Clouds coming over, we were unable to pursue the investigation; but it would be well if possessors of good telescopes would occasionally watch the same.

My principal object in addressing you is to bear testimony to the advantage of Mr. Vallance's stand, which you figured and described in your journal of May 1st ult. On first looking at it I was inclined to think that it was somewhat unwieldy, and not likely to answer its purpose; but, after testing it, I was surprised at the ease and perfect control with which it was managed. With the eye engaged, the two hands were free to manage the screws, and so light was the working that this mass, weighing nearly 400lb., only required a finger and thumb, with the gentlest pressure, to keep the star in the field, or shift the telescope on to another object. In examining the nebulæ this was a great advantage, as the larger could be at once removed partially or wholly from the field, or brought back, without the slightest tremor or oscillation.

There is another and striking feature of this stand, in which it may vie with any other altazimuth stand, and that is, that it can be driven by, I was going to write *clock-work*, but as there is no clock, I should rather say a pneumatic arrangement, so that a star is kept as steadily in the field of view as any terrestrial object might be in a fixed instrument. This is accomplished by a very simple and inexpensive contrivance. Two boxes are fixed to the instrument, containing each two large indiarubber bladders, into which air is blown, and which are pressed downwards by weights (in this case two common bricks are used); a rod protrudes through the top, to which is attached a pulley, and as it descends a string passed through carries the whole instrument with it. There are two of these boxes—one on the lever directs the telescope in altitude, the other directs it in azimuth. Indiarubber tubes from the two bladders are brought near the eyepiece, and are terminated by small cocks, and by allowing the air to escape in more or less volume the time is regulated to the motion of the star. The convenience of this arrangement can only be appreciated to the full by experimental use of the same.

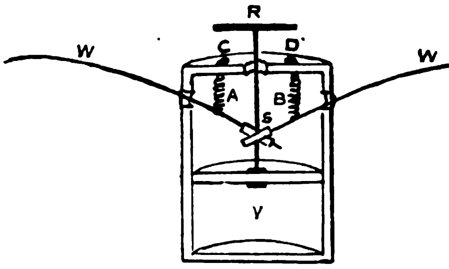
Mr. Vallance endeavoured to procure photographs of the instrument; but from the position of his observatory he could not get a good standpoint to have it properly taken. He, however, got one, but looking down on the instrument, and he has kindly given me some copies, one of which I inclose.

Now, considering that the whole of this stand and its mounting is of the most primitive kind, as for example, the trunk of an elm tree sunk in the ground for a support, the arms being common gas pipes, the second of which carries a fine 4¼in. refractor, thus allowing two persons to examine the same object simultaneously; and for counterpoises, old weights, sash weights, or paint-can filled with old iron scraps; two large gimlets for screws, carrying ordinary string; the companion telescope adjusted by wedges,—I could not but be struck with the ingenuity shown in the application of such simple means to procure so successful a result. In fact, to my mind, it is a triumph of simplicity and success, carried out by the most unpromising and inexpensive materials.

I think the wonder is increased when we reflect that Mr. V. is in his ninetieth year, and constructed and fitted up the above with only the assistance of a common country workman. **Canis Minor.**

MODERN MAN-FLIGHT.

[24816.]—I AM afraid I, for one, think "Norfolk" (letter 24747) to be wrong; but this may be because I do not see what the parallelogram of forces has to do with it, although I see "that there is internal motion going on." The accompanying diagram is essentially the same as that given by "Norfolk," but the parts are so arranged that I think he will see the absurdity of his "machine."



A and B are the strong springs (in tension); S, two sleeves fixed to piston-rod ("Norfolk's" square, H); V, the vacuum; W, the wings. The man stands on top of cylinder with his feet at C and D. Why should the pressure of the air cause the machine to rise any more than the piston to fall? **Crumby.**

[24817.]—IN letter 24747, p. 34, with above heading, there is shown a sketch of a machine which, in my opinion, is wrong in principle for the purpose intended, and consequently would prove a failure if made. If any supporting power be obtainable by its means, it will depend wholly upon the wings. The part which is supposed to utilise the atmospheric pressure may be as well left out for all the good it is. If "Norfolk" will study the thing more closely, he ought to see that the pressure of the air is the same in all directions, and consequently there can be no motion or support. The pressure of the atmosphere is only equal to its own weight. If part of this weight be displaced, as in the case of the balloon, the upward pressure becomes effective. Bird-flight does not depend upon the pressure of the air, but upon its weight or substance.

The downward pressure of the air can be partly displaced by a horizontal jet of air or steam, which may be shown by a simple experiment. Take a small tube and blow through it over a small piece of paper held horizontally. Part of the pressure of the air will be blown off the upper surface, and the upward pressure will lift the paper. Or if you blow across the end of a tube which has one end dipped in water, it will cause the water to rise in the tube to a certain height. I know this is not new; but still it may not be generally known. I should like to know what lifting power there would be with a powerful jet of steam. Has any one ever tried it? I was thinking it would be possible to make a machine on this principle for the purpose of obtaining support in the air. A machine of this kind would only require a steam-boiler for producing large quantities of steam to be used for blowing off a given horizontal surface the downward pressure of the air. No wings or other machinery would be required. I should like the opinion of our aeronautical friends on this idea.

If steam would not answer the purpose then we could fall back upon gunpowder, which would be a much better use for it than for destroying people.

Albert H.

THE OPTICAL LANTERN.

[24818.]—I THINK "Rector, F.R.A.S." (letter 24782) pokes a bit of fun at us when he inquires for modes of utilising the heat of a four-wick kerosene lantern lamp. Does it not seem enough already when it cracks the condenser, melts the varnish off the slides, unsolders seams, unpleasantly warms and fumigates the room, and causes coughs and headaches into the bargain? For my part, I should have preferred to see the query, How to get rid of this rather warm guest.

Still, if any suggestions should be desired by any reader, here are a few. By mere chance, or by a slight modification, the dome-shaped lantern-top may become a parabolic one, and reflect the heat rays into a focus somewhere near the explosive oil; a very striking and real dissolving effect will then be produced with *one* lantern. "Rector" may convert this heat into an electric current by arranging one face of a number of thermopiles over the lantern-top, and around its chimney. Some 800 to 900 pairs would suffice to render incandescent a good bit of platinum wire, and by its light the lecture might be read; or the current could drive an electro-motor, which automatically changed the slides; or a still more homely use might be made of this heat by forming the top of the lantern into a sort of kettle or saucepan. In this way we should become independent of Jane, the cook: we could prepare the grog or warm supper ourselves. There are many other ways of furnishing this heat; but I will leave them to abler pens. As to the gas cylinders, they are certainly a great advance on the bags and pressure boards. Properly

ɪnd used, they are safe, compact, and durable.
ːe these good qualities, they are not much
ːet, because few have the pumps necessary to
ːm with. Let the demand be made, and they
ɔon be forthcoming. In an age of chemistry
urs there ought to be no fears in using, or
lty in making, oxygen. With the Editor's
ssion, I may have another word to say on a
occasion. **A. Caplatzi.**

CLAMP v. CRAMP.

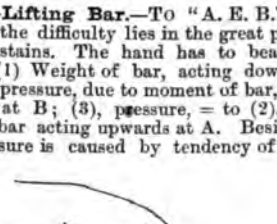
19.]—It seems singular to me that there can
imaginable error in using the word "clamp"
ify the act of squeezing together with a tool,
, according to dictionary authority, if that is
anything at all, is distinctly termed a clamp.
r words are repeatedly used both as nouns
rbs. "J. K. P.'s" "idea" may be correct,
at is not quite to the point. The question
at are the ordinary senses in which the words
d? "J. K. P." (letter 57183, p. 39) considers
amp' to be an instrument which is portable
movable, as soon as it has effected its object,
at a 'clamp' is a permanent attachment to
t displacement or distortion of the com-
parts of any structure." Nevertheless, as I
hown on p. 17 (letter 57183), the latter term
in the former sense. Although the terms
by "J. K. P." appear to bear out his dis-
n—and it would be convenient that such a
istinction should exist,—what I contend for
that there is nothing, either in dictionary
ions or in literary usage, or in colloquial
, to condemn the use of the term in the
n which I have employed it. I do not care
te much from books, since the practice
s of pedantry; but I am sure that I have
he term many times in the course of my
used in precisely the sense in which I have
ed it, and that an hour or two spent in re-
would supply a number of apt quotations. I
on it as a question rather of literary finesse,
is hardly worth disputing about, since in
e the context would determine the sense in
the words were used. **J. H.**

EPLIES TO QUERIES.

*In their answers, Correspondents are respect-
quested to mention, in each instance, the title
mber of the query asked.*

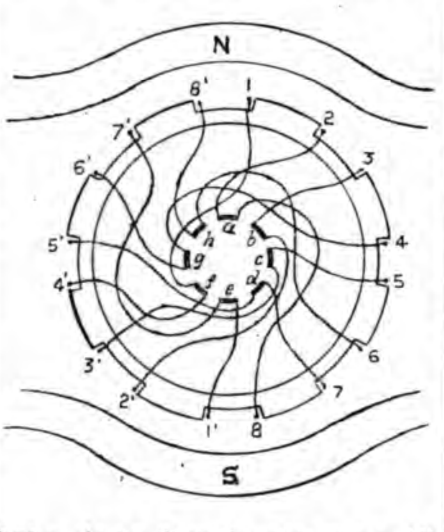
35.]—**Copying Drawings.**—First sensitise
ood close-grained paper with the following
n:—Water 40oz., red prussiate of potash
yanide of potassium) 3oz., ammonio-citrate of
oz.; either by floating it upon the solution
minutes, or carefully brushing it equally
e surface of the paper, and then hang up to
ich operation must be done in a dark room,
ight by a weak artificial light. Both solu-
d paper should be kept in the dark. Plans
wings done on tracing-cloth give the best
. All lines, &c., should be solidly drawn;
g a little red paint mixed with the Indian
d other colours, the lines are more opaque.
inting is carried on in the sun (placing the
ed paper under the plan, with face of draw-
inst the glass of printing-frame) until all
es are visible, showing as a dingy yellow
dark ground, then taken from the frame
shed under the tap (in a subdued light),
he drawing will show white lines upon a
rface. To make notes or corrections upon
y, write with a solution of carbonate of
ashing soda), 10 per cent. solution. Have
a little clean water and sponge to wash the
of paper to prevent the alkaline solution
reading.—H. E. M. V.

4.]—**Lifting Bar.**—To "A. E. B."—Cer-
not; the difficulty lies in the great pressure
d sustains. The hand has to bear three
es: (1) Weight of bar, acting downwards
(2), pressure, due to moment of bar, acting
rds at B; (3), pressure, = to (2), due to
t of bar acting upwards at A. Besides the
pressure is caused by tendency of bar to



nd either A or B; upward pressure at B
s rotation round A, downward pressure at
nts rotation round B. And this tendency
s as the distance between the end A and B
less than the distance between B and the
d of the bar; at middle of bar distances are
nd weight of bar alone acts on the
Y.

[57072.]—**Siemens-Alteneck Armature.**—If any diametrically opposite commutator strips—such as *a e* or *g e*—were placed in contact with the poles of battery, or other source of electricity, the core would have a N. and a S. pole at right angles to the coils through which the electricity was



flowing. In the illustration given at page 525, Vol. XLI., there is an error (either mine or the engraver's) as to the joining up of the ends, numbered 2 2' and 4 4'. The annexed cut sets this right.—S. Bottone.

[57210.]—**Tar.**—Probably if the tar is kept long enough (!) and is then subjected to distillation, it will be as black as the coal tar. Does our friend "D. D." ask this question seriously?—Nun. Dor.

[57211.]—**Steam Launch.**—There have been some curious queries about steam launches in your columns, and some equally curious replies by your correspondent "Invicta"; but this idea of building a launch to suit an engine is rich indeed. Let the querist search through your back volumes, and peruse Dixon Kemp's book for ideas.—Essar.

[57217.]—**Taxidermy.**—"Young Beginner" expects too much: there must be a change of colour; but he should use his size cool, not hot.—R. O.

[57219.]—**Screw-cutting.**—I should not wonder if "Busby," in looking through back volumes, came upon the answer to his question several times repeated.—T. W. B.

[57223.]—**Chemical Action in Leclanche.**—I greatly wonder what was Mr. John Grey's state of mind when he penned his letter on the above subject, for short it is, but not very sweet. The only error in the equation, which he wishes I had corrected, as far as my elementary experience of chemistry and electricity shows me, is one which even Mr. Grey himself may fall into—namely, that of omitting a figure; for the equation should read:

$$Zn + 2ClNH_4 + 2MnO_2, \&c.,$$
$$\text{not} \quad Zn + 2ClNH_4 + MnO_2, \&c.$$

This error, those conversant with chemistry, and knowing what was wanted, would ascribe to some mistake in writing, as was the case in this instance in copying the letter rather too hurriedly. However, the other side of the equation remains unaltered, and the following remark of Mr. Grey's, the meaning of which I totally fail to understand, has not the slightest bearing on the error:—"The reduction of alumina by sugar itself would be a mere detail compared to the spontaneous generation of manganese and oxygen in a Leclanché cell," as I, having read over my letter, p. 549, at least half a dozen times, am at a loss to perceive what statement of mine he uses to make me assert the spontaneous generation of manganese and oxygen in a Leclanché cell; perhaps Mr. Grey will explain.—J. Kean, Northampton.

[57227.]—**Cleaning Sextant.**—Under the circumstances, I should say scrape it, and relacquer. J. T. M.

[57234.]—**Colour Lakes.**—There are no modern colours except the aniline products, and their behaviour in varnish, when submitted to light, is a matter for experiment. The old transparent colours are given in any list of pigments.—T. J. M.

[57244.]—**Dentistry.**—I am very sorry to hear "Mechanic" (p. 63) has got into the hands of people who wish to get money for teaching him the art of dentistry in a few months (during the evening). I should like to know what connection engineering has with dentistry? Certainly they are both mechanical; but one is rough work, and the other requires accurate manipulation. rong when he thinks dentists model their own teeth, or model vulcanite at all. I am a dental assistant, and in a good practice in the West of London, but do not get anything like three or four pounds a week; and as to making for the trade (working for the profession), it is a very poor speculation. I should advise "Mechanic" to keep his money, and not throw a whale to catch a sprat. In conclusion, I pity a patient getting into the hands of a three months' engineer dentist.—Jack of One Trade.

[57244.] — **Dentistry.** — "Mechanic" (p. 63) could no more earn £3 or £4 per week at mechanical dentistry after three or four months' experience, than he could do the same as a consulting engineer. He might be a second-rate workman in vulcanite, and a third or fourth-rate workman in metal; but he could no more take every case from the impression and bite and finish it satisfactorily without constant supervision than he could fly. There are many beginners and apprentices out of their time who would jump at the chance of earning 25s. or 30s. per week, and to take in work from dentists an important essential is that he shall be a first-class workman, with experience enough to plan and carry out cases entailing constant changes. A good workman can be got for about 25s. to 30s. per week out of London, and in London often for next to nothing, if time is given to attend lectures and hospital practice. Any man with special skill may make a good income at mechanical dentistry; some can do so without the skill, and the same remark applies with greater force to almost any business. If "Mechanic" looks on dentistry as an easy way of making money, he is mistaken. The same skill and judgment necessary for success can be quite as profitably employed in any business.—998.

[57246.] — **Boiler.** — This boiler might stand 100lb. pressure; but it would not be safe to work it at that—20lb. much nearer the mark. No rule for such affairs, as so much depends on the manner in which the work is done.—Essar.

[57247.]—**Tempering Twist Drills.**—These drills are tempered in the usual way, and as to the best material for grinding taps, use grindstone slurry, oilstone dust or rouge; not emery on any account.—S. T. P.

[57248.]—**Speed of Launch.**—If this querist has a launch 10ft. long, which goes at a speed of eight miles an hour with 200 revolutions of the paddles per minute, surely he can easily try what it will do with 2,000 revolutions in the same time. I should say the extra speed would be nearly all wasted in churning up the water.—Nun. Dor.

[57254.] — **Photo. - Chemigraphy.** — If this querist would mention the page on which he finds the vague directions, perhaps he may obtain an answer to his question.—Nun. Dor.

[57256.]—**Fees to Fire Brigade.**—Surely this querist could obtain information direct on application at the Metropolitan Board of Works, or any of the fire stations?—Nun. Dor.

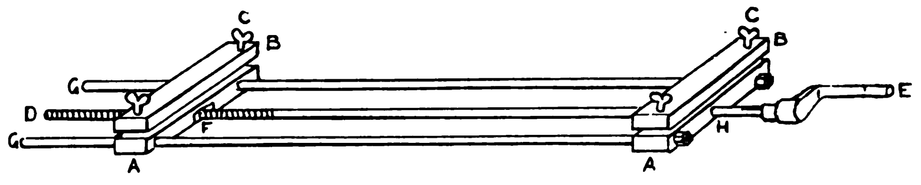
[57271.]—**Flageolet Tuning.**—The instrument is supposed to be tuned by the maker, and cannot easily be altered. What is the matter with it?—D. W.

[57322.]—**Violoncello.**—The bad tone of Mr. Smith's instrument is probably due to the bass bar not being long enough. Otto's rule is about half the length of the belly; but this is much too short. Two-thirds, or even three-fourths, would be better, especially if the belly has been worked out rather thinly.—Thos. Lisle, Wolverhampton.

[57324.]—**Wire on F.M.'s.**—Much depends on the build of the dynamo. If series-wound, the general rule is that the resistance of the F.M.'s should somewhat exceed that of the armature. If shunt-wound, the resistance of fields should be at least 20 times that of the armature; but as I understand from this correspondent's private letter that the maker has advised a given quantity at a given size, and as I know that maker is accurate in his work, I should strongly advise "Tubal Cain" to adhere to those quantities and dimensions.—S. Bottone.

[57398.]—**Tin and Brass—To Crystallise.**—To Mr. A. S. Castleford, Yorks.—I have followed your instructions, but have failed. I used sulphuric acid, 4oz.; soft water, 2oz., increased to 2½oz., then to 3oz.; 1¼oz. salt; that is your mixture, I believe. I might say the sulphuric is commercial, and common house or table salt—is that right? The effect I obtain is, at slight heat, no visible effect; at such that it cannot be held only by pair of tongs, dark colour. If you can give any more information I shall be obliged, thanking you for reply in first instance.—In Want of Knowledge.

[57381.]—**Trousers Stretching.**—I send you a design of a trousers' stretcher which I have used for a couple of years or more. A B are wood strips, C wing-headed set screws, working free in B and in a nut let into each end of A. D is a long rod passing through the nut F in the lower strip A, and



working free in the upper strip at H. The rod is screwed about 8in. up at the lower end, and fitted with a collar at the other, inside top strip A, and worked by a loose handle E. Guide-rods, G, are secured with collar and nut to the top strip A, and pass free through the bottom strips. To use, lay the trousers, neatly folded, on the stretcher with the ends between the strips A and B. Screw down the strips B by means of the wing-headed set-screws, and wind up the screwed rod D, and you can stretch them as much as you like; leave in the stretcher all night. I reckon to save a pair of trousers a year by this means, and always have them nice and straight, and never wear a pair of "baggy breeks."—MARCUS.

[57420.]—**Incubator.**—TO MR. H. ROWTON.—I, like "W. P. W.," should be very pleased to receive this instruction from Mr. Rowton, or any other correspondent. As Mr. Rowton did not send it some time ago, I made an incubator; but am sorry to say I cannot work it successfully. The eggs that hatched have been very delicate, and required much assistance, which I do not think should be necessary.—IGNORANT.

[57430.] — **Tricycle Chain.**—The new chain, Morgan's, is (according to his circular) tested by Tangyes up to a strain of 2,464lb., treble the strength required for any tricycle. — FRANK COCKS.

[57449.]—**Sanitary.**—It seems a pity that anyone should be misled by "Sanitary Dusthole." I burn many fires usually in my house, but do not put any of them to the purpose of burning vegetable and other kitchen refuse. To carry all such things away is the business of the parish authorities. As I have always refused to give beer or money, I had no little trouble a few years ago to get my dustbin kept clear, and wrote more than once to the scavenging authorities without much effect. At last I wrote to the sanitary inspector, pointing out that whereas he had just before sent me a circular on the necessity of keeping the house in the best sanitary condition in order to check smallpox, fever, &c., this was rendered impossible by the scavengers declining to empty my dustbin regularly, or to take away kitchen refuse, unless I gave them money, though I could see them constantly taking away, at the expense of fellow ratepayers, as "Sanitary Dusthole" puts it, all kinds of rubbish such as was never put into my dustbin, from neighbours who gave them money. The inspector came at once, said that there was nothing in the dustbin which the dustmen were not required to take away, and must have given them such a reprimand as has saved me from the like annoyance since that time. The men complained to my servants about their having informed me of the dustbin not being cleared and money being asked for, and I ordered them to be told that if my servant suffered any unpleasantness from them again, I should immediately complain about that. I did not hear of another word being said, or of any further trouble. All householders should do likewise. I told the parish authorities that it was their business to pay the dustmen sufficiently if their pay was insufficient, and that I would willingly bear my share of the burden; but I utterly objected to paying through the parish officers and then allowing them to levy a tax from me directly in addition. I object also to helping on beer-drinking in any way.—X.

[57455.]—**Killing Rats by Electricity.**—I am obliged by the answers to the above query, but I am afraid that none has helped me much. I fear that part of the reason is that my original query was not well worded. The ground I wish to surround and protect from rats has no buildings on it, only coops in which the birds are bred. The ground is ordinary stubble, and would contain no rats. The rats which invade the place come from the neighbouring hedgerows. I intend to surround the ground with two wires about 2½in. apart, and the lowest about 2in. from the ground on insulators. This I can easily do; but what I want to know is what size induction coil would be necessary, and which kind of battery the best. The coil and battery would be kept in action all night. I hear that in the Paris sewers thousands are killed by electricity annually. I am an engineer, but no electrician, so that I should be much obliged if somebody understanding that part of the subject would kindly give me the necessary information—viz., size of coil, and size and kind of battery necessary to kill a rat, best gauge of copper wire. I do not mind incurring some expense, as I annually lose over £100 worth of birds.—GLADIATOR.

[57458.]—**Surveying and Measuring.**—If "J. C. H." will apply to the secretary of the Surveyors' Institute, 12, Great George-street, Westminster, he can obtain the rules and syllabus of subjects set at the examinations, which will meet his case.—SURVEYOR.

[57468.]—**Recovering Gold from Old Watch Plates.**—Remove all steel parts and cover the plates with a paste of two parts of sulphur to one of sal-ammoniac in vinegar, anneal in charcoal fire and plunge into water acidulated with sulphuric acid, and leave therein for several hours, and, before removing, brush with a fine and soft scratchbrush, when the gold will become loosened to the shape of fine scales; the water is then filtered, and the gold, which will remain on the filter, washed, dried, and melted with finely-powdered borax and saltpetre.—T. B. BOSCOMBE.

[57470.]—**Brush Dynamo.**—To MR. BOTTONE.—The total length of F.M.'s is 6½in.; inside flanges, 5in.; thickness of iron (C.I.) in centre, 1¼in. by 4¼in. deep; flanges 4¼in. wide by 7¼in. long; insulation, $\frac{1}{32}$ asbestos sheet, well varnished. F.M.'s cover $\frac{7}{10}$th full circle of "A." leave ⅛in. clearance on sides. "A." is wrought iron in one piece, and is cut up into six sections, each of 2in. wide, ½in. deep, and ⅛in. Machine series-wound.—WILLIAMS.

[57482.]—**Warm Water for Bath.**—"A Fireman" will find no better means of obtaining hot water for his bath than by providing himself with one of Messrs. W. Sugg and Co.'s "Thermas" which, with an ample supply of gas and water, will give him 40 gallons at 100° in less than half an hour. I was in a similar difficulty to "A Fireman," and tried a variety of arrangements, each of which, while professing to accomplish all manner of things, utterly failed, and Sugg's patented "Therma" (invented by A. Vernon Harcourt, M.A., F.R.S.) is by far the best thing of the kind. It is rather costly—about 6 guineas—but "Fireman" had better incur this cost in the first instance than do as I did, spend almost as much, or more, in preliminary experiments on other almost worthless so-called bath heaters.—H. H.

[57492.]—**Locomotive Query.**—The height of the G.W.R. 7ft. singles from the centre of boiler to rail is 7ft. 1in.; G.E.R. singles, 6ft. 11in.; G.N.R. singles, 7ft. The "singles" are generally considered the best on the G.E.R. for heavy work; but, with light trains, the compounds are not far behind them.—A. F. O. B.

[57483.]—**Sinking Sphere.**—In my reply the sign − should be before the $3d^3$ in line 5 from bottom. In line 3 from bottom, "sphere" should be "segment." In "Milverton's" reply the $2r^2x$ (in three places) should be $3r^2x$.—J. S. C.

[57483.]—**Sinking Sphere.**—Let r = radius of sphere, S = specific gravity of sphere ∴ 3 S = specific gravity of liquid. Let x = volume of sphere immersed in liquid. Then we have the following equation:—$\frac{4}{3}\pi r^3 \times S = x \times 3\,S$ $x = \frac{4}{9}\pi r^3$ ∴ the volume of sphere below liquid is $\frac{4}{9}\pi r^3$.—H. L. C.

[57483.]—**Sinking Sphere.**—As the sphere displaces its own weight of the liquid, and as the specific gravity of the liquid is three times that of the sphere, it follows that the volume of the portion immersed is one-third of the volume of the sphere. Let r = radius of sphere, and h = height of spherical cap immersed; then volume of immersed portion or cap $= \pi h^2\left(r - \frac{h}{3}\right)$, and volume of sphere $= \frac{4\pi r^3}{3}$.

$$\therefore \pi h^2\left(r - \frac{h}{3}\right) = \frac{4\pi r^3}{9}$$

$$\therefore h^2 r - \frac{h^3}{3} = \frac{4r^3}{9}$$

$$\therefore h^2\, 3\, h^2 r = -\frac{4r^3}{3}$$

a cubic equation to find h

Put $r = 1$, and we have

$$h^3 - 3h^2 = -\frac{4}{3}.$$

A few trials will show that $h = 0{\cdot}7738$ will satisfy this equation very nearly; hence the depth to which the sphere will sink $= 0{\cdot}7738r$.—J. E. GORE.

[57486.]—**Mechanics.**—If $M_1 + M_2$ acts on M_2 with a force T, M_2 will react on $M_1 + M_2$ with an equal opposite force, and as both these forces are transmitted along the thread, T is the tension of the thread. Now, the velocities of the bodies are always equal, therefore, the acceleration $M_1 + M_3$ velocity must equal that of M_2 veloci But $M_1 + M_3$ moves downward under a fo $M_1 + M_3 - T$, and M_2 upwards under a fo $T - M_2$. Therefore, we have—

$$\frac{f}{8} = \frac{M_1 + M_3 - T}{M_1 + M_3} \text{ and } \frac{f}{8} = \frac{T - M_2}{M_2}$$

$$\therefore \frac{M_1 + M_3 - T}{M_1 + M_3} = \frac{T - M_2}{M_2}$$

But as $M_1 = M_2 = M_3$, therefore—

$$\frac{2M_1 - T}{2M_1} = \frac{T - M_1}{M_1}$$

$$2M_1 T - 2M_1^2 = 2M_1^2 - M_1 T$$

$$2M_1 T + M_1 T = 2M_1^2 + 2M_1^2$$

$$T(2M_1 + M_1) = 4M_1^2$$

$$T = \frac{4M_1^2}{3M_1} = \frac{4}{3}M_1$$

—DAVID STEPHEN, Jun.

[57486.] — **Mechanics.** — Descending we $= 2\,M_1$ and ascending weight $= M_1$. Let T = sion of the cord. Force producing motion in is $2\,M_1 - T$. Let f be the acceleration of system, and g gravity. Then, by the third la motion, we have—

$$\frac{f}{g} = \frac{2\,M_1 - T}{2\,M_1}$$

Similarly force producing motion in M_1 is T − and

$$\frac{f}{g} = \frac{T - M_1}{M_1}$$

Hence—

$$\frac{2\,M_1 - T}{2\,M_1} = \frac{T - M_1}{M_1}$$

$$\therefore 2\,M_1 - T = 2\,T - 2\,M_1$$

$$\therefore 4\,M_1 = 3\,T$$

and

$$\therefore T = \frac{4\,M_1}{3},$$

the required tension.—J. E. GORE.

[57491.] — **Bisschop Gas-Engine.** — I reply of "One Who has had Same Complaint this week's edition, and think "A. H. A." m reap some advantage from it. I would, how however, strongly advise him to write the ma of the Bisschop (Messrs. J. E. H. Andrew Co., Stockport) for their book of instructions working of same, which, I believe, they send users free of cost. "A. H. A." would thereb tain information which, no doubt, is the out of several years' experience. From my knowl of the Bisschop, I should say it is nothing but with the aid of the book referred to, coul easily and soon rectified. The book is wonder concise, and anyone thoroughly acquainting selves with it could almost undertake the fix one, though an utter stranger to mechanical binations.—SOCRATES ZEUGLODON.

[57494.]—**Whitworth Scholarship.**—If apply to South Kensington you will get all th formation you require. I believe there are fi given every year, and the highest is £200 a yea three years.—A. T.

[57499.]—**Charging Porous Cells.**—To ch the porous cell of a Leclanché battery, crush carbon into various sizes from a pea down, pack the larger pieces tightly in the porous j layers, so that the particles are in firm co among themselves, and with a plate or b carbon, which forms the main conductor. finer grains should be mixed with three times bulk of manganese, also in fine grains, and be among the network of large pieces. The powder should be sifted out, because it resist penetration of the liquid.—H. H. B.

[57514.]—**Valve Query.**—Rule for findin pressure per square inch when the area of weight of ball, &c., are known. Multiply the w of the ball by the length of the lever, and mul the weight of the lever by one half its leng its centre of gravity), then multiply the weig valve and stem by its fulcrum. Add these products together. This sum divided by the duct of the area of the valve and its distance the fulcrum will give the pressure in pound square inch. In answer to "Young Firer," valve will blow off at 147·56lb. per square I shall be glad to give any further informati J. W. DEAR.

[57516.]—**Tube Wells.**—Inquire of thre perienced people in Norton's "Abyssinia"— Hawksley, 420, Caledonian-road, N.; Le G and Sutcliff, 100, Bunhill-road, E.C.; Isler an 88, Southwark-street, S.E. There are usually sizes, from 1¼in. They are comparatively ine sive, and are adaptable up to about 100ft. Be the nature of the soil (a soil in which wells i district are found) they may require to usual depths at which wells are in the distr BREAM'S BUILDINGS.

[57522.] — **Bell-ringing with Lecla Battery.**—"Amateur's" bell may have fail ring by reason of the iron of the electro-m being too hard. If so, the hammer coul vibrate, but would stick to the magnet as long as a current was passing.—BOBADIL.

[57522.] — **Bell - ringing with Leclanche Battery.**—The fact that the magnet attracts the armature shows that the battery is not at fault. The bell itself appears to be wrongly constructed. Have you fitted a contact breaker, and if so, is it insulated from the other parts of the movement? Look to this, as no doubt you will find the cause of the trouble to be in this particular.—C. D. R.

[57522.] — **Bell-ringing with Leclanche Battery.**—From the wording of "Amateur's" query, he appears to have simply connected the ends of his coils with the battery, without putting the armature in circuit. If so, try again; but this time connect one pole of your battery to the contact screw, which must touch the spring on armature. Now connect one end of your wire from the coils to the armature, and the other to remaining pole of battery. Should the armature still stick, look for contacts; or you might try by pasting a piece of paper on the armature. Sticking is often caused by making a good magnetic contact between armature and magnets, thus preventing ready demagnetisation.—E. THORNTON.

[57526.]—**Heat in Dynamo.**—The high temperature of the room will account for much of the heating, as it increases the initial temperature of the wire, and hence the resistance. Other reasons are:—First, defective build of dynamo, the iron in the armature being solid. Secondly, wire on armature too fine for current to be carried. Thirdly, resistance of outer circuit too low (too few lamps if in series, or too many if in parallel.)—S. BOTTONE.

[57530.] — **Bar Magnets.** — A battery of six Grove cells will be more than sufficient to magnetise your magnets. No. 24 silk covered copper wire may be too thin with this battery power, as it is apt to get heated. It would be much better in every way to use a thicker size, say between Nos. 16 and 20, either silk or cotton-covered. I am not aware of any special book on magnets; but a very able and exhaustive chapter on the subject will be found in Sprague's new book on electricity.—BOBADIL.

[57530.]—**Bar Magnets.**—To magnetise your steel bars they should first be hardened, and then placed in one long coil of No. 16 or 18 cotton-covered wire, about three or four layers. The coil should be long enough to stretch one or two inches beyond each end of the bar, and in the space thus produced should be placed a piece of soft iron, same size as interior of the coil. Your battery would, I think, be sufficient. As regards No. 24 wire being of service, I should think it would not be stout enough.—A. W. J. LAUNDY, Stratford, Essex.

[57531.] — **Pulleys.** — "Millwright" will find 30¼in. give the desired results.—J. P.

[57531.]—**Pulleys.**—To drive your shaft at the required speed you would have to put a 31·5in. pulley on the intermediate shaft.—H. L. C.

[57533.]—**Setting Small Coleoptera (Beetles).**—I have never seen any beetle so small as not to admit one of the finest entomological pins through its thorax. Perhaps the querist is not aware that the No. 20 pin is of about the same diameter as the leg of a house-fly. Should he prefer cementing the specimens in their place, I should advise him to use the cement for insects which dries directly applied. It is sold by all dealers in entomological apparatus, where he will also be able to purchase the pins. J. E. C.

[57537.]—**Lathe Query.** — Messrs. Bundy are quite right in the advice they have given to this querist, for if the guide screw be much used for self-acting it becomes ruined for its legitimate purpose, as getting worn most near the headstock, a thread cut there will not correspond with one cut at the other end of the bed. When, however, self-acting is obtained off the screw, it is done by an arrangement of wheels and eccentric on the tail end of the headstock; but it cannot be made self-acting in the traverse motion. If J. H. Phyl wants his lathe for surfacing, I should advise him to get the makers to fit a back shaft, as that is by far the best plan.—F. R. DAVIS.

[57539.]—**Wimshurst's Influence Machine.**—Algernon Forsyth will find metal bosses for carrying the glasses are objectionable, inasmuch as part of the electricity escapes to them. No doubt wood soon chafes away, and the hole becomes too large for the spindle. I have never gone so far as to try it; but always have put a length of brass tube through the hole in the wooden boss, and thus have made a metal bush at little cost. I cannot state how long the brass tube will last, for several years' wear has caused no waste in it. Of course, it requires a little sperm oil as lubricant. "A. F." should try similar, and then he may advantageously run his glasses as close together as he wishes.—X. Y. Z.

[57540.]—**Dynamo.**—None cheaper than one built on the lines described by me in "The Dynamo: How Made and How Used," in the back numbers of the ENGLISH MECHANIC. A laminated armature will insure coolness.—S. BOTTONE.

[57540.]—**Dynamo.**—Would it not be better to communicate with the makers of the water wheel and get from them the particulars of cost, &c., as you suggest? I presume that you have a constant supply of water at a sufficient height to give the necessary pressure per square inch to work the wheel, otherwise it will be of no use to you. I have seen the wheel at work in the Inventions, but the result did not appear to recommend it to me.—C. D. R.

[57544.]—**Harmonium.**—If "J. C." had carefully read his "MECHANICS" he would never have asked the questions put forth on p. 68 of our new volume. The querist there states that he has "a harmonium with one row of 8ft. reeds." He also asks "which of the two will be best?—to add another row of reeds?" I must interrupt him here, and say that another row, or even a half-row (2½ octaves) would necessitate the adoption of a new soundboard, suitable for the required number of reeds, not forgetting the extra amount of space in width of case required for its application to the instrument. Having had considerable experience with reed organs of various sizes, it is only a matter of kindness and goodwill to advise "J. C." not to attempt to carry out the ideas expressed in the query. I offer the following suggestions and hints, which I hope will benefit "J. C." and others interested in the matter—1st. Harmoniums containing one row of vibrators (generally speaking) are not constructed to admit of any future addition in the number of reeds. 2nd. Harmoniums and also American organ cases are made of suitable dimensions in depth, or width, according to the number of rows of reeds employed. In the larger classes of instruments, the height and length is also increased, as well as the depth or width. By this I infer that in all probability (unless your instrument is made larger in proportion to the general run of instruments) the case of your one-row harmonium is not of sufficient dimensions in depth to allow of the application of a soundboard for two rows of vibrators. Besides, it is very doubtful if the bellows are large enough to supply the necessary amount of wind required for two rows of reeds. 3rd. The "exhaust system" to which you refer in the latter portion of your query, does not apply to harmoniums at all. The harmonium, bellows are constructed on the "pressure system," which means that the air is forced on the reeds by the aid of springs placed under the reservoir. In the American organ "exhaust principle," the bellows is of very different construction to that of the harmonium. The air in the reservoir is exhausted by the action of the feeders, and when the reservoir expands, the air is drawn through the reeds by the power of the springs, which are, in this case, placed inside, instead of outside the reservoir. I may here remark that some makers place the springs outside the reservoir of exhaust bellows; but in this case the springs are so fixed as to expand the reservoir, instead of forcing the air contained in it, as is the case with regard to the harmonium pressure bellows. I should be pleased to fully explain the two principles at any time, if requested to do so. 4th. I should advise "J. C." to dispose of his one-row harmonium, and purchase either an American organ containing two rows of vibrators (8 and 4ft.) or a harmonium containing two rows of vibrators (8 and 16ft.). By taking this advice, I think (if I may judge from the wording of his query) he will have his desires gratified. If he likes, and with Editor's permission, I shall be pleased to give him any necessary information with regard to the matter of constructing an American organ or harmonium. For the benefit of "J. C." and others, I send particulars of dimensions of harmonium cases for certain numbers of rows or half-rows of vibrators, or reeds. One row: Length, 41in.; depth or width, 12in.; height, 30in. Two rows: Length, 42in.; depth, 20in.; height, 37in. Two rows and a half: Length, 42in.; depth, 24in.; height, 38in. The dimensions here given, for cases, afford ample space for both bellows and soundboard, for a certain number of reeds. It will be seen from this that the dimensions of case for one row of reeds is not sufficient for two rows, for obvious reasons. With regard to American organs, the dimensions of the case is of some consideration and importance with regard to the quality of the tone produced, but to fully explain this matter, I should require more space than could be spared in this column. Some makers devise the so-called (as they term it) resonant cases, and consider the dimensions or form of the cases of little or no importance so long as the cases are made sufficiently large to hold the action. I do not apply these latter remarks to the subject of harmoniums.—G. FRYER.

[57545.]—**Turk's Head Knots.**—Pass your spun yarn twice round the rope from you, then dip your end under the first turn, then dip your first turn under second, then dip your end through first again, then follow your starting end round as often as you like. I should prefer a diamond knot, made by making a crown and dipping your ends up the centre.—FLYING FISH.

[57546.]—**Dynamo.** — TO W. H. EAVES.—The smallest machine I make on the system you quote gives 50 volts and 12 ampères, so you will see that I could only guess at the sizes you would require for a machine to light one 10 and two 5-c.p. lamps. In fact, I do not think such a machine would be practicable, or worth the time and trouble of making. For these very small machines there is nothing so good as a small laminated Siemens H armature, and one of these I should advise you to get, about 4in. by 1½in. An armature this size, mounted in a moderately strong field, would be ample for your requirements.—W. H. EAVES, Coventry.

[57547.]—**Gas Tanks for Theatre.**—The pressure of gas certainly is reduced as the column of water falls in the upper chamber; but in working with two tanks the pressures are in ratio, and can be increased by adding water to the top chamber of each tank. I have used tanks made on this principle from 20in. to 7ft. high, and have found them to work most satisfactorily, only for travelling have nothing that can be knocked off. The pressure in the retort is not great when filling the tank. Ordinary rubber tube with slip joints can stand it, provided the gas is brought off gently over a Bunsen burner.—J. T. F.

[57548.]—**Water-Wheel.**—No, certainly not; there is no such thing as perpetual motion, and this is what your query amounts to.—C. D. R.

[57548.]—**Water-Wheel.**—You could only make your water-wheel pump a very small percentage of its own water, and then you would require some small pump with very little friction, and even then you would probably find it unsatisfactory.—E. THORNTON.

[57548.]—**Water-Wheel.**—TO "T. C. W."—If you could do this you would have perpetual motion, which I always thought was impossible. Of course you could make the wheel pump up a certain quantity of water from the lower to higher tank, but not enough to keep it always in motion.—H. L. C.

[57552.]—**To "W. H. E."**—As you have made the armature just half the length of the one described in my letter on the 30-light machine, you had better follow the same plan with the F.M's. To do this, use only two electro-magnet bars, 4in. in diameter, and leave the pole pieces the same thickness as in the 30-light dynamo. Wind the F.M's. with 45lb. of No. 18 d.c.c. At 1,700 revolutions per minute, you will get about 47 volts; for short runs (3 to 4 hours) you may use 1 to 25 ampères; for continuous work, from 1 to 20 ampères, including the current passing through the F.M's. If you had used double s.c. wire for A. instead of double c.c., you would have obtained these results at a much less speed.—W. H. EAVES, Coventry.

[57555.]—**Brass and Leather Cement.**—The following is recommended. 56 parts of common glue melted, and 3½ parts of gum ammoniac added; stir well till reduced to an even mass; remove from the fire, and pour in gradually 3½ parts of nitric acid, and incorporate with the rest. The acid acts on the metal and secures a firm grip.—R. A. R. BENNETT.

[57555.] — **Cement for Leather and Brass.**—In reply to "Uranium," the best cement for the above is that used by bicycle makers, and sold under the name of tire cement, and in my experience there is nothing to equal it for tenacity; but it must be used in the right manner, which is thusly:—Warm the brass enough to melt the cement when applied to same, so that it will leave sufficient cement on the brass to cover it; then lay the leather on same, and work down with a warm iron; when cold, you will find it perfectly firm. I have used the above over and over again for the brass regulating tails on swell keys (coupler swell to great), and always with satisfaction. In conclusion, allow me to welcome your reappearance in our columns, and to express my thanks for the information I have gained from your numerous replies on organ building. "May your shadow never grow less."—HARMONY.

[57558.] — **Dry-Plate Development.** — Since much of the pictures remains clear glass, it is evident that these faulty pictures are under-exposed. This is further corroborated by the fact that changing developer does not change results.—S. BOTTONE.

[57558.]—**Dry-Plate Development.**—The behaviour you describe has all the signs of an under-exposed plate. They are evidently not exposed long enough, although "the exposure appears right." At any rate, it is easy to try a subject you have failed in before in this way, exposing it longer and developing as usual, when I expect you will find it come all right. When the image does not appear in five minutes you should put in more ammonia. The sulphite developer is more under control, it seems to me; the ferrous oxalate is an awful spoiler of negatives, at least in my hands: I have never got one good picture with it yet, though eminently successful with the sulphite.—R. A. R. BENNETT.

[57559.]—**Studio.**—I think Willesden paper will be just the thing. It is light, waterproof, and easily put up. Price differs. I have just put some on roof of small shed, and paid only 1s. per yard, 54in. wide; but I don't think that sample would be thick enough for "Amateur," who, however, can write for particulars to the Willesden Paper Co., Willesden Junction, London.—KENSINGTONIAN.

[57560.]—**Press.**—In Marion's book I find it given that before being rolled, the prints ought to be coated with a solution of 1gr. of Castile soap in 1oz. of methylated spirit. Possibly this will remove your difficulty. They are to be rolled when dry.—R. A. R. BENNETT.

[57561.]—**Phosphorus and Silicon in Steel.**—"Novice" should try heating the vessel containing the solution from the sides instead of from the bottom. Small pieces of glass are sometimes introduced to stop bumping; but in this case it would not be advisable.—C. F. P.

[57561.]—**Phosphorus and Silicon in Steel.**—Why not use a sand bath? They are generally used for this very reason, as they distribute the heat more equally over the bottom of the evaporating dish. Is it possible that this idea has never crossed your mind? If not, try it by all means. There is also another dodge—viz., putting one or two small pebbles with unequal edges into the solution; the steam is given off evenly from the sharp points, and so does not form the large bubbles which are the cause of your distress.—R. A. R. BENNETT.

[57562.]—**Speed of Air Particles.**—Maxwell, in his book on heat, calculates that the average velocity of hydrogen molecules is 6,097ft. per second; and as the velocity in any gas is inversely as the square root of its density, we easily get 1,524 and 1,629 as the velocity for oxygen and nitrogen respectively. I venture to remind Mr. Noel that 33,000lb. falling through an infinitesimal space would do only an infinitesimal quantity of work, and that the same weight, or any other weight, at rest, would do no work at all.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[57564.]—**Leclanche Battery.**—The crystals are chloride of zinc, and as they are formed close round the zinc rods they must to a certain extent hinder the action of the sal-ammoniac solution, for which reason it would be better to get rid of them when their number is great. But I think that although you don't use a conc. solution of NH4Cl, yet it gets conc. by evaporation, in which case if more water was poured in the crystals would disappear.—R. A. R. BENNETT.

[57564.]—**Leclanche Battery.**—These crystals are oxychloride of zinc. They indicate that the battery has been worked to exhaustion. This may have been caused by a short circuit or by the manganese being of an inferior quality, or by the battery being called upon to supply a current for which it is not fitted. You must determine the cause by examination, and remedy it. Take out the zincs, and dissolve the crystals with hot water; well wash the porous cells likewise, and recharge with fresh sal-ammoniac, made by dissolving the salt in cold water until it will take no more, and then diluting with the same bulk, forming a half-saturated solution.—C. D. R.

[57565.]—**Gramme Machine Wiring.**—TO MR. BOTTONE AND OTHERS.—Field magnets are very small for such a ring. I do not understand what is meant by "nine spaces for holes." A 3in. ring, for incandescent lighting, should be wound with No. 22 wire, about ¼lb. On the fields there should be about 4lb. of No. 16. Series-wound would be best for so small a dynamo. Two tens in parallel would be the utmost you could get from such a machine.—S. BOTTONE.

[57569.]—**Electric Light.**—The 7d. fairy lamps are platinum lamps, and not very satisfactory. A 2½-candle lamp, carbon, Swan, would do well. The Leclanché battery would do if the light is only wanted at intervals, so as to give the battery time to recover itself. In this case six ordinary Leclanche cells would work such a lamp well. But for continuous work, a more constant battery, such as Bunsen or Grove, must be employed.—S. BOTTONE.

[57569.]—**Electric Light.**—The Leclanché cell is totally useless for your purpose. The batteries commonly used for lighting are the Bunsen, Grove, bichromate, and chloride of zinc. Fairy lamps are good enough in their way; but the light from one would be too meagre to have much effect in the smallest shop-window. The most popular lamps among small folks like you and me range from 2½ to 10-candle power, and they cost from 2s. 6d. to 5s. each, according to the makers.—BOBADIL.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

57122. Second and Fourth West India Regiments, Colonial Police Forces, &c., p. 441.
57132. Cork Making, 441.
57134. Painting Iron Bath, 441.
57137. Sewing Machine Work, 442.
57147. G. W. R. Goods Engines, 442.
57162. Automatic Musical Instruments, 442.
57167. Mineralogy, 442.
57172. Best Valves in Hydraulic Rams, 442.

57212. Co-ordinate Geometry, p. 529.
57218. Electro-Magnetic Problem, 529.
57222. Gas Engine. To "Inventor," 529.
57225. Copper Bath, 529.
57228. 5ft. Reflector, 529.
57231. Tinman's Piecework Prices, 529.
57241. Robinson's Patent Lubricating Pads, 529.
57242. Condenser, 529.
57245. Compound Tandem Engines, 529.
57252. Waterwheel. To "Inventor," 530.
57255. Making Patterns in Glass, 530.
57260. Files, 530.
57264. Blue Paint, 530.
57266. Sea Voyage, 530.
57267. Live Spindle, 531.
57268. Dyeing Fishing Baits, 531.

QUERIES.

[57571.]—**Producing Fire.**—The following query has often suggested itself to me, and, doubtless, also to many others in these days, when almost everything, both ancient and modern, is placed under investigation; and I have been able to find nothing in books or other sources to enlighten me on the subject:—What method of procuring fire for domestic or other purposes was in use amongst the ancient Greeks and Romans? It is difficult to imagine nations so polished and advanced putting up with the most ancient-known method of obtaining fire by the friction of two pieces of wood, which was the means by which the Vestal fire at Rome was replenished when accidentally extinguished, or repeating this laborious and clumsy operation each time fire was required for domestic or other purposes. Possibly, a lamp was kept burning in each house, or some public provision might be made for obtaining it? Amongst the admirable Greek vases at the British Museum there are numerous instances of designs in which lighted torches and fires, sacrificial or otherwise, are illustrated in the elegant decorations of these vessels; but I can nowhere recognise the illustration of so important an operation as that of obtaining fire. Perhaps someone among your many subscribers, who is versed in such matters, may be able to throw some light on so interesting a subject, for, great as many human inventions and discoveries may be regarded, it seems to me that the original discovery of fire may be looked upon almost as the most important of them all, since so little can be effected without it. In connection with this subject, may I raise the additional query as to whether it is known with any degree of probability when the flint and steel method was invented, and by what people, for this mode practically solved the whole difficulty?—SEMAPHORE.

[57572.]—**Lightning Protection.**—I shall be much obliged to "Sigma," or any other correspondent, for some advice in regard to the best method of protection in the following case:—The house is a dwelling in the country, standing by itself; stabling and outhouses 200ft. to the rear; roof entirely of slate; a tower about 75ft. high, at S.E. corner, and about 25ft. above the highest portion of roof. The roof on main building terminates in a flat platform, used as a look-out. On this is built an observatory, with a 4in. equatorial on cast-iron pillar, pillar resting on brick pier from the ground up. Up this pier comes a small gas-pipe for the observatory, running past the pillar at a distance of 2in. The tower is capped with a copper ball, about 10in. diameter, and at the rear of back building there is a small cupola ventilator, with another copper ball, about 6in. Inside of the building there is a good deal of metal, such as gas-pipes, steam-heating pipes, water-pipes, as well as some large waste and drain pipes. The waste pipes, however, only run about 25ft. from the house, and then they are continued by terracotta ones. Under the dining-room there is a well, and all the water pipes are connected with this. In the third story of back building there is a large iron water-tank, holding 1,000 gallons, and into this tank the water is pumped by a small engine from the well. The steam pipes run to a boiler in one cellar, while the gas-pipes run to another cellar, and from there to a large iron tank, buried 10ft. or more in the ground, at a distance of 50ft. from the building. As this tank holds several hundred gallons of gasoline, would there be any danger in case the lightning should take to the gas-pipes? Now the question arises, What is the best plan to get a good ground connection for the rod, for I suppose the earth contact of the rod must be better than that of all the piping in the house if the lightning is expected to take to the rod in preference to the piping? Would it be best to connect the rod with the water pipes, and thus ground it in the well? At the bottom of the well the water comes up between some large rocks, but I suppose this would make no difference, as it must be in close connection with the subterranean water-bed? Most of the authorities that I have read maintain that all large masses of metal in the building should be put in metallic contact with the rod; but Prof. Clerk-Maxwell, in a paper read before the British Association in 1876, seems to think that this is unnecessary, unless the piping comes into the building from some distance outside. Would it be advisable to ground one portion of the rod on the water pipes, and another on the gas-pipes outside the building? The gasoline tank, I find, was put down in the ground in its wooden case. Should a connecting-rod be run from the cast-iron pillar to rod, or should it be put in contact with the small that runs within a few inches of it? How would connect all the piping in the house (gas, water, an together by means of a copper rope, about ½in. and then make one ground with the well, another gas-pipe outside, and a third with a low, moist ground with a ditch, into which the waste pipe AMERICAN.

[57573.]—**Label Turning by Machiner** any of your ingenious readers kindly show me make a contrivance to turn down labels previo eyelet being put in. The operation has to be p by the fingers at present, so far as I am concern is a very tedious and fatiguing work. I am a machine, which is in the market, but it is a v affair.—VERNON.

[57574.]—**Reversing Gear for Electro** —Will someone versed in electrical matters kindl a description of a reversing gear for an electro-mo Siemens type, as I am sorry to say. I can make the sketch given by Mr. Eugene Brown, in N 570, in answer to query 57249?—W. B. L.

[57575.]—**Amount of Oil used in Eng** Can anyone kindly inform me how much oil is per day for lubricating purposes: (a) in a first-c motive, (b) in the engines of an Atlantic liner? rough estimate would suffice.—E. R. P.

[57576.]—**Battery for Electric Light.**- BOTTONE.—I have a six-cell bichromate battery 6 by 2 by ¼, zincs the same size, the cells are rou the inside measurement being 6 by 3¼. I wish 5 candle-power lamp with it. Could you tell quired charge for the same? Also whether they best, one in series, or two, or which would be way to place them?—A NEW SUBSCRIBER.

[57577.]—**Compounding Launch Eng** have a steam launch, 23ft. long, 5ft. beam; c 4½ dia., 5in. stroke; steam pressure, 70lb.; speed miles. I wish to convert the engine into a comp and should be much obliged if any correspondent good enough to tell me the way to effect this. to have a larger cylinder in place of the present the latter on top for high pressure. What size have the low-pressure cylinder respectively for pressure, and, if I was to increase it to 90lb. (the quite strong enough), what is the rule for prop the cylinders of compound engines? Please w example applicable to the above in plain figure compounding have the effect of saving steam speed, or enable me to go faster on present con about 1cwt. for six hours? Would the strain on be same as at present? I should also like to ha surface-condensing (by outside pipe); but have an air-pump cannot be worked in about as small size? I wish to know if this is correct, and, if small air-pump cannot be worked as well as a I should much prefer an air-pump, if possible can't use one, can I condense the steam, so as to water for feed? I feed at present with injector turn engine into condensing one, must I not hav to draw off water as soon as condensed? Any instructions for carrying out the compounding, &c., would greatly oblige—H. G.

[57578.]—**G.W. Engine.**—Can any of our re me the dimensions of the new outside cylinde gauge express? Is this one of the compou number is 9. It took out the 5 10 p.m. on Friday —A. T.

[57579.]—**Invalids' Tricycles.**—Are suc made as rotary hand-power tricycles for invalids, handle driving both wheels by balance gear, handle ratcheted to axle, or left wheel, as auxilia about 36in.; front steerage?—J. COLBY.

[57580.]—**Dentistry.**—Would "Dental Refor advise the works to study to enable a student t L.D.S. degree in dentistry?—REFLEX.

[57581.]—**Wax Castings.**—Will some on numerous readers tell me how I can harden wa get a sharp impression? Ordinary white wax be too soft; after taking an impression (say, from the head and hair are somewhat blurred. I thi wax could be hardened with some foreign body would be overcome. I want it to look like iv cast; how may this be done? What colour ca the white wax to get it as I desire?—BUSY BEE.

[57582.]—**Steam-jacketed Cylinders.**- of our engineer correspondents be kind enough me whether it is universally recognised by a engineers that the best system of making stea cylinders is by forcing a bush into the outer cas cylinder? Where are the air-vent holes made in ing? Are the holes generally filled with covered with plates?—LOCO.

[57583.]—**Dynamo.**—Would Mr. S. Botton other subscriber be kind enough to give me som to the following:—Some time ago I purchased a s ings for a so-called 100 candle-power dyna Pacinotti ring armature. I wound the F.M.'s type) with 14lb. of No. 16, and the armature w 2lb. of No. 22. On running the machine by m lathe, I can barely obtain current sufficient to li candle lamp. I have tried shunts of various resis being series-wound), but with no great imp Have I, in my ignorance of electrical matters, fine wire? The mechanical part of the fitting-u well done, and the insulation at the time of win The ring is of cast-iron. Would a laminated on the working?—C. E. O.

[57584.]—**Dynamo.**—Will some kind electri say where, or in what book, I could find out how late the size of field magnets, armature, and gaug used in constructing a dynamo to do a given work.—H. L. C.

[57585.]—**Casting Zinc.**—I am trying to articles in zinc, and succeed, as far as casting go soon as I attempt to release them from the moul to pieces (just as if the zinc was rotten). What know is if any reader can tell me how to do properly? Ought I to use the mould very hot, o have used both iron and brass moulds; and shoul an alloy with the zinc?—CATHODE.

[57586.]—**Elwell-Parker Accumulator.** — Will Mr. Bottone, or others, give me some information as to the Elwell-Parker accumulator, the electrodes of which are of lead honeycombed? I am going to make an accumulator, and I prefer making it on this principle, as the time and trouble taken to form other plates is considerable, this form of cell only requiring to be charged twice, and it is then ready for use. Will you tell me how to make the electrodes, and whether it is filled up with red-lead?—L. H.

[57587.]—**Glycerine Barometer.**—I have constructed a glycerine barometer after the method described in your issue of the 11th Sept., but find it quite impossible to make the cork air-tight round the glass tube which passes through it. Could any kind reader of the "E. M." inform me how this difficulty would be best overcome?—LEAKAGE.

[57588.]—**Engine.**—Will any person give me the stroke and bore for a ¼ h.-p. horizontal steam-engine, as I propose to make an engine of two such cylinders working side by side? Also the size of a boiler and furnace for the same, to be made of iron?—A. H.

[57589.]—**Incandescent Lamps.**—Will any person give me directions for making incandescent platinum lamps of 5 and 10 candle-power, with Sprengel pump?—. H.

[57590.]—**Piano.**—I have a very old, but good, trichord piano, by Broadwood, but the strings are rusted. Will someone advise me where to get the best strings and cost of same for six octaves? Would silver wires be better than steel? I don't mind a little extra cost if strings are really good?—A. T.

[57591.]—**Photography.**—In intensifying a negative taken on a Fry's special instantaneous plate, the result has been that it has become of such a dense copper colour that it won't print at all. Can any brother reader help me to get it right? The development was with pyro., soda sulphite, and carbonate of potash; the negative was fixed with hypo., and then cleared with alum and citric acid; and it was intensified with bichloride of mercury and ammonia. I don't think want of washing had anything to do with the result.—PERTHSHIRE FARMER.

[57592.]—**Electric Motors.**—Can any reader recommend, by personal experience, electric motors as an efficient means of driving a lathe of about 5in. centres; and also tell me if they found them at all troublesome to keep in working order?—R. R.

[57593.]—**Straightening Sheet-iron Plates.**—Can any reader help me in this query? I have much sheet iron to straighten 24 gauge, size of sheets 24in. square. Is there any particular place to strike the iron to take out the buckle, as the tinners call it? I find the more I hammer it the worse it becomes.—TINKER JACK.

[57594.]—**Gun Boat.**—I am about to make a model of H.M.S. *Northampton*. Would some kind reader oblige me with dimensions of her hull? I should be very thankful for a sketch showing where the guns are placed. I want to make it as perfect in detail as possible.—C. GODDARD.

[57595.]—**Electric Engine.**—I have an electric engine, composed of two pair of electro-magnets, 3 by 1, fixed at opposite sides, and a drum, 8in. diameter, with five soft iron armatures therein, and capable of rotation, but I cannot get drum to rotate. Suppose connections are wrong. Will any of your readers kindly give sketch of the correct corrections for such a machine and battery power required?—PUZZLED.

[57596.]—**Orguinette.**—Having a case by me, I wish to use it for an orguinette. The bellows space is 15in. by [illegible]in., depth 24in. inside measurement. Will any kind friend tell me if I can get bellows power enough for three rows of 3½ octaves of Monro reeds in that space? Shape of bellows, with sketch, will oblige. Whether would be best: waterproof sheeting or American cloth for the same, for wear?—A. B. C.

[57597.] — **Photographic Camera.** — I thank "O. F. D. R." and A. Freyer Evans, Monmouthshire, for their replies to my queries relating to the gelatine bromide dry plates and sensitised paper. Could they or any of your readers inform me how to make a ½-plate photographic camera; and what lens would they recommend for general use (photos., landscape, and copying) for an amateur?—AMATEUR PHOTOGRAPHER.

[57598.]—**Chemical Problem.**—Mallet determined the atomic weight of aluminium: 1st, by estimating the hydrogen evolved by the action of caustic soda on the metal, when 5·2362 grams aluminium gave 5·2562 grams H_2O; 2nd, by analysis of the bromide, when 8·6492 grams of the bromide required 10·4897 grams of metallic silver for precipitation. Required, the at. wt. from (1) and (2), $Ag = 107·66$, $Br = 79·75$, $O = 15·96$.—CRYOLITE.

[57599.]—**Gauge of Railway.**—Can any reader inform me why the present gauge of railway, used, I believe, all over England, was originally adopted, especially as to the ½in.? Is the same gauge used in other European countries?—LIQTAR.

[57600.]—**Copper Bronze.**—What is the commercial method of precipitating copper (if any) in the state of bronze?—CRYOLITE.

[57601.]—**Mounting Horses' Hoofs.** — Can any reader of the "E. M." inform me how to mount a hoof? I had a favourite fast-trotting thoroughbred mare, who, a week or two since, had to be killed, having broken her leg, and I should much like to keep, as a memento, one of her hoofs. An early reply will greatly oblige—NORTH LONDON.

[57602.]—**Waggonette.** — Will any correspondent inform me how to make a portable frame for a small waggonette, to be covered with a waterproof sheet for wet weather?—E. MELLOR.

[57603.]—**G.W.R. Broad Gauge.** — Would "A Friend of the Bone Shakers," or any other of the numerous correspondents of the "E. M.," kindly give me the length (engine and tender separately) and diameter of boiler of a G.W. broad-gauge engine, such as the "Great Britain," or the "Dragon"; and could they also tell me where I could get a photograph of one, and what would be about the price?—GREAT BRITAIN.

[57604.]—**Construction of Magic Lantern.**—To MR. LANCASTER, OR OTHERS.—Having the necessary lens for the above, required to know the proper distance to place them from each other, and, from reflector, distance for slide, and, if not asking too much, rough outline of the structure, with dimensions? The small lenses are 1⅜ dia., there being two of them inclosed in a brass frame worked by rack and pinion. The larger lenses are 3½ dia. fastened in the same manner.—ONE IN A FIX.

[57605.]—**Difference of Power.**—Would some of your many readers say what is the difference of power in a horizontal engine, 12in. dia. cylinder, 30in. stroke, 80 revolutions per minute, and steam pressure 40lb. per square inch, and one the same, 12in. dia., revolving on shaft at 30in. dia., and 80 revolutions per minute, with 40lb. steam pressure per square inch? This would be equal to 94·24in. travel of piston, the other only 60in. Also if the same rules will apply to water pressure? Reply in plain figures requested.—YOUNG ENGINEER.

[57606.]—**Lathe.**—I want one of your numerous correspondents to kindly give me a sketch in your valuable paper of a lathe for wood and small iron and brass work. The height from ground to centre of chuck, 2ft. 6in.; total length, 3ft. 2in.; centres, about 5in., so as to take a job about 9½in. diameter. I should prefer an A frame, flywheel about 2ft. in diameter.—ALEXANDER RAMSAY.

[57607.]—**Dynamo.**—TO MR. EAVES.—I thank Mr. Eaves very much for his courteous reply, but am not quite clear yet. The small machine described is shunt-wound—that is, as I understand it, a part of the current generated in armature is sent through field mag., not coils, while the remainder is utilised in the external circuit. Will Mr. Eaves kindly explain how that particular part of current is shunted through F.M. coils? Now, in compound winding the same machine, how much No. 14 should be used for main coils, and how much No. 20 for shunt coils, provided arm. is wound as you describe? I should very much like to construct a machine as I suggested—viz., 60 amp., at 10 volts, and would feel greatly obliged if Mr. Eaves would assist me. I am actively engaged in making a 30-lighter, as described.—ANGLO-DANE.

[57608.]—**Polisher's Glaze.**—Will someone who knows kindly give me a good recipe for glaze, stating quantities? I have been in the habit of making it of benzoin and spirit, but it does not always turn out satisfactorily. Should there be anything else in? Can anyone also explain the reason that in using glaze in repolishing it very often dries quite off, and leaves the surface dull and granular-looking? Sometimes it comes right as it dries, but more often not. It seems to be due to something which has been used in the previous polishing, perhaps varnish. I had a couch back recently, in which part came up all right and the other part acted as I have described. A little advice will greatly oblige—A COUNTRY CABINET-MAKER.

[57609.]—**To Mr. Bottone.**—Referring to your kind reply (57476, page 66), what proportion of the circumference of armature should the pole-pieces cover—that is to say, what should the intermediate neutral spaces be, dividing the two pole-pieces, and about what measurement should the bridge-piece be at the top of F.M.'s connecting them?—TUBAL CAIN.

[57610.]—**Telephone Transmitter.** — Will any correspondent kindly tell me why in both a Blake and Crossley transmitter I always have a jarring sound, which completely destroys the distinctness of speech? The sounds are loud, but indistinct, and a person at a distance of 10ft. is heard speaking with the Blake transmitter very loudly, but indistinctly. The carbon used in both cases is carbon pencil, not gas carbon (scurfing). I used pencil, as the surface seems much more homogeneous. No amount of adjustment of the Blake transmitter improves matters. When the sounds are more distinct they are so very weak. Diaphraghm is of sheet-tin, 2¼ diameter, about 1-32in. thick. No difference whether one or two No. 2 Leclanché cells are used. Coil has 22 primary, 40 secondary. Telephones alone work well. Can anyone kindly give me a hint as to cause of trouble?—C. L.

[57611.]—**Shunt.**—TO MR. BOTTONE, OR OTHERS.—I have a series-wound dynamo; could I arrange it for charging accumulators and electro-plating by connecting up as a series and placing a resistance of German-silver wire between one brush and field magnet, so that introduced resistance, plus resistance of fields, equals 364 times that of armature?—PAX VOBISCUM.

[57612.]—**Locomotives.** — Can any readers of the "E. M." inform me if there are any lectures given on locomotive and marine engines in the neighbourhood of Clapton; and also what the dimensions are of the 640 class G.E.R., 50 class N.L.R., and 880 class Mid. R.?—PISTON ROD.

[57613.]—**Construction of Formula.**—Can anyone answer query 54207, page 450, Vol. XXXIX.? A correspondent stated the answer, which I gave, in a slightly different manner (simply putting $8n^3$ instead of $(2n)^3$), and this brilliant effort saved the query from appearing in the "Unanswered" list, so that it may have escaped attention. If query does not seem clear, please refer to page 40, Vol. XL. If I suppose that 3 has some relation to 216 similar to that between 5 and 1,000, how can I find out what this relation is? Work by logarithms, please.—GLATTON.

[57614.]—**Hydropathy.**—I have been most anxiously expecting to see in "Ours" a description and dimensions, &c., of "Hinckley Man's" new and improved hot-air bath, and am sure such a contribution would be heartily welcomed by a great number of our readers. I am now spending a few weeks at "Smedley's Hydropathic," and am, I may say, a firm convert to hydropathy.—J. H. M.

[57615.]—**Coals and Fraud.**—Will any reader kindly work out the following?—A contractor undertook to supply coals at 22s. 6d. per ton. He delivered them by weight in sacks, each sack estimated to weigh 3½lb., and to contain 1½cwt. of coals. If the sacks really weighed 7lb. each, what would be the money value of his fraud on 1,000 tons charged, and what was the increase per cent. in the price of coals?—BOGIE.

[57616.]—**Damp in Underground Workshop.**—I purpose building an underground workshop, light and air from top window, situation on slightly sloping ground. Will some person, experienced in this kind of construction, kindly give a few hints as to what precautions are necessary for excluding damp?—POTEY.

[57617.]—**Lathe Wheels.**—Will some brother reader of the "E. M." [illegible] a sketch of the wheels when they are in their position on the traversing frame to cut a screw 16 threads to the inch, right-hand thread, and also the different position of the wheels to cut the same pitch left-hand thread, with a leading screw, having three threads to the inch, and how many teeth each wheel must contain?—TURNER.

[57618.]—**G.W.R. Locos.**—Can any reader give particulars and drawing of either the old B. and E. 9ft. engines, or the G.W.R. b.g. coupled engines, as I have not got the back numbers containing the illustrations of them? Are there any engines without flanges on the driving wheels running on the G.W.R.? I saw one 7ft. single, which did not seem to have them?—A. F. O. B.

[57619.]—**Compressing Air.**—With undermentioned conditions, could you tell me (1st) to what pressure I could compress air in a cistern one cubic foot in size; (2nd) if, after the air was compressed to the highest point, I made a hole in the cistern one quarter of an inch square, at what height could I maintain the pressure in the cistern? Conditions:—A cistern, one cubic foot in size, inside measurement; two air-pumps, with levers 3ft. long, with fulcrum 1ft. from air-pumps, piston of air-pump 2in. in diameter. The pumps to be wrought by a man exerting a power equal to 10lb. at end of each lever, and making 30 strokes per minute with each pump.—AN AMATEUR IN MECHANICS.

[57620.]—**Printing Machine.**—Could any of your numerous subscribers help me with the following:—I wish to make a treadle printing machine, to print about 8in. by 12in.? I should be greatly obliged if anyone could help me by giving working drawings, &c.—TYPO.

[57621.]—**Chasing Screws.**—Will any reader inform me the best way to chase screws on tubing without getting screws irregular? Also way to grind in gas-cocks?—AMATEUR.

[57622.]—**Centring Cylinder.**—TO "INVICTA" AND OTHERS.—I have a small engine cylinder, 4½in. bore, 6in. crank, from centre to centre. Would any of our kind readers give me the dimensions of air-pump and condenser for the above, and h.-p.?—S. B. R. M.

[57623.]—**Casehardening Long Iron Rods.** — Could any reader inform me how to caseharden long rods of iron, 2ft. long, which are 1in. dia. and turned to ⅞ dia. in several places, 1in. broad? What method must I use to prevent them from flying out of truth.—J. P. C.

[57624.]—**Legal.**—A peal of bells has recently been put up in a Roman Catholic church steeple, situate in a populous neighbourhood. They are rung every morning from an early hour throughout a great part of the day, causing sleepless hours to late risers, and terrible annoyance to invalids. When ringing they completely put an end to all musical attempts over a large radius. Is there any law to prevent such a nuisance? If so, hundreds, if not thousands, of us will feel obliged as to information how to enforce it.—MUSICUS.

[57625.]—**Medical.**—Advice on the following will much oblige:—I am of a nervous temperament, but not grievously so; still, within the last few years, my right hand has taken to shaking, especially in the morning. I used to smoke, and, thinking this the cause, gave it up altogether. I am very moderate both in eating and drinking, principally vegetables and beer. After dinner the shaking ceases; and, strange to say, my left hand is never affected. My principal occupation is writing; would that have anything to do with it?—NERVOUS.

[57626.]—**Calculation.**—What is the quickest way of converting kilogrammes per square millimètre into tons per square inch? Please illustrate by converting 32 kilos. per square millimètre into tons per square inch.—JUAN XPTOBAL.

[57627.]—**Bicycle Race.**—I have a model of bicycle-race clockwork. The inside rider stops before it has gone two or three times round. It appears to run upright. How can I prevent them stopping? Would a rail round to keep wheels out remedy same? I have tried bending the wire which reaches to rider to alter same, but it still runs upright and locks.—PUZZLED.

[57628.]—**Watch Work.**—Will any reader kindly inform me how to rivet balance to staff and wheel to pinion? What kind of punch is used?—Is the operation precisely the same in both cases?—A. W.

[57629.]—**Waterworks Acts.**—TO MR. WETHERFIELD.—A week ago a fire took place in a house, which was burned down, although the wateworks main went past in front of the house. The nearest hydrant to house was 300 yards, and the fire engine, which was there in good time, had not sufficient hose. They had to flood a ditch near to main before they could get a supply. What I want to know is: can the local board not compel the water company to put in hydrants every 60 yards or so? Does Waterworks Acts of 1847 and 1863 not compel the companies to make provisions for a good supply of water in case of fire? The private Act of this company says nothing of water for fire. Can the Waterworks Acts of 1847 and 1863 be got anywhere?—ONE ANXIOUS TO KNOW.

[57630.]—**Water Gauge.**—At a small waterworks there is a tank that holds about 20,000 gallons of water, about one mile from pump. How is the man in charge to know when the tank is full, as he cannot see the tank? The water enters the tank at bottom. There is a pressure gauge on air-vessel; it works very unsteady, and does not tell the proper height of water in tank. Perhaps some of our readers who are in charge of waterworks at a distance will let us know how they get to know when their tanks are full.—WATER GAUGE.

Wimshurst Cylinder Influence Machine.—With reference to the paragraph in last week's issue (p. 56) stating that Messrs. Tudsbury & Sons were introducing an entirely new form of the Wimshurst machine, Mr. Wimshurst writes us that he has made cylindrical machines of his type for more than two years, and that he has shown them to many of the leading scientists. The reason why he has not brought them into prominent notice is that he found them to be more complicated and more costly than the simple plates. He, however, used the circular glass shades for cylinders; but hopes Messrs. T. may have overcome the above-named difficulties.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 23, and unacknowledged elsewhere :—

J. C. WHITE.—J. Wood.—W. H. Numsen.—J. Wilson, jr.—H. H. Holt.—Crompton and Co.—Miss Hamilton.—J. White.—Smith and Coventry.—G. Gaudibert.—Bera.—Sand Rat.—Young Chemist.—Chromo-lithographer.—G. G.—W. B. L.—Verax.—Ignorant.—R. W. F.—Portable.—R. B. W.—Fisherman.—Glatton.—Temeraire.—Procelia.—A Laundry.—A. E. B. J. Hughes.—Dextrose.

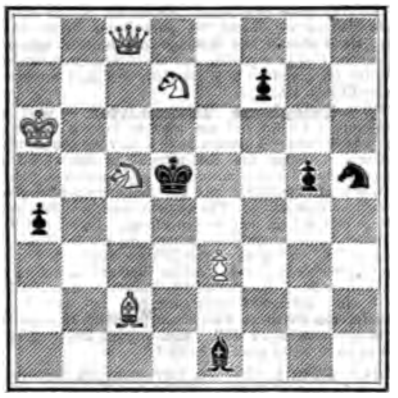
BUSINESS MAN. (It is constitutional, and the remedy is to avoid whatever brings it on, and to improve the general health by exercise, &c.)—VITAL AIR. (Certainly not poisonous; but we do not understand about the "crude substance" in oxygen. Better read up a textbook of chemistry.)—UHR. (We know of no other; but there is much information in back volumes.)—PUZZLED. (They can be brazed with spelter.)—WHEELDON. (See indices of recent volumes. The "battery" is a costly source of the electric light. At Mr. Swan's stand at the Inventions you can see the electric light applied to a lantern.)—E. C. (We know only the mirror device.) J. W. G. (They are not spliced at all; they should be moulded in a ring. 2. Coat the parts with borax as a flux.)—C. H. (See index, published last week.)—DUILIO. (Directions for making crystoleum pictures were given in No. 936, p. 597. See also the indices of subsequent volumes.)—ANXIOUS TO LEARN. (See No. 883, p. 108, for Gresham's automatic vacuum brake. They have nearly all been illustrated in back volumes, but vary in details. The vacuum is made by an ejector on the engine, usually consisting of the air-pipe within a steam-pipe. When steam is ejected in a thin ring, it draws the air with it, and the drums under the coaches collapsing through the pressure of the outer air, the blocks are brought on to the wheels by the rods. In the automatic arrangement a constant vacuum is maintained either by a small pump, or a small ejector, and when air is admitted either purposely or through breaking of the pipes, the blocks are put on by the air compelling the drums to move. If you will tell us the name of the brake, we will give you a more complete answer.)—SOFT BRAIN. (We have not an almanac of that date; but think we can safely say "no." Neither have we a table of eclipses to come.)—ASTRON. (Apply to the Secretary, Mr. W. H. Davies, Irvine-street, Liverpool.)—PERSEVERANCE. (Many given in back volumes. Raw linseed-oil 10oz., lac varnish 5oz., wood spirit 5oz. If wanted dark add a little alkanet root. Shake well before using.)—HANKEY. (First question answered so recently as p. 42, under head Lightning Paper. 2. See the indices or textbooks of chemistry.)—CHEMICAL STUDENT. (If you cannot find the information in the Science Directory, write direct to the Secretary at South Kensington.)—LEATHER. (Thomas and Co., Cheapside, E.C., exhibit one at the Inventions. We do not know of a treatise on the subject.)—IMPROVEMENT. (Balkwill's "Mechanical Dentistry" is suited to the pupil, mechanical assistant, and young practitioner; Cole's "Manual of Dental Mechanics" includes an account of the materials and appliances used in mechanical dentistry. See, however, the catalogue issued by Messrs. Churchill, 11, New Burlington-street, W., who publish the above-named works.)—NEW READER. (See No. 1026, p. 266.)—COIL T. H. (Kindly look through the index published last week.)—AN ENGINEER. (We do not know to what you refer.)—M. M. (It is probably composed of glue 1, glycerine 4, and sufficient whiting to colour and stiffen. Cut out, melt, and pour it back, removing bubbles by drawing a card over the surface whilst still liquid.)—HORNSEY. (An article about it on p. 405 of the last volume. 2. Do you mean "Ice at High Temperatures" on p. 204, No. 815?)—E. WOOD. (There is no useful book on the subject. Surely there has been enough in back numbers.)—INQUIRER. (We never heard that it did, and see no reason why it should.)—NELSON. (Dissolve red sealing-wax in methylated alcohol, or add some dragon's blood to shellac varnish.)—S. J. (We do not know of any. Look out for advertisements in local papers.)—C. J. D. (A simple hot-air engine was illustrated on p. 369, No. 796. See index to Vol. XXXIII.)—INTERESTED READER. (It depends on what you want to keep. 2. Could not the secretary of the club give you the information?) A YOUNG SUFFERER. (Better consult a medical man. The gall ointment is only for hæmorrhoids.) WOOD-CUT. (For "cleaning engravings," see pp. 44, 169, Vol. XXXVI., and many other places in back volumes.)—LITHO. (Japanned iron will not do. You could find out by procuring the specification of the patent, or from the Litho Plate Co., 56, Farringdon-street, E.C.)—SLEEPY ONE. (You will find a number of alarums in back volumes. A tea-tray knocked down by the descending weight of a clock is said to be infallible.)—LIVERPOOL. (Had you looked in the index published last week you would have found that there was something about browning gun-barrels on pp. 87, 109, of the last volume.)—J. B. NEWTON. (The question has been frequently answered, even recently. There is no such thing as a "best battery" for the purpose with the zincs to "always remain in." See the index issued last week.)—HENRY LOVE. (The Balanced Float Water Motor is exhibited by Mr. Sealy Allin, stand 406, Middle-court, Inventions. If you can wait a little while, you will probably find full particulars in our pages.)—ENGINE-DRIVER. (Must know the character of the audience or of the members of the society, before any useful advice can be given. Do you mean papers are to be read by way of lectures and discussions taken on them, or merely a sort of "penny reading"?)—A. W. J. (It is not uncommon. Many fluent writers are poor speakers; but in your case we should think there is some constitutional weakness akin to that which troubles the stammerer. Practise reciting alone, and you will probably overcome your difficulty.)—RUSTIC. (You had better write and ask the company. Previous replies from them are much of the nature of gratuitous advertisements, and your query looks very much as if it were meant to elicit another.)—JOHN KEAN. (We had no more space to spare; besides which, it is impossible to substitute replies just when readers please.)—SAND-RAT. (We should be glad to insert the papers you offer on moulding. For the rest, you should apply to any respectable printer or publisher. You might do as other correspondents have done—publish your book in instalments in our columns, and then offer the right of reproduction as a volume to some publisher.)—A SUFFERER. (Well steam your face at night by holding it for some minutes over a tub of hot water, and then well shampoo it with your fingers with a little paraffin. This softens the hard fatty obstructions in the skin, and renders them softer and easier to get rid of.)—JOHN TAYLOR. (We have inserted your query, and that is all we can do. You must watch for the replies. Our columns are meant for the benefit of regular readers, and not for those who send queries and expect us to point out which numbers the replies appear in.)—H. B. F. AND OTHERS. (We get no further in discussing "What is Creation?" and must abandon the subject for want of space.)

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLVIII.—ORLANDO.

Black.



White. [6 + 6

White to play and mate in three moves.

This is the last three-mover in the Tourney.

SOLUTION TO 956.

White.	*Black.*
1. Q-K 8	1. K-K 4 (*a*)
2. Kt-B 5	2. Anything
3. Q or B mates	
	(*a*) 1. Q takes R (*b*)
2. Q-Q B 6, &c.	
	(*b*) 1. Q takes P, or B, or Q-Q 2, or Bsq, or K B 2 (*c*)
2. Kt-B 6 (ch), &c.	
	(*c*) 1. Q takes Q Kt (*d*)
2. Kt takes Q, &c.	
	(*d*) 1. Q takes KKt (*e*)
2. Q takes Q, &c.	
	(*e*) 1. Q-K 4 (*f*)
2. Q-Q R 4, &c.	
	(*f*) 1. R-Kt 8 (*g*)
2. Kt-B 5 (ch), &c.	
	(*g*) 1. P-Q Kt 4 (*h*)
2. Kt-B 6 (ch), &c.	
	(*h*) 1. Any other move to prevent 1. B-Q R 2
2. Q-Q R 4, &c.	

This position requires a Black Pawn at Q R 2.

NOTICES TO CORRESPONDENTS.

AUTHOR'S correct solutions to 955, by F. O'N. H. (very good).

TO 956, by B. Fison (clever and complicated), J. A. Miles (very good problem, not easy), R. A. Bennett, E. S., H. Culmer (the only two correspondents who have discovered the fatal imperfection in the problem), F. O'N. H. (much ado about nothing), A. S. Olver (complicated and fine, but several duals).

TO 957, by J. A. Miles (seen at first glance), Streetgate, A. S. Olver (the two P's on Q-Kt file seem superfluous, as the K on Q-Kt 4 would answer all purposes), E. S., R. A. Bennett, and H. Culmer.

T. CLOTHIER, H. BALSON.—Names entered.

T. RUSSELL.—Game received, with thanks.

THERE still remain two vacancies in the Game Correspondence Tourney.

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Indexes for Vols. I., VI., VII., VIII., and IX., 2d. each. Post f 2½d. each. Indexes to Vol. XI. and to subsequent vols., 3d. each, post free, 3½d. Cases for binding, 1s. 6d. each.

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Dynamo, Siemens armature, 6in. long, 2½ diamet beautifully finished; photo. on application; also "Engineeri volume XXXVI., July to December, 1883; volume XXXVIII. 1884, not bound, also numbers for January, February, June, Exchange for hand Sewing Machine, preferably "Howe" "Prima Donna," or offers, separately or together.—H. PADGHAM, Malpas-road, Brockley.

Two magnificent **Models** of an American Sal Steamer, 48in. long, "The Bristol," and H.M.S. "Devastation," long, made to Admiralty drawings (guaranteed), both to scale, minute, under glass cases, inspection invited, value £250; part change.—49, Goodhind-street, Bristol.

"Knight's London and Timbs' Curiositie complete in 32 numbers, cost two shillings each. What off Exchange.—T. GORMAN, Hawthorn-road, Kettering.

Wanted, **Stereoscopic Camera**, complete, extra slides for dry plates. Good exchange. Microscopic Slides —Full particulars on foreign postcard to CHURCHILL, Gibraltar.

Emery Wheels.—Will exchange three for be stock, &c.; also genuine foster mother for incubator.—T. H., Iv stone, S. Devon.

Lathe, back-geared, part finished, 6ft. oak bed, fa with iron, double crank, 4-speed turned wheel, gut, iron standa exchange mutual.—W. SMITH.

Perambulator Wheels, ⅝ rubbers, axles turn complete; approval. Anvil, 2½ cwt., lot tools, 14 gallon tank; change offers.—W. SMITH, Bilston-road, Wolverhampton.

Model Printing Press, with three lots type. Breech-loading Gun. Silber Lamp. Offers for above.—FLO 139, Portobello-road, Notting Hill, London.

Horizontal Slide-Valve Engine and Boil in good order, cost, when new, £1 10s.; cylinder, ⅝in. bore; stroke; flywheel, 4¼in. diameter; engine bed, 1ft. long; boiler, long. What offers to value of 35s.?—R. HEWETT, 14, stre t, Luton.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, OCTOBER 2, 1885.

WOOL AND WOOL FIBRES.*

IN reviewing, on p. 342, Vol. XXXIV., Dr. Bowman's "Structure of the Cotton Fibre," we mentioned that its publication had been delayed because the author purposed at one time to add some chapters on wool. No one will regret that the two works have been published separately, for they are examples of the kind of technical books which are much wanted. The present volume contains the full text, with additions, of five lectures delivered to the students of the Bradford Technical College and the members of the Dyers and Colourists' Society in the early part of this year. These lectures are far from exhaustive, and, as no one knows better than Dr. Bowman, form only the commencement of a scientific investigation of the nature and relations of the cotton and wool fibres, so far as their structure and technical applications are concerned. A wide field is still left untouched; but partial knowledge is better than none, and textile workers will thank Dr. Bowman for what he has already done with much labour and experimental research. The author is a microscopist, a chemist, and a trained student, as evidenced by the "D.Sc." after his name; but he is more than is implied by those facts, for he has himself erected and worked all the machines used in the spinning of worsted yarns, and is consequently justified in saying that he is better qualified than many to undertake the work, because few who have had the necessary scientific training, have had also the practical experience. Even Dr. Bowman has had to rely on the assistance of friends for some of his facts—those, for instance, connected with the breeds of sheep, &c., while the samples of various yarns and wool, which formed the subjects of his experiments, were supplied by friends in Bradford, Halifax, and elsewhere. The first lecture deals with the importance of technical knowledge, without hinting even at the "necessity" for State aid to science, and yet Dr. Bowman writes: "The day is gone by when we can expect in this country to hold our position as a manufacturing nation unless we bring to bear upon all our processes the advantages which a thorough knowledge of the nature of the raw materials which we use alone can give." He has a robust faith in the intelligence and energy of his countrymen, and asks for a sound technical education and as thorough a knowledge of the raw material as can be obtained. He knows that simple absence of knowledge has in the past been productive of much annoyance and pecuniary loss to the trade—where, for instance, the lustre of the wool has been destroyed by the chemical means used to cleanse it, or the staple has been broken and destroyed by imperfect construction or bad setting of machinery.

The spinner and weaver are, as a rule, distinct from the dyer and finisher, and the former seldom consider the processes to which the goods are to be submitted by the latter. The influence of temperature upon the wool fibre is a very important point in determining the after-strength and lustre of the fabric, as well as the power of the fibre to receive the dye, but it is rarely that the thermometer is requisitioned in the washing process to determine the heat of the water. Rule of thumb is to test by the hand or by the haphazard turning in of steam, a process which Dr. Bowman says, between two different conditions of the body or two different individuals, will not be the same within a very much wider range than we should imagine possible without making the experiment. What is wanted is an intelligent comprehension of every process, and the co-ordination of each to the after-treatment of the fibre, so that every step shall be a step in the right direction, and none of which need be retraced, or require a subsequent step to correct. Through a want of knowledge amongst the different workers it not unfrequently happens that some of the means employed in the earlier stages of manufacture are absolutely detrimental to some subsequent process, and even render it impossible to achieve the results aimed at. Between fibres of vegetable and animal origin there is one great chemical difference, for the basis of vegetable cells is a substance composed, when pure, of carbon, hydrogen, and oxygen, which has very little affinity for other bodies, and which can scarcely be acted upon by any reagents except strong acids and alkalies. This substance is named cellulose. In all animal fibres the base is gelatine or an albuminoid allied to it, which, while containing the same elements as cellulose, possesses also nitrogen and sulphur: hence its structure is much more complicated. The cells of vegetable fibres are larger than those of animal fibres, and as there are consequently a greater number in a given length, vegetable fibres have less tenacity, as a rule, than those of animal origin. It was long ago discovered that it was possible to do with animal fibres what could not be done with vegetable fibres—felting, for instance; but it was not until powerful microscopes were brought to the assistance of the investigator that the cause of the different behaviour of apparently similar fibres (to the naked eye) was understood. There are mechanical differences between the two kinds of fibre, and there are also chemical differences, small it may be, but very important in view of the processes to which the raw material is subjected in the factory.

In order to render this matter clear to his readers, Dr. Bowman devotes several pages to a description of the two typical vegetable fibres, cotton and flax. Cotton is the fibrous material which envelops the seeds (fruit) of various species of the genus Gossypium, and it is a curious fact that cultivation has rendered these fibres better adapted for the work they are called upon to perform by the manufacturers of cotton goods. When examined under the microscope the fibres, as they are removed from the boll, or seed, present the appearance of continuous twisted and flattened or collapsed tubes with a distinct cellular structure, the specimens taken from a whole bale of cotton differing only in regard to the nature of the internal cavity of the tube and the thickness of the tube walls. In immature cotton, the fibres are pellucid and ribbon-like; but when it is ripe the tube-walls are distinct and well defined, with a more regular and perfect twist—the peculiar characteristic upon which depends to a large extent the power possessed by cotton of forming a strong thread, or yarn, as it is technically termed,—the friction necessary to prevent the fibres drawing out when under tension being obtained by the interlocking of the twists of the fibres. The various classes of cotton differ in the amount of this twist, as well as in the length and fineness of the fibre, but the "twist" is the characteristic feature, and makes the fibre easy of detection in mixed goods. American cotton may be taken as the typical fibre, and that has an average length of one inch, with a diameter of about 1-1200th of an inch. Sea Island cotton is longer and finer, the diameter being about 1-1560th of an inch, and the average length 1¾in. Perhaps the principal reason why cotton holds so prominent a place amongst vegetable fibres is the fact that it requires little preparation before it is ready for the processes of manufacture. As soon as the boll, or seed capsule, is ripe it may be picked, and the separation of the fibre from the boll by the ginning operation is all that is necessary to produce cotton ready for the market; in the case of most other vegetable fibres the stems, branches, or leaves of the plant are used, and several preliminary operations are required before the raw material is ready for the manufacturer. Amongst animal fibres, silk, from its intrinsic beauty, is the most important, and Dr. Bowman devotes some pages to it; but the wool industry covers a wider field, and is certainly of more interest in this country. Silk is really a stiffened gum secreted from the body of a worm; wool is an entirely different substance, and more nearly resembles hair, from which it differs in appearance only by the possession of a wave-like structure. Dr. Bowman introduces the subject of wool fibres by a dissertation on hair, in the course of which he introduces a plate showing a portion of a human hair magnified 175 diameters. The whole surface of the hair above the termination of the inner root-sheath is coated externally by a firmly adherent, thin membranous layer of flat, imbricated, epithelial scales, which have their free margins directed to the unattached end of the hair; but in order to see these scales and to comprehend the effect they must have when a number of hairs are placed in close juxtaposition it is necessary to treat the hair with some reagent, which to a certain extent disintegrates its component parts, and allows the free edges of the scales to stand up, as it were, and present what may be termed a series of serrations all over the fibre. In a typical fibre, such as is obtained from the merino sheep (one of the most valuable and beautiful of all animal fibres), the pointed and serrated edges of the epidermal scales are well shown under a power of 250 diameters after the fibre has been treated with caustic soda, and it will be readily understood that if two similar fibres are placed close together with the free edges of these scales pointing in opposite directions, the two fibres will become locked together in the most intimate manner. Wool differs from hair in this respect, that the free margins of the scales are much longer and deeper, and are pointed rather than rounded; but various specimens of wool also differ amongst themselves, and it is notable that in proportion to the care taken in breeding—that is, in securing the survival of the fittest—so does the fleece of the sheep contain fewer hairy fibres and more true wool. These differences in the character of the wool obtained from different kinds of sheep being recognised, the importance of investigating in the scientific manner the nature and properties of the various raw materials commonly called wool becomes at once apparent, and that is technical education in its true sense.

We cannot, however, follow Dr. Bowman into this branch of the subject: we can recommend all who are interested in the woollen trade to study his work, to make original investigations, and to add, if they can, to our knowledge of the subject. To many it may seem that the woollen manufacture is practically perfect, but those who know most about it are the first to acknowledge that there is a great deal more to learn, especially in connection with the various processes and the effects of some operations on the subsequent treatment, notably in dyeing. To place students in a position to carry on the work so well begun by Dr. Bowman is the object of this volume, which is a model of what a technical manual should be, and, in the words of the author, will, we hope, form the nucleus around which will be gathered a wider knowledge both of the principles and processes employed in the textile arts.

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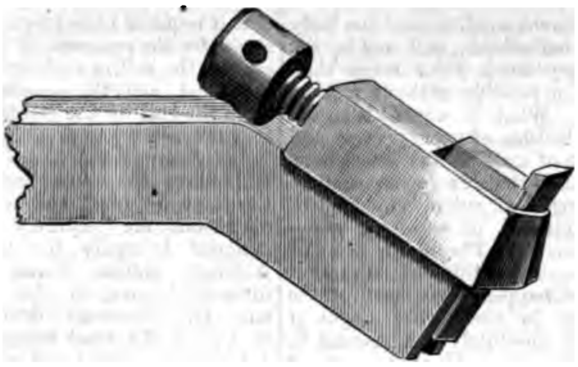
* The Structure of the Wool Fibres. By F. H. BOWMAN, D.Sc. Manchester: Palmer and Howe; London: Simpkin, Marshall, and Co.

VOL. XLII.-NO. 1,071.



THE HAYDON CUTTER BAR.

THIS useful appliance bids fair to come into use in the workshops of amateurs and others to a far greater extent than appeared probable when Mr. Haydon first called attention to its merits. Those who have given it a fair trial have found that difficulties attending its use are, in reality, imaginary, and that nothing can exceed it for convenience and general utility. The price asked has, however, rather stood in the way of its adoption, and we are, therefore, glad to call attention to the bar recently issued at 10s. 6d. by the Britannia Company, of Colchester. It is got up in a plain, workmanlike form, suited for use and not for ornament, and is accurately made from a pattern bar that was certified correct by the inventor.

Printed directions for its use and for grinding the cutters are sent with each tool, so that failure in metal-turning will be almost impossible. The cutters of ¼in. square steel bar can be made by the amateur, and renewed at pleasure without the use of a forge, rendering him independent of professional assistance.

Directions for Using the Haydon Cutter Bar.

The shank must lie flat on the table of the slide-rest and must never be tilted up at either end to raise or lower the point of the tool.

The point of the cutter must never stand higher than the level of the top of the bar, and will work best low down in the sling, as there will be less tendency to "catch in" and break.

If, when thus placed, the point falls below the level of the lathe centres, which is the height at which it is to stand, the shank of the bar must be blocked up with a parallel bar of metal placed under it upon the tool plate of the rest.

In whichever direction the tool is made to traverse the second or following edge is to stand nearly parallel to the work,—these tools not being intended to be used as "end-on" tools, but as distinctly double-edged ones, with a leading and a following edge at work simultaneously, the following edge leaving the face of the work in a highly finished state, bright as a looking-glass if a lubricant is used with the final cut.

In order to place the second edge in a position approximately parallel to the work the bar can be laid at any desired angle on the table of the rest, or the tool can be ground so as to bring its edges into the required position.

For merely a rough cut the bar can be used more as an "end-on" tool; but in finishing, the parallelism of the second edge is important.

Grinding the Cutters.

The principle of this bar, which is bent at a definite angle, is that three faces require to be ground—viz., two lower ones to give clearance and the upper face, the inclination of which determines the acuteness of the two cutting edges. The formation of the two lower faces produces a front line at which they meet. The upper face is ground to a given angle with this front line.

The *plan angle*—i.e., the angle at which the lower faces meet—may be of any desired size; but for general work a normal angle of 120° is about the best, as it will give a stronger point than one of 90°, the latter, or a still smaller one, being, however, necessary for getting into corners and for screw cutting. The larger the angle made by the top face with the front line already alluded to, the blunter will be the cutting edges. If this angle is 55° the cutting edges will be 60°, which is a good angle for general work in iron. If the plan angle is 90° the top face must be ground to 45° with the front line to give the same angle.

To grind the lower faces to give proper clearance, the cutter is raised in the sling, so as to raise the point somewhat above the bar. The bar is then laid on a block of wood on the grindstone frame, of such thickness as to give a clearance of about 3°. The thicker the block or the higher the tool in the sling, the greater will be the clearance. The two lower faces having been formed, the tool is to be taken out of the sling and reversed, so as to bring the top face outwards. It can thus be held and ground by hand without injury to the sling.

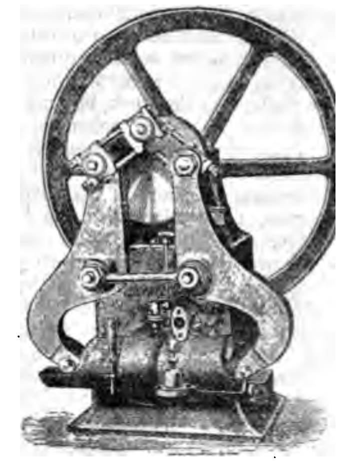
Angles are easily gauged by notches in a piece of tin or thin steel plate. A notch made with a saw file will make a 60° gauge for cutting edges. A notch made with two such files held together will give 120° for the front-angle gauge of a normal tool. There are also some files sold for machine knives with one angle of 120°, and two of 30°. If the piece of tin be shaped as a triangle, of which one side is at 3° to the base, this will also form a gauge for the clearance if stood on the lathe-bed and brought against the lower faces—*not the front line* of the cutters, when the bar is in its place upon the rest.

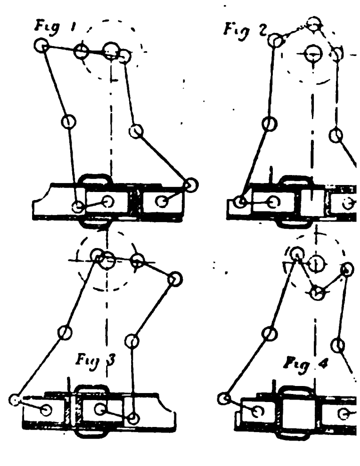
AN ELECTRO-MECHANICAL CLOCK.

A SELF-WINDING clock, which dispenses with heavy weights or powerful springs, and can be trusted to keep at work without attention from one year's end to another, is certainly a desideratum, especially if it can also be synchronised at stated intervals with a master clock or regulator keeping absolutely correct time. Such a clock can be seen at 29, Leadenhall-buildings, Leadenhall-street, E.C., where Mr. B. F. Watkins has a number connected by wires in series to show the method of regulating all the clocks in a factory or of keeping a uniform time at all the stations of a railway line. Instead of using the long and powerful springs necessary for eight-day clocks, we find here a small spring which has sufficient tension put upon it normally to keep the clock to which it is attached going for one hour. Beneath the spring, and connected to its barrel by gearing, is a little electro-motor, worked by a single Leclanché cell, which at stated times, usually at the hours, is set in motion for six seconds, and puts sufficient tension on the spring to keep the clock in motion for one hour—that is, when the mainspring has been wound by the action of the electro-motor, there is sufficient tension in the spring to last for two hours. At each hour, or at any other division of the dial to which the mechanism may be set, circuit is made with the battery, and the motor at once begins to wind the clock, an operation which occupies six seconds—a very little power sufficing, as the friction is reduced to a minimum. The contact maker is ingeniously contrived, and any desired number of clocks may be arranged in series up to the full capacity of the battery. In practice, however, where clocks are arranged in series, it will be with the object of synchronising them at stated intervals, which may be at any position of the long hand on the dial, and each clock will, therefore, have its battery cell working the magnet and armature by which the mechanism is operated. In the case of a railway, the ordinary telegraph lines will be utilised, and a signalman or stationmaster can have his clock synchronised with the regulator or master clock by simply sending, at any of th
intervals during the day, the req
switch the clock into the circuit.
pose the hour is the appointed i
then at any hour when he is lea
a few minutes before the long
reaches the XII., the signalman will
request for the switch, and when the r
marks the completion of the hour, the
the signal-cabin will be automatica
chronised, the long hand being moved
if slow, backward if fast. Where tel
are in use the batteries employed wi
can be utilised for working all the
in a building; but it will be better
separate batteries, which, being called
six seconds' work only in each hour,
fairly expected to last without renew
about two years, the only attention
quire being the addition of a little w
that used for the solution is evaporat
making a small spring, automatically
at every hour, do the work of the heav
springs now in use, a great deal of frict
unnecessary strength of parts are obviat
the clocks keep better time, while a nu
cheap clocks can be easily synchronis
an absolutely correct timekeeper.

ATKINSON'S DIFFERENTIAL ENGINE.

ON p. 272 of the last volume we all
the novel exhibit amongst gas-
shown by the British Gas-Engine a
gineering Co. (11, Queen Victoria-street
at the Inventions. It is one of the f





novelties shown at the Exhibition; but
mises to be as useful as it is novel. The
was filed by Mr. Atkinson in the early sp
this year, and in the course of two mon
drawings, patterns, and engine were
and completed. In these circumstance
the fact that the engine has run so well
volumes in its favour. Recognising t
that the limit of economy had been
with the well-known Otto engine, the i
of this novelty determined to strike out
line, and endeavour to save some of t
wasted through the water—a loss which

ıgines amounts to about 50 per cent.,
to the cooling action of the water on the
ɜr and its contents. He obtained his ob-
causing the gases to expand much more
r, thus shortening the time in which they
contact with the cooling walls of the
er; and in accomplishing that he devised
gine which dispenses with slide-valves
eir gear, and in which the wearing parts
the simplest and most easily replaced
consisting as they do of round pins or
gs and pistons. Further, there is no joint
engine that is ever subjected to a higher
re than 10lb. The perspective engraving
ive an idea of the general appearance of
gine, and the diagrams, Figs. 1 to 4, will
o explain the motions of the pistons.
ylinder is alternately a pump and
rking cylinder, and one piston is
a working piston and the other
mping piston. In Fig. 1 the two
s are close together, having just ex-
the residual gases from the previous
. In Fig. 2 the pumping piston (that
left) is shown travelling at a quicker rate
he working piston, and drawing in a uni-
charge of gas and air, through a self-
suction valve, which, as it is never
pressure, does not require to be tight,
voiding trouble in the matter of adjust-
as well as friction and consequent wear.
is point, or a little later, the working
closes the inlet and exhaust openings,
valve having shut in the charge, the
is compressed to about 60lb. by the
ce of the working piston. Just at this
nt the pumping piston passes the igniting
Fig. 3, and the explosion drives the
ng piston to the position shown in Fig. 4.
orking piston continues its outward move-
opens the exhaust, and, being followed by
umping piston, the residual gases are
n out, and the pistons return to position
n in Fig. 1. It will be noticed, by
ng carefully at Fig. 3, that during the
sion the pumping piston may be said to
actically stationary, and thus acts as a
der cover. It will be seen also, on com-
g Figs. 2 and 4, that the space between the
ns occupied by the exploded charge is
larger than that into which the charge
awn (Fig. 2); consequently the original
nts are expanded to nearly double the
ne, and are emitted at a much lower pres-
than usual with engines of other types,
of which have an exhaust pressure of as
as 40lb. This expansion, too, takes place
ne-fourth of a revolution, and the rapid
n of the working piston, which means
ess time for the charge to be subjected
e cooling action of the water-jacket, ex-
s theoretically the considerable economy
ned in the "differential" engine. We
rstand that about 40 per cent. of the total
y contained in the gas is realised. The ig-
g tube is kept red-hot by means of a burner
e Bunsen type, and consequently wears
but as these tubes cost a merely nominal
it is cheaper and less troublesome to re-
them than it is to clean one of the ordi-
slides. At first sight one might imagine
was a great deal of extra friction in such
ngine; but an examination of the diagrams
n herewith will show, when it is remem-
d that there are no slide-valves, that the
design compares favourably with others,
gives promise of being as useful as it is
l. For instance, referring to the positions
he crank-pin and the connecting-rods, as
n in Figs. 2 and 3, it will be observed that
ig. 2 the intake charge of air and gas has
completed, and that the compression here
mences and is continued to a point slightly
nd the position shown in Fig. 3, when the
ecting-rods are in a straight line. During
portion of the cycle the motive force de-
d from the momentum stored up in the fly-
el is transmitted through the crank-pin
connecting-rods in the best possible manner
z., when the resistance due to compressing
charge is slight, the motion transmitted
ugh the "toggle" joint, formed by the
ecting-rods, is quick, but as the resistance
eases towards the end of the stroke, and the
ecting-rods straighten, the motion becomes
er until the rods are actually in a straight
when it ceases altogether. Advantages
similar kind are obtained in other portions
e cycle. Thus, in that part from Fig. 4 to Fig. 1, when the left-hand piston is expelling the products of combustion and the resistance is merely nominal, the crank-pin is at such a position as to give a very rapid motion to the pumping piston.

CHEMISTRY OF PIGMENTS.—III.*

By J. M. Thomson, F.R.S.E., F.C.S.,
Demonstrator of Chemistry at King's College, London.

Chromes.

NEXT to the ochres, the most important group of yellow pigments are the chromes, which are produced by the combination of chromium, in the condition of chromic acid, with the metals lead, zinc, barium, strontium, or calcium. They are divided into two large classes—namely, "yellow" and "orange" chromes—and I must content myself with showing you generally how these different conditions are attained, without entering into the details of their special preparation. The yellow chromes may be obtained by the precipitation of a salt of the metal from which the chrome is required, with neutral potassium chromate, as you see on the table before you. In this jar I have a solution of barium nitrate, which, on the addition of a solution of potassium chromate, yields us a brilliant yellow precipitate of barium chromate. In the same way the lead chromate may be prepared, and obtained as a yellow powder of considerable brilliancy and density. The chrome which we have here produced is what is technically termed "lemon chrome," but by mixing this with some other white pigment a lighter shade may be made. This is generally done by mixing with lead sulphate, and we must not, in such a mixture, regard the sulphate of lead added as placed there for the purpose of adulteration, but only as a diluent to the chrome colour. The chromates of barium, zinc, strontium, and calcium all possess shades comparable with that of the lemon chrome.

Orange Chromes.—These pigments consist of the basic lead chromate obtained by slight differences in the method of preparation, and are generally formed by boiling the neutral chromate with caustic alkali, by which means the chromate associated with an additional quantity of lead oxide is produced. The formation of a simple orange chrome can be easily shown to you by boiling, as I now do, a little of the lemon chrome with caustic lime; you see that, as the temperature rises, a darkening in colour takes place, which may be increased at will by still further heating. If we regard the neutral lead chromate as possessing the chemical composition $PbCrO_4$, the orange chrome formed from it would have the composition ($PbCrO_4$. PbO), and will evidently be produced by processes of oxidation. In fact, one of the methods adopted for its preparation—namely, that one in which it is formed by adding the neutral chromate to ordinary nitre in a red-hot crucible—depends on this property. The objection to the chromes as pigments depends on the action of alkalies upon them, which, as we have seen, produce this darkening effect, and, if in excess, exercise a solvent action on the substance. The colours, of course, formed by lead chromate are subject to the same action of sulphuretted hydrogen gas as other lead pigments. Processes of reduction also affect the chromes, giving to them a slight green tint; such a reduction being produced by organic substances with which the colour may be mixed. I have here a small quantity of lemon chrome, which I mix in this tube with a little strong hydrochloric acid and alcohol, when you perceive that, on boiling, the colour rapidly changes, the chromate being dissolved, and, finally, the mixture changing to a green colour, this reduction being produced by the alcohol. The admixture of other bodies with the chromate of lead, such as calcium, or lead sulphates, does not seem to interfere with the colour unless carried to too great an extent, as is done in the case of "Cologne yellow," which contains a large admixture of these two bodies. Before leaving the yellow pigments yielded to us by lead, there is one substance which might be mentioned, from the brilliancy of its colour, but which is not to be recommended as a durable pigment—that is, the lead iodide. This substance is formed by bringing together solutions of lead nitrate and potassium iodide, when we obtain a beautiful canary-coloured precipitate of considerable body. This pigment, however, apart from its decomposition with noxious gases, is easily soluble in hot water, becoming converted into a crystalline variety, which is deposited in that condition on cooling. Other yellow colours containing lead are found in the pigments formed from Massicot (PbO), and in "Turner's yellow," which is apparently an oxychloride of lead. I now come to two yellow pigments which are definite in their composition, and, in one case, permanent in colour; these are yellow orpiment, or "King's yellow," and "cadmium yellow," the first of these being a sulphide of arsenic, the second, sulphide of cadmium.

King's Yellow may be formed by subliming together flowers of sulphur and arsenious acid, or by making a solution of arsenious acid in water acidulated with hydrochloric acid, and passing a current of sulphuretted hydrogen through the solution. The pigment obtained in both cases has the arsenic tersulphide for its basis, but the body prepared by sublimation generally contains small quantities of free arsenious acid. King's yellow forms but a poor pigment without much durability, and when containing free arsenious acid is poisonous. Another yellow may be formed from arsenic by fusing together litharge (lead oxide) and arsenious acid, and is sold under the name of "mineral and arsenic yellow"; the fused mass must be thoroughly ground to secure perfect homogeneity of the pigment.

Cadmium Yellow.—Sulphide of cadmium prepared in a manner similar to that indicated for King's yellow may, I think, be regarded as one of the most permanent of the yellow pigments. It mixes well with other colours, and, as it is not easily decomposed, has no tendency to deteriorate lead pigments. It may be obtained in different shades, according to the proportions in which the ingredients forming it are taken, this constituting a little difficulty in its preparation for the trade. You can readily judge of the ease with which it may be obtained by my adding some sulphuretted hydrogen to this large vessel of water, containing a little of a salt of cadmium, when a brilliant yellow precipitate of cadmium sulphide is obtained. The last yellow pigment to which I would specially draw your attention is the one which is sold under the name "Aureolin." It is a somewhat complex compound produced by the precipitation of a salt of the metal cobalt with potassium nitrite, when the solution is strongly acid with acetic acid. In this flask I have such a solution of cobalt sulphate rendered acid with acetic acid; to this I now add excess of potassium nitrite. At first no precipitate is seen, but on standing a brilliant yellow powder, consisting probably of the double potassium and cobalt nitrite, begins to be formed, this increasing on the mixture being allowed to stand. This pigment, when prepared in a pure condition, is strongly to be recommended, as it is entirely unacted upon by gases containing sulphur, and, when in a pure condition, withstands the action of weak alkalies. Various other bodies yield us yellow pigments of greater or less brilliancy and durability, such as Turner's yellow, and the yellows sold under the names of Cassel, Montpelier, and Verona yellows, which are all oxychlorides of lead. They are not worthy of special notice, and I will therefore content myself with merely mentioning them. In my next lecture I propose to take up the consideration of certain pigments yielding us green and blue colours. The following tables give some of the more common pigments, arranged in groups according to their more or less poisonous properties:—

FIRST GROUP.

PIGMENTS DANGEROUS TO HEALTH.

Orpiment (arsenic sulphide).
Realgar.
Mercury biniodide.
Turbith mineral.
Lead arsenite.
Lead oxychloride.
Lead sulphate.
Cobalt arseniate.
Verdigris (copper-acetate).
White lead.
Massicot.
Litharge.
Minium.
Naples yellow (lead antimoniate).
Scheele's green (copper arseniate).
Prussian blue.
Prussian green.

SECOND GROUP.

PIGMENTS LESS DANGEROUS TO HEALTH.

Lead chromate.
Vermilion.
Tin sulphide.
Mineral lake (tin chromate).
Copper chromate.
Purple red.
Thenard's blue.
Zinc oxide.
Zinc chromate.
Barium chromate.
Antimony oxychloride.
Cadmium sulphide.
Smalt.
Ultramarine.

THIRD GROUP.

NON-POISONOUS PIGMENTS.

Carbonate of lime.
Barium sulphate.
Yellow and red ochre.
Venetian red.
Mars red.
Cochineal or carmine.
Manganese brown.
Vandyke brown.
Raw umber.
Burnt umber.
Raw sienna.
Burnt sienna.
Cologne or Cassel earth.
Sepia.
Ivory and lamp blacks.
Indian ink.
Colcothar.
Indigo.
Terra verte.

(To be continued.)

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[*] The substance of the Cantor Lectures delivered before the Society of Arts.

BRITISH ASSOCIATION.

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THE ADDRESS IN MECHANICS.

THE address in Section G was delivered by Mr. B. Baker, M.I.C.E., president of the section. In the course of his remarks he said:—Professor Rankine, addressing you thirty years ago, said it was well understood that questions of pure or abstract mechanics form no part of the subjects dealt with in this section. With characteristic clearness of conception and precision of language he told you what the term "mechanical science" meant, and, after thirty years' interval, his words may be recalled with advantage to every one proposing to prepare an address or report for this section. "Mechanical science," said Prof. Rankine, "enables its possessor to plan a structure or machine for a given purpose without the necessity of copying some existent example; to compute the theoretical limit of the strength and stability of a structure or the efficiency of a machine of a particular kind; to ascertain how far an actual structure or machine fails to attain that limit, and to discover the cause and the remedy of such shortcoming; to determine to what extent, in laying down principles for practical use, it is advantageous for the sake of simplicity to deviate from the exactness required by pure science; and to judge how far an existing practical rule is founded on reason, how far on custom, and how far on error." There is thus an ample text for many discourses; but, as I am not writing a treatise on engineering, but merely delivering a brief address, I will confine my attention at present to a particular case of the branch of mechanical science referred to in the last clause of Prof. Rankine's definition, and will ask you to consider how far the existing practical rules respecting the strength of metallic bridges are "founded on reason, how far on custom, and how far on error." The first question obviously is, What are the rules adopted by engineers and Government departments at the present time?—and it is one not easily answered. I have for some time past been receiving communications from leading Continental and American engineers, asking me what is my practice as regards the admissible intensity of stress on iron and steel bridges, and in replying I have invited similar communications from themselves. As a result I am able to say that at the present time absolute chaos prevails. The old foundations are shaken, and engineers have not come to any agreement respecting the rebuilding of the structure. The variance in the strength of existing bridges is such as to be apparent to the educated eye without any calculation. If the wheels of a miniature brougham were fitted to a heavy cart the incident would excite the derision even of our street boys, and yet equal want of reason and method is to be found in hundreds of bridges in all countries. It is an open secret that nearly all the large railway companies are strengthening their bridges, and necessarily so, for I could cite cases where the working stress on the iron has exceeded by 250 per cent. that considered admissible by leading American and German bridge-builders in similar structures. In the case of old bridges the variance in strength is often partly due to errors in hypothesis and miscalculation of stresses. In the present day engineers of all countries are in accord as to the principles of estimating the magnitude of the stresses on the different members of a structure, but not so in proportioning the members to resist those stresses. The practical result is that a bridge which would be passed by the English Board of Trade would require to be strengthened 5 per cent. in some parts and 60 per cent. in others before it would be accepted by the German Government, or by any of the leading railway companies in America. This undesirable state of affairs arises from the fact that in our own and some other countries many engineers still persistently ignore the fact that a bar of iron may be broken in two ways—namely, by the single application of a heavy stress or by the repeated application of a comparatively light stress. An athlete's muscles have often been likened to a bar of iron, but, if "fatigue" be in question, the simile is very wide of the truth. Intermittent action—the alternative pull and thrust of the rower, or of the labourer turning a winch—is what the muscle likes and the bar of iron abhors. Troopers dismount to rest their horses, but to relieve a bar of iron temporarily of load only serves to fatigue it. Half a century ago Braithwaite correctly attributed the failure of some girders, carrying a large brewery vat, to the vessel being sometimes full and sometimes empty, the repeated deflection, although imperceptibly slow and wholly free from vibration, deteriorating the metal, until, in the course of years, the girders broke. These girders were of cast iron; but it was equally well known that wrought iron was similarly affected, for in 1842 Nasmyth called the attention of this section to the fact that the "alternate strain" in axles rendered them weak and brittle, and suggested annealing as a remedy, he having found that an axle which would snap with one blow when worn would bear eighteen blows when new or after being annealed. Soon after the introduction of wrought-iron bridges on railways, the testimony of practical working was added to that of experiments. In 1848 several girder bridges of unduly light proportions were erected in America, and one of 66ft. span broke down under the action of the rolling load. Again, in early American timber bridges the vertical tie-rods were often subject to stresses oscillating between 1 ton and 10 tons per square inch and upwards. Many of these broke, as did also the suspension bolts in platforms subjected to similar stresses. In my own experience, dozens of broken flange-plates and angle-bars, and hundreds of sheared rivets, have been the silent witnesses of the destructive action of a live load. Like evidence was afforded by early constructed iron ships deficient in girder strength. Under the alternating stresses due to the action of the waves weaknesses not at first apparent would, in the course of time, be developed. and additional strength, in the way of stringers and otherwise, become imperative. If none of the preceding evidence had been forthcoming, the result of the historical series of experiments carried out by Wöhler for the Prussian Ministry of Commerce would alone be conclusive. For the first time a truly scientific method of investigation was followed, and an attempt was made to determine the laws governing the already proved destructive action of intermittent stresses. In previous experiments the bar or girder was alternately fully loaded and wholly relieved of load. Wöhler was not satisfied with this, but tested also the result of a partial relief of load. The striking fact was soon evidenced, on testing specimens under varying tensions, that the amount of the variation was as necessary to be considered as that of the maximum stress. Thus, an iron bar having a tensile strength of 24 tons per square inch broke with about 100,000 applications of a stress varying from *nil* to 21 tons, but resisted 4,000,000 applications of the 21 tons when the minimum stress was varied from *nil* to 11½ tons. The altenations of stress in the case of some test pieces numbered no less than 132,000,000; and too much credit cannot be bestowed by engineers upon Wöhler for the ingenuity and patience which characterised his researches. As a result, it is proved beyond all further question that any bar or beam of cast iron, wrought iron, or steel may be fractured by the continued repetition of comparatively small stresses, and that, as the differences of stress increase, the maximum stress capable of being sustained diminishes. Hundreds of existing railway bridges which carry 20 trains a day with perfect safety would break down quickly under 20 trains per hour. This fact was forced on my attention nearly 20 years ago by the fracture of a number of iron girders of ordinary strength under a five-minute train service. Similarly, when in New York last year, I noticed, in the case of some hundreds of girders on the "Elevated Railway," that the alternate thrust and pull on the central diagonals from trains passing every two or three minutes had developed weaknesses which necessitated the bars being replaced by stronger ones after a very short service. Somewhat the same thing had to be done recently in this country with a bridge over the Trent, but the train service being small the life of the bars was measured by years instead of months. If ships were always amongst great waves the number going to the bottom would be largely increased, for, according to Mr. John, late of Lloyd's, many large merchant steamers afloat are so deficient in longitudinal strength that they are liable, under certain conditions of sea, to be strained in the upper works to a tension of from 8 to 9 tons per square inch, and to a compression of from 6 to 7 tons—stresses which the experiments already referred to proved would cause failure after a definite number of repetitions. Similarly, on taking ground or being dry-docked with a heavy cargo on board, it has been shown that vessels are liable to stresses of over 11 tons per square inch on the reverse frames, but no permanent injury results from such high stresses, because the number of repetitions is necessarily very limited. It appears natural enough to every one that a piece even of the toughest wire should be quickly broken if bent backward and forward to a sharp angle; but, perhaps, only to locomotive and marine engineers does it appear equally natural that the same result would follow in time if the bending were so small as to be quite imperceptible to the eye. A locomotive crank axle bends but 1-34th of an inch, and a straight driving axle the still smaller amount of 1-64th of an inch, under the heaviest bending stresses to which they are subject, and yet their life is limited. During the year 1883 one iron axle in fifty broke in running, and one in fifteen was renewed in consequence of defects. Taking iron and steel axles together, the number then in use on the railways of the United Kingdom was 14,848, and of these 911 required renewal during the year. Similarly, during the past three years no less than 228 ocean steamers were disabled by broken shafts, the average safe life of which is said to be about three or four years. In other words, experience has proved that a very moderate stress alternating from tension to compression, if repeated about one hundred million times, will cause fracture as surely as a sharp bending to an angle repeated perhaps only ten times. I have myself made many experiments with a view to elucidate the laws affecting the strength of iron and steel work subject to frequent alternations of stress. Perhaps the most suggestive series was one in which I subjected flat steel bars about 8ft. long, in pairs, to repeated bendings until one bar broke, and then testing the surviving bar under direct tensile and compressive stresses to ascertain to what extent the metal had deteriorated. It had come under my notice, as a practical engineer, that if the compression members of a structure were unduly weak the fact became quickly evident, perhaps under the test load; but if, on the other hand, the tension members were weak, no evidence might appear of the fact until frequent repetition of stresses during several years had caused them to fracture without any measurable elongation of the metal. In the case of crank-shafts, also, the fracture is invariably due to a tearing and not a crushing action. It appeared to me, therefore, eminently probable that repetition of stresses might be far more prejudicial to tension than to compression members, and, if so, the fact ought to be taken account of in proportioning a structure. This proved to be the case in my experiments. For example, the companion bars to those which had broken with 18,000 reversals of a stress less than half the original breaking weight behaved, when tested as columns 30 diameters in length, precisely the same as similar bars which had done no work at all; whereas when tested in tension, the elongation was reduced from the original 25 per cent. to 2·5 per cent., and the fracture appeared to indicate that the bars had been made of three different kinds of steel imperfectly welded together. With a stress reduced by one-fourth, the number of bendings required to break the bars was increased to 1,200,000. In this instance, the calculated maximum working stress on the extreme fibres was 48 per cent. of the direct ultimate tensile resistance of the steel, and about 80 per cent. of the stress the bar was capable of sustaining as a beam under the single application of a load. Of course, the bars failed by tension, and the extreme fibres had thus deteriorated as regards tensile stresses to the extent indicated by the above percentages. Tested as a column, however, the injury the bar had received from the 1,200,000 bendings was inappreciable. The ductility was of course very largely reduced; but ductility is a quality of comparatively little importance when a material is in compression. There is no ductility in the slender Gothic stone columns of our cathedrals, which, though heavily stressed, have carried their loads for centuries. As I found repeated bendings raised the limit of elasticity, I rather anticipated finding an increased resistance from this cause in long columns. This did not prove to be the case, nor did I find any difference in short columns four diameters in length. In addition to the preceding experiments with rectangular bars, I have tested the endurance of many revolving shafts of cast iron, wrought iron, and steel with similar results. About 5,000 reversals of a stress equal to one-half the static breaking weight sufficed generally to cause the snapping of a shaft of any of the above materials. When the stress was reduced and the number of applications increased, I found the relative endurance of solid beams to be more nearly proportional to the tensile strength of the metal than to the breaking weight of the beam, a distinction of great importance where axles, springs, and similar things are concerned. Many of my experiments were singularly suggestive. Thus, it was instructive to see a bar of cast iron loaded with a weight which, according to Fairbairn's experiments, it should have carried for a long series of years broken in two minutes when set gently rotating. Also to find a bar of the finest mild steel so changed in constitution by some months of rotation as to offer no advantages either in strength or toughness over a new cast-iron bar of the same section. Why an originally strong and ductile metal should become weak and brittle under the frequent repetition of a moderate stress has not yet been explained. Lord Bacon touched upon the subject two or three centuries ago, but you may consider his explanation not wholly satisfactory. He said, "Of bodies, some are fragile, and some are tough and not fragile. Of fragility, the cause is an impotency to be extended, and the cause of this inaptness is the small quantity of spirits." I am sorry to have no better explanation to offer, but whatever may be the immediate cause of fragility, no doubt exists that it is induced in metals by frequent bendings, such as a railway bridge undergoes. This fact, however, is not recognised in our Board of Trade Regulations, which remain as they were in the dark ages, as do those of the Ministry of Public Works of France and other countries. With us it is simply provided that the stress on an iron bridge must not exceed 5 tons per square inch on the effective section of the metal. In [illegible] still worse, as the limiting stress of a tons per square inch is estimated upon the gross section, regardless of the extent to which the plates may be perforated by rivet holes. In neither case is any regard had in the rules to intermittent stresses or the flexure of compression members. In Austria the regulations make a small provision for these elements; and American specifications make some one, the limiting stresses, instead of being constant at 5 tons, as with us, ranging from about 2½ tons to 6¾ tons per square inch, according to circumstances. It is hardly necessary that I should say more to justify my statement that, as regards the admissible intensity of stress on metallic bridges, absolute chaos prevails. Engineers must remember that if satisfactory rules are to be framed, they, and not Governmental departments, must take the initiative. In former days the British Association did much to direct the attention of engineers to this important matter; but, so far as I know, the subject has been dropped for the past twenty years, and I have ventured, therefore, to bring it before you again in some detail. We are here avowedly for the advancement of science, and I have not been deterred by the dryness of the subject from soliciting your attention to a branch of science which is sadly in need of advancement. Had I been addressing a less scientific audience I might have been tempted rather to boast of the achievements of engineers than to point out their shortcomings. The progress in many branches of mechanical science during the past fifty years has exceeded the anticipation of the most far-seeing. Fifty years ago the chairman of the Stockton and Darlington Railway, when asked by a Parliamentary Committee if he thought any further improvements would be possible on railways, replied that he understood in future all new railways would have a high earthwork bank on each side to prevent engines toppling over the embankments, and to arrest hot ashes, which continually set fire to neighbouring stacks, but in other respects he appeared to think perfection was attained. Shortly before the introduction of locomotives it was also thought perfection was attained when low trucks were attached to the trains to carry the horses over the portions of the line where descending grades prevailed, and all the newspapers announced, with a great flourish of trumpets, that a year's experience showed the saving in horseflesh to be fully 33 per cent. Although these views seem childlike enough from our present standpoint, I have no doubt that as able and enterprising engineers existed prior to the age of steam and steel as exist now, and their work was as beneficial to mankind, though different in direction. In the important matter of water supply to towns, indeed, I doubt whether, having reference to facility of execution, even greater works were not done 2,000 years ago than now. Herodotus speaks of an of a tunnel 8ft. square and nearly a mile long, driven through a mountain in order to supply the city of Samos with water; and his statement, though long doubted, was verified in 1882 through the abbot of a neighbouring cloister accidentally unearthing some stone slabs. The German Archæological Society sent out Ernst Fabricius to make a complete survey of the work, and the record reads like that of a modern engineering undertaking. Thus, from a covered reservoir in the hills proceeded an arched conduit about 1,000 yards long, partly driven as a tunnel and partly executed on the "cut and cover" system adopted on the London underground railway. The tunnel proper, more than 1,100 yards in length, was hewn by hammer and chisel through the solid limestone rock. It was driven from the two ends like the great Alpine tunnels, without intermediate shafts, and the engineers of 2,400 years ago might well be congratulated for getting only some dozen feet out of level and little more out of line. From the lower end of the tunnel branches were constructed to supply the city mains and fountains, and the explorers found ventilating shafts and side entrances, earthenware socket-pipes with cement joints, and other interesting details connected with the water-supply of towns. In the matter of masonry bridges, also, as great works were undertaken some centuries ago as in recent times. Sir John Rennie stated in his presidental address at the Institute of Civil Engineers that the bridge across the Dee at Chester was the "largest stone arch on record." That is not so. The Dee bridge consists of a single segmental arch 200ft. span and 42ft. rise; but across the Adda, in Northern Italy, was built, in the year 1377—more than 500 years ago—a similar segmental arch bridge of no less than 237ft. span and 68ft. rise. Ferario not long since published an account of this, for the period, colossal work, from which it would appear that its life was but 39 years, the bridge having been destroyed for military reasons on December 21st, 1416. I believe our American cousins claim to have built the biggest existing stone arch bridge in the world—that across the Cabin Johns Creek; but the span, after all, is only 215ft., or 10 per cent. smaller than the 500-year-old bridge. In timber bridges, doubtless, the Americans will ever head the list, for the bridge of 840ft. span built across the Schuylkill three-quarters of a century ago will probably never be surpassed. Our ancestors were splendid workers in stone and timber, and, if they had been in possession of an unlimited supply of iron and steel, I fear there would have been little left for modern bridge-builders to originate. The labours of the present generation of engineers are lightened beyond all estimate by labour-saving appliances. To prove how much the world is indebted to students of this branch of mechanical science, and how rapid is the development of a really good mechanical notion, it is only necessary to refer to the numerous hydraulic appliances of the kind first introduced 40 years ago by a distinguished past-president, Sir W. G. Armstrong. I should be sorry, indeed, to have anything to do with building the Forth Bridge if hydraulic appliances were not at hand to do a giant's work. Let me shortly describe to you what we are doing there at the present time. More than 42,000 tons of steel plates and bars have to be bent, planed, drilled, and riveted together before or after erection, and hydraulic appliances are used throughout. The plates are handled in the shops by numerous little hydraulic cranes of special design, without any complication of multiplying sheaves, the whole arm being raised with the load by a 4in. direct-acting ram of 6ft. stroke. A total length of no less than 60 miles of steel plates, ranging in thickness from 1¼in. to ⅜in., have to be bent to radii of from 6ft. to 9in., which is done in heavy cast-iron dies squeezed together by four rams of 24in. in diameter, and the same stroke. With the ordinary working pressure of 1,000lb. per square inch, the power of the press is thus about 1,750 tons. Some 3,000 pieces, shaped like the lid of a box, 15in. by 12in. wide, with a 3in. deep rim all round, were required to be made of ½in. steel plate, and this was easily effected in two heats by a couple of strokes of a 14in. ram. In numberless other instances steady hydraulic pressure has been substituted by Mr. Arrol, our able contractor, for the usual cutting and welding under the blacksmith's hammer. It would not only be impossible to build a Forth Bridge, but it would be equally impossible to fight a modern ironclad without the aid of hydraulic appliances. The latest type of battleship weighs, fully equipped, about 10,000 tons. There are about 3,400 tons of steel in her hull, apart from armour, which, with its backing, will weigh a further 2,800 tons. The machinery, largely of steel, is about 1,400 tons; the armament, including ammunition, 1,100 tons; the coals, 1,100 tons; and general equipment, 270 tons. Members of this section who visited the United States last year, not for the first time, could hardly have failed to notice that American and European engineering practice are gradually presenting fewer points of difference. Early American iron railway bridges were little more than the ordinary type of timber bridge done into iron, and the characteristic features, therefore, were great depth of truss, forged links, pins, screw-bolts, round or rectangular struts, cast-iron junction pieces, and, in brief, an assemblage of a number of independent members more or less securely bolted together, and not, as in European bridges, a solidly-riveted mass of plates and angle-bars. At the present moment the typical American bridge is distinctly derived from the grafting of German practice on the original parent stock. Pin connections are still generally used in bridges of any size, but the top members and connections are more European than American in construction, whilst for girders of moderate span, such as those on the many miles of elevated railway in New York, riveted girders of purely European type are admittedly the cheapest and most durable. From my conversations with leading American bridge builders, I am satisfied that their future practice and our own will approach still more nearly. We should never think of building another Victoria tubular bridge across the St. Lawrence, or repeat the design of the fallen Tay Bridge, nor would they again imitate in iron an old timber bridge, or repeat the design of the fallen Ashtabula bridge. In one respect the practice in America tends to the production of better and cheaper bridges than does our own practice, and it is this: each of the great bridge-building firms adopts by preference a particular type design, and the works are laid out to produce bridges of this kind. It is an old adage that practice makes perfect, and by adhering to one type, and not vaguely wandering over the whole field of design, details are perfected, and a really good bridge is the result. Engineers in America therefore need only specify the span of their bridge, and the rolling load to be provided for, with certain limiting stresses, and they can make ture of obtaining a number of tenders from different makers of bridges, varying somewhat in design, but complying with all the requirements. With us, on the other hand, it is too often the privilege of a pupil to try his 'prentice hand on the design for a bridge, and it is no wonder, therefore, that many curious bits of detail meet the eye of observant foreigner inspecting our railways. The magnificent steel wire rope suspension-bridge of 1,600ft. span, built by Roebling across the East River at New York well marks the advanced state of mechanical science in America as regards bridge-building. It is worthy of note that, at the second meeting of the British Association, held so long back as 1832, there was a paper on suspension-bridges, and the author entreated the attention of the scientific world, and particularly of civil engineers, to the serious consideration of the question: "How far ought iron to be hereafter used for suspension-bridges, since a steel bridge of equal strength and superior durability could be built at much less cost?" "I earnestly call upon the iron-masters of the United Kingdom," said he, "to lose no time in endeavouring to solve this question." In this, as in many other engineering matters, America has given us a lead. America is, indeed, the paradise of mechanics. When the British Association was inaugurated, years ago, there was, I believe, no intention to have a section for the discussion of mechanical science. Possibly it may have been considered too mean a branch. Even the usually generous Shakespeare speaks contemptuously of "mechanic slaves, with greasy aprons, rules, and hammers"; and our old friend Dr. Johnson's definition of "mechanical" is "mean, servile." We have lived down this feeling of contempt, and the world admits that the "greasy apron" is as honourable a badge as the priest's cassock or the warrior's coat of mail, and has played as important a part in the great work of civilising humanity and turning bloodthirsty savages into law-abiding citizens.

SIR J. LUBBOCK ON THE INTELLIGENCE OF THE DOG.

BEFORE a crowded sitting of the Biological Section of the British Association, Sir John Lubbock read a paper in which he gave some interesting notes on the intelligence of the dog. The man and the dog, he said, have lived together in more or less intimate association for many thousands of years, and yet it must be confessed that they know comparatively little of one another. That the dog is a loyal, true, and affectionate friend must be gratefully admitted, but when we come to consider the psychical nature of the animal, the limits of our knowledge are almost immediately reached. I have elsewhere suggested that this arises very much from the fact that hitherto we have tried to teach animals rather than to learn from them—to convey our ideas to them rather than to devise any language or code of signals by means of which they might communicate theirs to us. The former may be more important from a utilitarian point of view, though even this is questionable, but psychologically it is far less interesting. Under these circumstances, it occurred to me whether some such system as that followed with deaf mutes, and especially by Dr. Howe with Laura Bridgman, might not prove very instructive if adapted to the case of dogs. I have tried this in a small way with a black poodle named Van. I took two pieces of cardboard about 10in. by 3in., and on one of them printed in large letters the wood "food," leaving the other blank. I then placed two cards over two saucers, and in the one under the "food" card put a little bread and milk, which Van, after having his attention called to the card, was allowed to eat. This was repeated over and over again till he had had enough. In about ten days he began to distinguish between the two cards. I then put them on the floor and made him bring them to me, which he did readily enough. When he brought the plain card I simply threw it back, while when he brought the "food" card I gave him a piece of bread, and in about a month he had pretty well learned to realise the difference. I then had some other cards printed with the words "out," "tea," "bone," "water," spelt phonetically so as not to trouble him by our intricate spelling, and a certain number also with words to which I did not intend him to attach any significance, such as "nought," "plain," "ball," &c. Van soon learnt that bringing a card was a request, and soon learned to distinguished between the plain and printed cards; it took him longer to realise the difference between words, but he gradually got to recognise several, such as food, out, bone, tea, &c. If he was asked whether he would like to go out for a walk, he would joyfully fish up the "out" card, choosing it from several others and bring it to me, or run with it in evident triumph to the door. I need hardly say that the cards were not always put in the same places. They were varied quite indiscriminately and in a great variety of positions. Nor could the dog recognise them by scent. They were all alike, and all continually handled by us. Still I did not trust to that alone, but had a number printed for each word. When, for instance, he brought a card with "food" on it, we did not put down the same identical card, but another bearing the same word; when he had brought that a third, then a fourth, and so on. For a single meal, therefore, eighteen or twenty cards would be used, so that he evidently is not guided by scent. No one who has seen him look down a row of cards and pick up the one he wanted could, I think, doubt that in bringing a card he feels he is making a request, and that he can not only distinguish one card from another but also associate the word and the object. This is, of course, only a beginning, but it is, I venture to think, suggestive, and might be carried further, though the limited wants and aspirations of the animals constitute a great difficulty. My wife has a very beautiful and charming collie, Patience, to which we are much attached. This dog was often in the room when Van brought the "food" card, and was rewarded with a piece of bread. She must have seen this thousands of times, and she begged in the usual manner, but never once did it occur to her to bring a card. She did not touch or indeed even take the slightest notice of them. I then tried the following experiment:—I prepared six cards about 10in. by 3in., and coloured in pairs—two yellow, two blue, and two orange. I put three of them on the floor, and then holding up one of the others, endeavoured to teach Van to bring me the duplicate. That is to say that if the blue was held up, he should fetch the corresponding colour from the floor; if yellow, he should fetch the yellow, and so on. When he brought the wrong card he was made to drop it, and return for another till he brought the right one, when he was rewarded with a little food. The lessons were generally given by my assistant, Miss Wendland, and lasted half-an-hour, during which time he brought the right card on an average about 25 times. I certainly thought that he would soon have grasped what was expected of him. But no. We continued the lessons for nearly three months, but, as a few days were missed, we may say ten weeks, and yet at the end of the time I cannot say that Van appeared to have the least idea what was expected of him. It seemed a matter of pure accident which card he brought. There is, I believe, no reason to doubt that dogs can distinguish colours; but as it was just possible that Van might be colour blind, we then repeated the same experiment, only substituting for the coloured cards others marked respectively I., II., and III. This we continued for another three months, or, say, allowing for intermission, ten weeks, but to my surprise entirely without success. I was rather disappointed at this, as, if it had succeeded, the plan would have opened out many interesting lines of inquiry. Still, in such a case, one ought not to wish for one result more than another, as of course the object of all such experiments is merely to elicit the truth, and our result in the present case, though negative, is very interesting. I do not, however, regard it as by any means conclusive, and should be glad to see it repeated. If the result proved to be the same, it would certainly imply very little power of combining even extremely simple ideas. I then endeavoured to get some insight into the arithmetical condition of the dog's mind. On this subject I have been able to find but little in any of the standard works on the intelligence of animals. Considering, however, the very limited powers of savage men in this respect—that no Australian language, for instance, contains numerals even up to four, no Australian being able to count his own fingers even on one hand—we cannot be surprised if other animals have made but little progress. Still, it is surprising that so little attention should have been directed to this subject. Leroy, who, though he expresses the opinion that "the nature of the soul of animals is unimportant," was an excellent observer, mentions a case in which a man was anxious to shoot a crow. "To deceive this suspicious bird, the plan was hit upon of sending two men to the watch-house, one of whom passed on, while the other remained; but the crow counted and kept her distance. The next day three went, and again she perceived that only two retired. In fine, it was found necessary to send five or six men to the watch-house to put her out in her calculation. The crow, thinking that this number of men had passed by, lost no time in returning." From this he inferred that crows could count up to four. Lichtenberg mentions a nightingale which was said to count up to three. Every day he gave it three mealworms, one at a time; when it had finished one it returned for another, but after the third it knew that the feast was over. I do not find that any of the recent works on the intelligence of animals, either Büchner, or Perty, or Romanes in either of his books, give any additional evidence on this part of the subject. There are, however, various scattered notices. There is an amusing and suggestive remark in Mr. Galton's interesting "Narrative of an Explorer in Tropical South Africa." After describing the Damara's weakness in calculations, he says—"Once while I watched a Damara floundering hopelessly in a calculation on one side of me, I observed Dinah, my spaniel, equally embarrassed on the other: she was overlooking half-a-dozen of her new-born puppies, which had been removed two or three times from her, and her anxiety was excessive, as she tried to find out if they were all present, or if any were still missing. She kept puzzling and running her eyes over them backwards and forwards, but could not satisfy herself. She evidently had a vague notion of counting, but the figure was too large for her brain. Taking the two as they stood, dog and Damara, the comparison reflected no great honour on the man." But even if Dinah had been clear on this subject, it might be said that she knew each puppy personally, as collies are said to know sheep. The same remark applies generally to animals and their young. Swans, for instance, are said to know directly if one of their cygnets is missing, but it is probable that they know each young bird individually. This explanation applies with less force to the case of eggs. According to my bird-nesting recollections, which I have refreshed by more recent experience, if a nest contains four eggs, one may safely be taken; but if two are removed, the bird generally deserts. Here then, it would seem as if we had some reason for supposing that there is sufficient intelligence to distinguish three from four. An interesting consideration rises with reference to the number of the victims allotted to each cell by the solitary wasps. Ammophile considers one large caterpillar of Noctura segetum enough; one species of Eumenes supplies its young with 5 victims; another 10, 15, and even up to 24. The numbers appears to be constant in each species. How does the insect know when her task is fulfilled? Not by the cell being filled, for if some be removed she does not replace them. When she has brought her complement she considers her task accomplished, whether the victims are still there or not. How then does she know when she has made up the number 24? Perhaps it will be said that each species feels some mysterious and innate tendency to provide a certain number of victims. This would under no circumstances be any explanation, but it is not in accordance with the facts. In the genus (Eumenes) the males are much smaller than the females. Now, in the hive bees, humble bees, wasps, and other insects where such a difference occurs, but where the young are directly fed, it is of course obvious that the quantity can be proportioned to the appetite of the grub. But in insects with the habits of Eumenes and Ammophila the case is different, because the food is stored up once for all. Now, it is evident that if a female grub was supplied with only food enough for a male, she would starve to death; while if a male grub were given enough for a female it would have too much. No such waste, however, occurs. In some mysterious manner the mother knows whether the egg will produce a male or female grub, and apportions the quantity of food accordingly. She does not change the species or size of her prey; but if the egg is male she supplies 5, if female 10, victims. Does she count? Certainly this seems very like a commencement of arithmetic. At the same time it would be very desirable to have additional evidence how far the number is really constant. Considering how much has been written on instinct, it seems surprising that so little attention has been directed to this part of the subject. One would fancy that there ought to be no great difficulty in determining how far an animal could count; and whether, for instance, it could realise some very simple sum, such as that two and two make four. But when we come to consider how this is to be done, the problem ceases to appear so simple. We tried our dogs by putting a piece of bread before them, and prevented them from touching it until we had counted seven. To prevent ourselves from unintentionally giving any indication, we used a metronome (the instrument used for giving time when practising the pianoforte), and to make the beats more evident we attached a slender rod to the pendulum. It certainly seemed as if our dogs knew when the moment of permission had arrived; but their movement of taking the bread was scarcely so definite as to place the matter beyond a doubt. Moreover, dogs are so very quick in seizing any indication given them, even unintentionally, that, on the whole, the attempt was not satisfactory to my mind. I was the more discouraged from continuing the experiment in this manner by an account Mr. Huggins gave me of a very intelligent dog belonging to him. A number of cards were place on the ground numbered respectively 1, 2, 3, and so on up to 10. A question is then asked: the square root of 9 or 16, or such a sum as 6 + 52-3. Mr. Huggins pointed consecutively to the cards, and the dog barked when he came to the right one. Now Mr. Huggins did not consciously give the dog any sign, yet so quick was the dog in seizing the slightest indication, that he was able to give the correct answer. This observation seems to me of great interest in connection with the so-called "thought reading." No one, I suppose, will imagine that there was in this case any "thought reading" in the sense in which this word is used by Mr. Bishop and others. Evidently "Kepler" seized upon the slight indications unintentionally given by Mr. Huggins. The observation, however, shows the great difficulty of the subject. I have ventured to bring this question before the section partly because I shall be so much obliged if any lady or gentleman present will favour me with any suggestions, and partly in hope of inducing others with more leisure and opportunity to carry on similar observations, which I cannot but think must lead to interesting results.

THE BED OF THE OCEAN.

THE Tuesday evening discourse during the meeting of the British Association was delivered by Mr. J. Murray, F.R.S., of the *Challenger* expedition, who took for his subject the "Bed of the Ocean, and some results of the Expedition." In commencing his lecture, Mr. Murray traced the development of geographical knowledge from the crude conception of the ancients down to the extended knowledge of the nineteenth century. It was not easy, he said, to estimate the relative importance of the events of one's own time, yet, in all probability, the historians of the reign of Victoria would point to the recent discoveries in the great oceans as the most important events of the century with respect to the acquisition of natural knowledge—as among the most brilliant conquests of man in his struggle with nature; and doubtless they would be able to trace the effects of these discoveries on the literature and on the philosophic conceptions of our age. The last of the great outlines showing the surface features of our globe had been boldly sketched; the foundations of a more complete and scientific physiography of the earth's surface had been firmly laid down. The lecturer then briefly described the chief surface features of the globe, the action of wind and water and ocean currents; referred to the temperature of the surface of the sea, and explained that the most important, as well as the most direct, effect of the unequal distribution of temperature over the surfaces of the oceans and continents was an unequal distribution of atmospheric pressure, varying more or less with season. He then proceeded: The advances during recent years in the knowledge of one form of life inhabiting the floor of the ocean surpassed those in any other department of oceanic investigation. Thousands of new organisms had been discovered in all seas and at all depths in the ocean, and either had been or were now being described by specialists in all quarters of the world. There did not seem to be any part of the ocean bed so deep, so dark, so still, or where the pressure was so great as to have effectually raised a barrier to the invasion of life in some of its many forms. Even in the greater depths all the great divisions of the animal kingdom were represented. As they descended into the deeper waters, and proceeded further seaward from the borders of the continents, species and the number of individuals became fewer and fewer, though they often presented archaic or embryonic characters, till a minimum was reached in the greatest depths furthest from continental land. Distance from continental land was, indeed, a much more important factor in the distribution of deep-sea animals than actual depth. If they neglected the Protozoa and compared the results of twelve of the *Challenger's* trawlings and dredgings in the central line of the Pacific, in depths greater than 2,000 fathoms, on globigerina ooze, radiolarian ooze, and red clay, with twelve trawlings and dredgings taken under similar conditions and depths, but on the blue and green muds within 200 miles of the continents, they found that the Central Pacific stations yielded 92 specimens of animals belonging to 52 species, all—with two doubtful exceptions—new to science, and among them 13 new genera. On the other hand, the stations near the continents gave over 1,000 specimens, belonging to 211 species, of which 145 were new species and 66 belonged to species previously known from shallower water. Although no new types of structure had been discovered in organisms from the deep sea, the peculiar modifications which animals had undergone to accommodate themselves to abysmal conditions were sufficiently interesting and remarkable. The eyes of some fish and crustaceans had become atrophied or had disappeared altogether, while in others they had become of exceedingly large size, or been so modified as to be scarcely recognisable as eyes. Fins and antennæ had become extraordinarily elongated, and at times appeared to simulate the alcyonarians of the deep sea. The higher crustacea and some families of fish had very few and very large eggs in the deep-sea species, while their shallow-water representatives had a very large number of very small eggs, showing apparently that the deep-sea species had relatively few enemies. Many deep-sea animals emitted, and some had special organs for the emission of, phosphorescent light, which appeared to play a large rôle in the economy of deep-sea life. One of the most striking facts with respect to deep-sea animals was their very wide distribution, the same species being found in all the great ocean basins. After referring to examinations of coral atolls and reefs, Mr. Murray said the results of many f investigations seemed to show that in the al regions they had the most permanent areas earth's surface, and he was a bold man who gued that in tertiary times there was a large f Continental land in the Pacific, that there nce a Lemuria in the Indian Ocean, or a ental Atlantis in the Atlantic. It mattered whether the opinions which he had given as bearing of some of the researches be correct

The great point was that there had been a ldition to human knowledge, and it must be er of satisfaction that our own country had so large a share in these important investiga- s to call forth the admiration of scientific f all countries. In the matter of deep-sea igation, neglecting mere details, we could say ccessive Governments during the past twenty had, either from design or by accident, aken a work in the highest interests of ce, had carried it on inno mean or narrow and were likely to carry it to a termination anner worthy of a great, free, and prosperous

TO MAKE A MAGIC THREE-SIDED FAN.*

AN that is equally applicable for winter or summer is a novelty. Such a fan any of the s can make by following the directions below, and they will be amply rewarded for trouble by the looks of astonishment and r with which their work will be greeted, if uced as part of some parlour entertainment the winter, or casually opened and closed fanning themselves on the piazza of their ite hotel at the seashore. The third side of n is made by pasting eight of the folds er in four pairs. When the fan is open, one the pasted folds is concealed. The third shown by opening the fan the reverse way. ree sides are made apparent, without any ation, by putting a different picture on each

Material Needed.

the material required is a sheet of stout 25in. by 19in.; an old fan, or a piece of t grained hickory about 12in. long and a ick.

How to Make the Fan.

the sheet of paper upon the table, and mark three-fourths of two circles on it (see Fig. 1). ner circle should have a radius of 4½in.; the ircle a radius of 11¼in. Use the same centre h circle. If you have no dividers to make ith, a piece of string with a loop in one end, e the pencil in, and a pin fastened in the and stuck in the table), will do equally as ig. 1). Divide the outer circle into twenty parts, each part $\frac{3}{32}$in. wide. From each of oints rule a line to the centre of the circle tted lines in Fig. 1).

utting out the paper, cut straight from the dotted lines cross the circles; do not the curve. The paper should be folded the dotted lines. By running the thumb ng each bent edge, the paper will be made in place while the pasting is being done. ond diagram (Fig. 2) shows how the paper en ready for the sticks to be placed in.

e are ten sticks in the fan; they may be got n old fan by removing the covering, or d from a piece of hickory. The eight sticks should be 11in. long, ¼in. wide, and the thirty-second of an inch thick. The tside sticks are the same width, but twice k, as the centre ones, and 1in. longer. The entre sticks should be tapered from about ldle until they come to a point at the top Three-quarters of an inch from the thick end stick, holes will have to be made to fasten gether; this can be done with a fine drill, ned through by a wire heated over a gas Fig. 3). To fasten the sticks together, bend l of a piece of wire (about 1in. long) in the f a loop, small as possible, then push the t end through the holes, and bend it in the ay. If the sticks of an old fan are used, ere are more than ten, remove the surplus nd fasten the proper number tightly r again.

sten the sticks to the paper, glue or mucilage the best thing. Begin by pasting the top the centre of the last fold to the right (as er lies in Fig. 2). When it has dried, turn le thing over, and after putting mucilage n the fourth and fifth folds, place the two ost sticks between them, at the extreme f the folds; press between the palms of nds and the table until they have had time ere. Then paste the two next sticks n the eighth and ninth folds in the same . Now fasten the next two between the twelfth and thirteenth folds, and you will have progressed as far as shown in Fig. 4. The sixteenth and seventeenth folds will use up the two remaining centre sticks. Now paste the last stick to the outside of the last fold, and close up the fan, allowing it to become thoroughly dry before putting on the pictures.

By putting only one picture on your fan, it can be made to appear and disappear at your wish, by opening and closing the fan in different directions. Be sure and get the picture on the flap side of the fan, or it will fail to make the magical change, because the other side does not alter whichever way the fan is opened. If scrap pictures are used, they will have to be divided (with a sharp knife) along the edge of each fold that they cross, after being put on. If you possess any artistic ability, it can be put to use by making some design, or taking some familiar story with three parts or incidents in it, and illustrating one on each side of the fan. For instance, the nursery rhyme, "The Three Crows," can be used by illustrating the first line on one side, the second on another, and the two remaining lines on the third side.

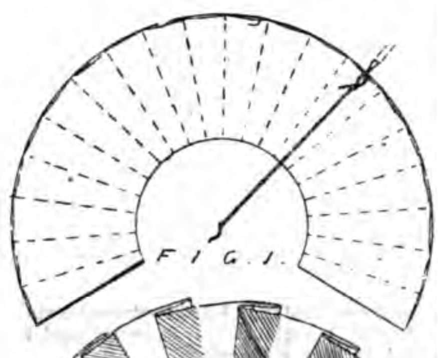
FIG. 1.

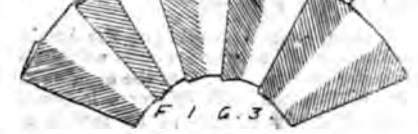
FIG. 3.

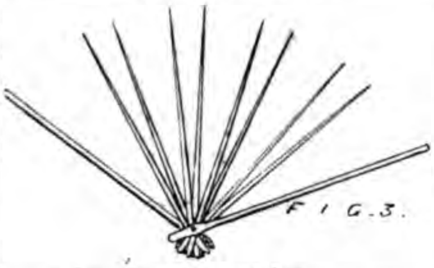
FIG. 3.

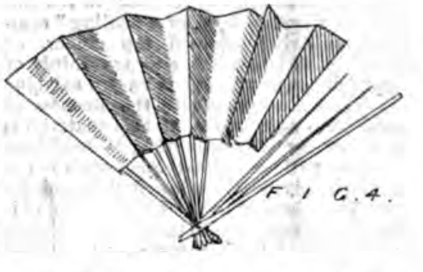
FIG. 4.

PNEUMONIA AND OZONE.

By DANIEL DRAPER, Ph.D., Director of the New York Meteorological Observatory, Central Park, New York City.

SINCE the beginning of this year there has been a severe and very fatal epidemic of pneumonia in this city (New York) from which many of our most eminent citizens have died. Several of the leading physicians have stated that the death-rate from pneumonia this year has been much larger than that of the cholera in the year 1854. As so much solicitude has been felt and expressed by the doctors and by the public at this sudden increase of deaths from pneumonia, I have thought it desirable to undertake a systematic study of the bearing of meteorology upon it, and see if there could be detected any connection between the weather and this disease in the city of New York. On comparing many thousands of observations from the self-recording barometer, thermometers (dry, wet, and sun), hygrometer, anemometers, and pluviometer, with the mortuary statistics, there could not be found any continuous connection between these observations and the prevalence of pneumonia. But when ozone was taken into consideration, there was found to be a very close connection between its observations and the death-rate from this disease.

In the following table is given a summary of the deaths from pneumonia, the amount of ozone, and the number of days on which ozone occurred for the months of January, February, March, April, and May for each year from 1878 to 1885 for the city of New York:

Years.	Deaths.	Ozone.	No. of days.
1878	1,304	9·50	73
1879	1,409	10·88	65
1880	1,490	12·39	75
1881	1,804	12·84	101
1882	2,056	16·19	86
1883	2,061	12·73	85
1884	1,608	6·45	48
1885	2,308	13·26	87

On an inspection of this table, it will be found that by the records of the Health Department of New York City there were for the first five months in the year 1878 1,304 deaths from pneumonia, while the observations at this observatory give 9·50 for ozone on 73 days for the same months. In 1882 the death-rate had increased to 2,056 deaths, and the ozone to 16·19 on 86 days. In 1884 there was a decrease in the death-rate to 1,608, and also in the ozone to 6·45 on 48 days. In 1885 the death-rate from pneumonia increased to 2,308; the ozone had also increased to 13·26 on 87 days. Having studied the observations thus far, the two following questions appeal to our attention: (1) What is ozone? (2) Can ozone produce pneumonia? For more than half a century scientists have been endeavouring to answer the first question. Some of them have called it "electricised oxygen," "allotropic oxygen," "active oxygen," "excited oxygen." Berzelius expressed the opinion that ozone was oxygen in a peculiar state. Becquerel demonstrated that oxygen may be converted into ozone by the prolonged action of electricity. By a majority of modern experimenters it has been admitted that ozone is an allotropic condition of oxygen, similar to that which may be assumed by chlorine, as was shown by my father the late Prof. John William Draper, M.D., of the New York University, and an account of which was published by him in a memoir entitled, "Allotropism of Chlorine, or its passive and active states," in the year 1845. Ozone like chlorine possesses powerful bleaching, disinfecting, and deodorising qualities, and in a concentrated form both these gases are very destructive to animal life. According to Schönbein, oxygen is capable of assuming three different conditions—viz., two contrary active states and one passive. These have been named respectively ozone, antozone, and neural oxygen. But why oxygen should assume its active or passive states little is known. My father found that the indigo rays of the solar spectrum could produce in chlorine the active condition. May not these same rays produce the corresponding state in oxygen?

In taking daily observations on ozone at this observatory, Schönbein's iodide of potassium and starch papers have been used, and also the iodide of calcium and starch papers. I have noticed that on some occasions, soon after the papers have been exposed to the atmosphere they change to a decided brown colour, while after a few hours this brown colour nearly disappears. On dipping the paper, while still brown, into water, the blue colour of iodide of starch is given. This shows that antozone has been present in the atmosphere, but has not had time to destroy entirely the ozone effects produced on the paper.

We come now to the consideration of the 2nd question—viz., can ozone produce pneumonia? As to the causes of this disease very little is known. Sometimes no cause at all can be traced. Very often it is supposed to be the consequence of exposure to cold, especially when the body has been previously heated by exercise. But why such exposure should in one person cause pneumonia, in a second pleurisy, in a third pericarditis, and in a fourth peritonitis we cannot tell. If, as we have seen in considering the first question, oxygen has the power of assuming different forms, one of them preservative, another destructive, may it not in one or other of these forms produce inflammation of the substance of the lungs, &c., thereby causing their engorgement with blood not properly arterialised? I think it might be well for physicians, in their treatment of pneumonia or its allied diseases, to consider whether these diseases may not be due to ozone or antozone, and whether it may not be possible to neutralise the evil effects of one form of oxygen by the use of the other. The further question arises whether the administration of pure oxygen to patients may not be the very worst treatment. It is well known that the oxygen of the atmosphere is mixed with about four-fifths of nitrogen. I regret to see that so many meteorologists neglect the taking of ozone observations, because they are not satisfied with the results obtained. I think that the day is not far distant when we shall know the exact influence of ozone upon disease, and if it should be discovered that in other cities there is the same connection between ozone and the death-rate from pneumonia and its allied diseases, as there seems to have been in this city for the past eight years, shall we not have made the first necessary step towards mitigating the evil results of this disease upon human life, as well as its disastrous effect upon cattle under the form of pleuro-pneumonia?

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* By V. J. S., in *Scientific American*.

SCIENTIFIC NEWS.

THE death is announced of Mr. Walter Weldon, F.R.S., F.C.S., Chevalier of the Legion of Honour, and the only foreigner whom the French Société d'Encouragement has deemed worthy of its grand medal. Mr. Weldon was a contributor in early life to several English and foreign scientific periodicals; but the world is indebted to him for the modern process of making bleaching powder, which, as the French chemist J. R. Dumas observed, cheapened every sheet of paper and every yard of calico made. Mr. Weldon discovered a method of reviving the spent manganese of the chlorine stills by effecting its aërial oxidation, a process which saved from 90 to 95 per cent. of the manganese and abolished the discharge of corrosive acid manganese liquors into the rivers and streams. Manufacturers have been satisfied with that process up to the present; but should the demand for chloride of lime largely increase, it is not unlikely that the manganite of magnesium chlorine process, also devised by Mr. Weldon, will come into use. That has never, we believe, been worked on the commercial scale, and probably requires more skill than the present process; but writing in 1872, Mr. Weldon stated that one ton of bleach could be made for each 16cwt. of salt, or about four times the average yield. Mr. Weldon went to Aberdeen to attend the meeting of the British Association, but was obliged to return to his residence at Burstow, where he died last week at the comparatively early age of fifty-three.

Mr. Maunder, examining the Andromeda nebula on Sept. 11 and 15, was able to trace the spectrum of the new star further in both directions than that of the nebula, but found it considerably fainter in the red and violet than the spectrum of a star of about equal magnitude with which it was compared. It was, however, brighter in the central part. A correspondent has informed him that he examined the nebula on August 18, and saw nothing unusual; but as Mr. Ward detected the new star on August 19, the probable time of the change is narrowed to within a few hours. Astronomers, however, have not yet settled amongst themselves, whether or not the new star is physically associated with the nebula.

The president of the American Association for the Advancement of Science, Prof. J. P. Lesley, of Philadelphia, in the course of his address, dwelt on the value of "dead work" to science. No one can become a true man of science without going through a great deal of "dead work," and no scientist can preserve his intellect in pristine vigour without performing "dead work." Learning is to be acquired from the experience of others; knowledge is our own, for it has been obtained by what is called "dead work"—the collection, collation, comparison, and adjustment of data, a kind of original investigation into the truth of the facts stated in the textbooks.

Amongst the papers read was one by Mr. Brashear on a practical method of working rock-salt surfaces for optical purposes, which we shall hope to give in extenso.

The chair of physics and engineering, University College, Bristol, has been filled by the appointment of Prof. John Ryan, M.A., D.Sc., Mem.Inst.C.E., of the University College, Nottingham, a practical engineer, as well as a doctor of science.

We understand that Mr. Twining's courses of familiar lectures on physics, chemistry, natural history, &c., which are well known under the title of "Science made Easy," have been translated into Japanese at the expense of the Education Department of Japan.

The trustees of the Gilchrist Lectures Fund have arranged for courses of six lectures in each of five Lancashire towns—Blackburn, Lancaster, Chorley, Colne, and Padiham, and for similar courses in Greenock, Paisley, Stirling, Alloa, and Kilmarnock during October and December. No lectures will be given during November in consequence of the General Election in that month. The lecturers intrusted with the work are Prof. R. S. Ball, Rev. W. H. Dallinger, Prof. W. C. Williamson, Dr. Andrew Wilson, and Mr. W. Lant Carpenter. Each course includes three lectures on biological and three on physical subjects, oxyhydrogen lantern illustrations being freely used, and in some cases experiments also. As usual the charge for admission will be one penny, and the largest available rooms are secured for the lectures, special measures being taken to insure the attendance of working men. There will probably be similar courses in five Midland towns in the spring.

At the Royal Victoria Hall, Waterloo Bridge-road, S.E., next Tuesday, Dr. A. H. Fison will deliver a lecture "On Some other Worlds," and on the following Tuesday Prof. H. G. Seeley, F.R.S., will discourse on "Coal—Bottled Sunshine." The lectures will be illustrated by means of the oxyhydrogen lantern, and the price of admission to the gallery is—One Penny.

The Essex Field Club holds its annual cryptogamic and botanic "foray" to-day and to-morrow in Epping Forest.

The annual general meeting of the Amalgamated Society of Railway Servants will be held in Leicester on Oct. 6—9. On the opening day Mr. C. E. Stretton will deliver a lecture on Railway Matters, illustrated by models and materials.

It is understood that the Board of Trade do not intend to fill up the vacancy caused by the death of the late Col. Yolland, R.E. Railway men will regret this, because they had hoped that a similar course would have been pursued as has recently been the case with factory and mine inspectorships - viz., the appointment of a practical man.

The dephosphorising process of Mr. Joseph Beasley, which has been practically tested for 30 months at Pensnett, Staffordshire, is now submitted for criticism. It consists in the employment of a special kind of "fettling" composed of one-third calcined tap cinder, or "bulldog," as it is termed, and two-thirds of ordinary rich ore, or of what is known as "blue billy." These are ground to the fineness of sand, and with each 100lb. of this material is mixed 5 per cent. by weight of hydrochloric acid diluted with an equal quantity of hot water. This mixture is allowed to stand for three or four days, during which time it is occasionally turned, so as to insure the thorough action of the acid upon the ore and bulldog. When the material is about to be used, ground lime and common salt are added to it, the lime proportioned to the amount of phosphorus in the pig-iron to be puddled, and ranging from 20 to 30 per cent. The whole is then mixed into a stiff paste with water and plastered over the lumps of ore or bulldog usually placed around the furnace bottom. Over this are thrown a few shovelfuls of a dry mixture, consisting of one-third of ground ore and two-thirds of ground squeezer, or hammer slag, prepared much in the same way as the material for making the paste just described, but used as a powder without being incorporated with water. For puddling pig-iron containing from 2 to 4 per cent. of phosphorus a mixture is used consisting of ground puddlers' tap cinder or hammer slag saturated with dilute hydrochloric acid, and turned over during 10 days. Neither salt nor lime is added to this mixture, which is laid on the furnace-bottom, and forms the bath in which the phosphoretic pig is melted. In all cases where the iron is fairly melted and the slag has commenced to thicken, the puddler throws on to the molten mass from 6lb. to 10lb. of iron oxide, in the form of simple rust. This addition causes a violent action in the mass of molten iron, and is held to play an important part in effecting its purification.

Some of our readers may desire to have authentic measurements of the *Puritan*: Length on deck from foreside of stem to aft side of taffrail, 93ft.; extreme beam, 22ft. 7in.; depth, 8ft. 5in.; displacement, 105 gross tons. The lead keel weighs 25 tons, and 20 tons of lead are stowed inside, four or five tons of which are run into the garboards. The centreboard is 21ft. long and 10ft. deep. The spar measurements are: Mainmast, 78ft.; topmast, 44ft.; boom 70ft.; gaff, 47ft.; bowsprit (outboard), 38ft.; lower sail area, 5,500 square feet.

The U.S. Commissioner of Patents has declared Jacob Reese the "prior inventor" of the basic process. The decision was given in an "interference" by James Henderson, who bases his claim on his English patent of 1870, and the process would therefore have been public property, as an American patent expires as soon as a patent in a foreign country has run its course. The result so far is to place the control of the basic process in the hands of Mr. Reese until nearly the end of the century.

A letter in the Bermuda *Royal Gazette* states that on Thursday morning, August 27th, two ladies observed a strange object in the clouds, which as it drew near was observed to be of a triangular shape, with chains attached to the bottom part. It is supposed that this object was one of the recently-missed balloons partially collapsed.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

MR. PERRY'S MEASURES OF NOVA 1885 ANDROMEDÆ, AND OF DOUBLE STARS.

[24820.]—MR. PERRY'S communication (letter 24793, p. 79) affords the solution of a question which had been the cause of some perplexity to Mr. Lynn and myself. On the appearance of Mr. Perry's letter in the *Times* announcing the suspected change in the position of the Nova, we examined a large number of drawings and catalogues in order to ascertain what mistakes Mr. Perry could have fallen into (motion to the extent supposed being of course out of the question), as I thought it possible he might have observed some other star. It is only due to Mr. Lynn to say that he at first suggested to me that Mr. Perry had probably confounded seconds of arc and seconds of time together; but I could hardly conceive that any observer not wholly inexperienced would have committed so obvious and gross an error, or when it was pointed out to him would not at once have seen his mistake. It appears, however, from his letter that he has not even yet grasped the fact that seconds of arc and seconds of time are two totally different things, as he credits Dr. Copeland with writing 1·6″ where the Dun Echt Circular most distinctly and indubitably has 1·6s. I write with some feeling about this, as Mr. Perry's mistake caused us considerable waste of time.

I fear that, judging from Mr. Perry's measures of the Nova, his micrometer is either a faulty one or, what is, perhaps, more probable, he has not determined the value of the screw revolutions correctly. Engelmann's measures of the relations between the Nova and the small star (D'Arrest's) are—

262·42° : 109·72″, 4 nights (Sept. 1—16).

For the relations between the Nova and the nucleus he gives—

76·14° : 16·33″ 7 nights (Sept. 1—16)
$\Delta\alpha = 1{\cdot}393s.$: $\Delta\delta = +\,3{\cdot}91''$,, ,, ,,

D'Arrest's star is the one which Mr. Webb suspected of variation. Mr. Perry should carefully measure the objects on pages 421 of Gledhill, Crossley, and Wilson's "Handbook."

Owing to the faulty distances and the absence of any information as to the number of measures or nights which Mr. Perry's results represent, his double star measures are, I regret to say, not of such value as they might otherwise prove to be. He makes Σ 2173 in his note revolve in the opposite direction to the real one. The actual change in the angle since the Cincinnati observations is 122·6°, if Mr. Perry's angle of 199·0° (i.e., 19·0°) is correct. The real angle, I believe, to be about 0° at the present time. His distance of μ^1 Herculis is about half the true value, and the angle of δ Cygni is considerably in error. Mr. Perry gave 318·5° in 1883-82, which compares favourably with the measures of Perrotin, Küstner, and Englemann about the same time. Taking this measure as correct, the angle should be about 315·5° in 1885-6.

Sept. 28. **Herbert Sadler.**

ASTRONOMICAL.—TO MR. SADLER.

[24821.]—I THANK Mr. Sadler for the new list of double stars he kindly gives in No. 1,069 of the ENGLISH MECHANIC. I will examine them and send the results. Mr. S. may rest assured that I shall not refer to any of my catalogues until my observations are sent. My constant practice with very close doubles is first to make my own estimations at the telescope, and then to compare them with the catalogue. I thus find that with stars whose distance varies between 0·35" and 0·4", I generally succeed. With stars of 0·3" and 0·25", I fail as often as I succeed, if not more. My successes under 0·25" are few and far between; but I find that some stars not so close are more difficult than some others closer. Thus, 126 Tauri did not give me half the trouble I had with β Delphini. δ Equulei was also seen with no very great difficuly. There is doubtless something inherent in some stars which renders them particularly difficult besides their closeness. Some are more unsteady than others, some have wings; others are thick and difficult, or even impossible! to obtain a clean disc. Σ 2367 is one of those whose elongation, though slight, I can see with no very great difficulty. The notes of Mr. S. give to this star a peculiar interest. I should, however, have thought that the Nice instrument would have mastered it, as it is said that it quite splits stars whose distance is 0·2". May I ask Mr. Sadler if he knew the P.A. of the stars of the previous list when he looked at them with his 6½ Calver mirror? Perhaps the reason of my failure with some of them was the low power I used; but the air would not allow a higher one. At any rate, I believe that Mr. Sadler's eye is better than mine for seeing minute points of light near bright stars. I can, however, just glimpse the star a little, *s.p.*, the new star in the great nebula of Andromeda. I am afraid there must be an error in my note on β 54. When I prepared my list of objects for observation, I put down β 54 as a double instead of a triple. Finding near an object which seemed to answer the description of β 54, I took it for that one, and in the field of a power of 150, found the two other doubles. At present the faint *comites* of these cannot be seen with the full moon. I hope later on to have another look at this object.

C. M. Gaudibert.

THE COLOUR OF THE NEW STAR IN ANDROMEDA.

[24822.]—THIS star has not only decreased in magnitude since first observed, but appears to me to have also changed colour.

When I observed it on Sept. 3 it appeared to my eyes, and apparently to those of a majority of observers, of a decidedly *yellow* hue. I did not see any trace of red as Mr. Tarrant (letter 24733, p. 32) appears to have done, but it was certainly of a yellow colour, and it remained unchanged till Sept. 9, when the yellow was not so decided; and by the 13th it had become very faint. But as it was of a yellowish colour from the 3rd to the 13th, I think our esteemed friend "F.R.A.S." (letter 24792) must have made a mistake in ascribing a bluish colour to it on the 4th. Possibly the difference in our apertures may account for our diverse estimates, mine being a 3in. refractor and "F.R.A.S.'s" a 4in. Observing the Nova, however, last night (Sunday), the *bluish-white* colour was unmistakable, so that the change must have taken place between the 13th and yesterday (the 27th). Can any reader supply the exact date?

Forest Gate, E., Sept 28. **B. J. Hopkins.**

THE ANDROMEDA NEBULA.

[24823.]—IN reply to letter 24798, the writer assumes certain inferences and conclusions that are foreign to what my letter intended to convey, and hence certain queries are put to me to solve that neither he nor I can. It would have been wiser had he, before taxing me to give information beyond the present bounds of science, have cleared up and stated reasons for the position taken up by himself. I do not wish to enter into any argumentative disquisition on this subject; but from the tone of that letter it appears that he has adopted the hasty conclusion of another writer, who at once and offhand gave "knowledge" that the Nova was set in the midst of the nebula, as favouring a modern theory respecting the structure of the universe.

In reference to 31 M, Herschel writes ("Outlines," page 648, edition 1869):—"Examined with instruments of superior defining power, however, the evidence of its resolvability into stars may be regarded as decisive."

Newcomb also writes ("Pop. Astron.," pp. 448-9, edition 1878), when speaking of its spectrum, "This would suggest that the object is really an immense star-cluster, so distant that the most powerful telescopes cannot resolve it." This is followed by cautious and qualified remarks; but the possibility is granted of its being set with stellar arrangements.

Dr. W. Huggins gives its spectrum continuous, which indicates structural solidity, or composed of solid bodies, whose united lustre is capable of emitting white light.

Such evidence as this preponderates in supporting the theory that this nebula is stellar in its construction, and needs only increased instrumental power to resolve it into separate and component stars. If this is so, whenever that stage of resolvability is attained, the star-dust that will be witnessed will only be infinitesimal points of lights that will in no wise compare with any standard of stellar magnitude that has yet been adopted. It is fair to infer that a mass of stars that can only be compared to star-dust may be more remote than any stratum of stars of larger and measurable magnitude. It is also fair to infer that a stratum of light indicating stellar composition, although no trace of star can as yet be traced, may be still further remote than the locus of a stratum where star-dust is visible.

This line of argument, then, would indicate that 31 M. may be infinitely more distant than those stars which Mr. Edwin Holmes gives as being in "the same line of sight." Stars and nebulæ being "in the same line of sight" indicates no physical connection whatever, as a fact taken alone.

Does this gentleman *know* that this nebula is *no* more distant "than the mass of the stars?" and does he further *know* that the stars he names are connected with any of the nebulæ?

"F.R.A.S.," the able writer in this journal, subsequently to my letter, supports the supposition that the Nova probably is situated between us and the nebula.

To place this new star of the 7th magnitude in the midst of a stratum of supposed stars, which from their infinite distance defy individuality, does indicate it to be a globe of more gigantic proportions than any yet conceived. A star of the 7th mag. would apparently occupy a space equivalent to myriads of that occupied by the components termed star-dust, and, assuming that star-dust consists of suns and bodies of average stellar dimensions, to conceive a body exceeding in size the proportions of average myriads, does seem almost a preposterous hypothesis.

I quite agree with Mr. H. "that bodies possessed of apparent magnitude, and which can be magnified, are really nearer to us than those which resist all scrutiny, and remain mathematical points however examined." This, his final argument, plays entirely in my favour, and is the special point desired to be expressed in the preceding observations.

From one part of Mr. Holmes's letter, it can be inferred that he thinks this new star not so very far from us, and this being connected with what is revealed by science, as to the nature of this nebula, his line of argument supports the supposition that our new comer is really situated between the earth and the queen of clouds.

Southampton, Sept. 28th. **S. S.**

[24824.]—IT strikes me, on looking at the drawing of this nebula (p. 80), copied by Mr. J. Rand Capron, that the positions of the *preceding* and *following* parts have been reversed, judging from the group of small stars which appear in the woodcut as on the *p.* side, whilst in the telescope they are on the *f.* side. This would, therefore, change the position of the star marked × with reference to the centre of the nebula, and it would not then agree with the position of the new star.

In Rev. J. J. Muschamp Perry's letter on p. 79, there is an error in giving the position of new star as *p.* the centre of nebula by 1·6" instead of 1·6s. as given in the Dun Echt Circular.

Belfast, Sept. 28. **I. W. Ward.**

COMET BROOKS.

[24825.]—THE comet discovered by me on the evening of August 31st, in Canes Venatici, has been observed almost nightly to the present time. At the time of discovery it had the appearance of a brightish, nearly circular, nebulosity, with very slight central condensation.

There has been little change in the aspect of the comet, except a peculiar flashing of its light on one or two occasions, which seemed independent of the condition of the atmosphere. The comet's motion is a little north of east, and last night was in the uplifted arm of Boötes.

On the evening of Sept. [illegible] sed almost centrally over an 8th [illegible] The light of the star was unchanged, unless it may have appeared slightly intensified rather than dimmed by the occultation. Perihelion passage was on August 17th. The comet was discovered with the 9in. Newtonian reflector, and achromatic positive eyepiece, of my own construction, giving a power of 30 diameters, and a clear field of 1⅓°. I had just finished this eyepiece—I believe it was the third night I had used it—when I discovered therewith the "Pons-Brooks" comet of 1883, or comet of 1812, as it had become familiarly known up to that time. So exceedingly faint was that comet at the time of discovery, that I do not think I could have detected it with the ordinary eyepiece.

William R. Brooks.

Red House Observatory, Phelps, N.Y., U.S.A.,
Sept. 12th.

STEPHEN GRAY'S WATER MICROSCOPES.

[24826.]—IN reply to "R. M." (query 57308, Vol. XLI. p. 551), my water microscopes were figured and described in the *Philosophical Transactions*, Vol. XIII. No. 221, pp. 281-3, 1 Fig.; No. 223, pp. 353-6, 1 Fig.; and No. 228, pp. 539-42, 1 Fig., published in 1696-7.

My first device consisted of a thin plate of brass, having a cylindrical hole, about $\frac{1}{10}$in. diameter, near one end, in which, by means of a pin, a small globule of water was conveyed, thus forming a plano-convex lens. By passing the pin vertically through the hole, and withdrawing it carefully, it was possible to apply the globule of water so as to form a bi-convex lens. The results were better by candle-light than by daylight. In practice this device magnified almost as distinctly as a single glass microscope.

My second device is shown in Fig. 1. It differed essentially from the former (1) in providing an object-carrier pivoted to the lens-carrier, and (2) in the application of a screw-adjustment for focussing, without which (or some equivalent arrangement), it is practically impossible to make any prolonged observation with a single microscope.

In Fig. 1, A B is the lens-carrier of the microscope. It consists of a plate of brass $\frac{1}{16}$in. thick. At A a hole is pierced about $\frac{1}{30}$in. diameter; encircling the hole on one side of the plate is a spherical cavity about $\frac{1}{11}$in. diameter, and in depth somewhat more than half the thickness of the plate; on the other side is a similar cavity about $\frac{1}{10}$in. diameter, and of such a depth as to nearly meet the other cavity in a sharp edge. In these cavities the globules of water are conveyed by a pin till there be formed a bi-convex lens, which, by the cavities being of different diameters, has unequal curvatures; by this means I found the object was seen more distinctly than with a plano-convex lens of water, or by a bi-convex formed on the plane surfaces of the plate, as in my previous device; moreover, I thus found the water better secured in its spherical form. C D E is the object carrier; a hole, C, is for fluid objects, whilst solid ones are adjusted on the point F. This object-carrier is bent slightly upwards from the plane of the paper, and is made of well-hammered brass to give it spring for the focal adjustment; it is attached to A B by the screw E, on which it pivots, so that the point F or the hole C will come directly in the axis of the water lens at A; it has a slot cut at D to allow the pivot motion past the screw G. A thumb-screw, G, about $\frac{1}{8}$in. in length, fits vertically in the centre of A B, and by means of a broad washer presses the object-carrier nearer to the lens; the reverse motion releases it, when it recedes by its own spring—the to-and-fro movement of focussing. At B is a hole $\frac{1}{10}$in. diameter, in which animalcules may be seen if a drop of stagnant water of suitable thickness be placed so as to form lenticular surfaces.

I may mention that a model of this water microscope, made from my figure and description, was exhibited recently at the Royal Microscopical

FIG. 1

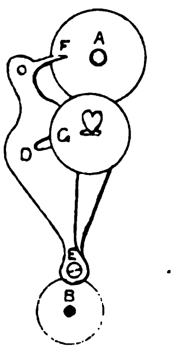
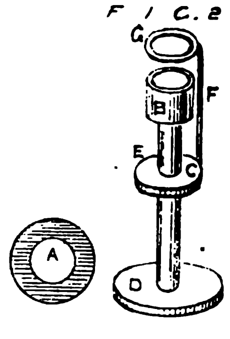


FIG. 2



Society (*vide* Report of Proceedings, ENGLISH MECHANIC, Vol. XLI., p. 299).

Fig. 2 shows my third device. It was not intended primarily as a water microscope, but as a fluid reflecting microscope. As, however, I suggested the modifications required to adapt it for use with water lenses, I describe it afresh.

A is a ring of brass, about $\frac{1}{30}$in. thick, the interior circle being about $\frac{4}{10}$in. diameter, which we may call the frame or cell of the speculum. The edge of the interior circle must be rubbed with a solution of quicksilver dissolved in *aqua fortis*, slightly diluted. It is then dried, laid flat on the table, and a globule of quicksilver put within it, which is pressed gently with the ball of the finger till it spreads out into a thin film adhering to the interior edge of the ring. The ring, with the adherent film of quicksilver, is then lightly dusted with a soft brush, and carefully placed flat on the hollow cylinder B, when by force of gravity the film will sink down, forming a concave speculum. The cylinder B has a screw-hole at the base by which it can be raised or lowered on the standard on D. C E F G is the supporter of the object-carrier, and can be raised or lowered on the standard. The object-carrier should be a glass one, and cemented to the ring G.

I stated in my original communication to the Royal Society in 1697 that this instrument, with a little variation, might be converted into a water microscope, if the ring G were replaced by a small arm, with a hole to receive a drop of water; and if the cylindrical vessel were either removed or screwed on the standard with its base upwards, so as to form an object-carrier. Thus modified, the apparatus would be more convenient for examining opaque objects than that above described, which is better suited for fluid and transparent ones.

I also experimented with water lenses consisting of minute globules suspended on the end of a piece of fine wire, and by dropping clear water on a plate of glass. Some of the latter I used as reading lenses for single words of small letters, as on globes and maps. The fluidity of the water obliged me to keep the glass horizontal; but I found a remedy for this inconvenience by dissolving isinglass in hot water, and whilst it was warm I let some drops fall on the glass as before, and when cold they acquired such a consistency that they could be held in any position, and though they were not so transparent as the pure water lenses; yet this was little or no impediment to their use. Lenses made of the solution of isinglass assume a more perfect figure than those of water, having their edges exactly circular, and they may be made of a much longer focus. I tried also to make objectives of water and the isinglass solution, for the telescope and compound microscope, by placing the drops within thin rings of metal laid on plane plates of glass; but the results were not satisfactory. By dropping these fluids in a suitable ring lying on a plane plate of glass, and pressing the finger on them, the surface assumed a concave form, and these concave lenses I found serviceable as oculars for perspective glasses.

The Ghost of Stephen Gray.

MICROSCOPICAL.

[24827.]—IN letter No. 24766, Mr. Francis Grant has attempted to answer the queries of several inquirers; but he has made so many erroneous statements that perhaps you will permit me to point out one or two of them.

In the second paragraph of his letter, he says: "Pushing the eyepiece up and down the tube has the same effect as turning the screw-collar of the objective to and fro, as far as distinctness of view is concerned." This is certainly an entirely new method of correcting an object-glass for cover, and one which I venture to think has now been heard of for the first and last time.

In the third paragraph he states the two methods commonly employed for ascertaining the magnifying power of a microscope; but in both cases his statements are utterly misleading. I grant that this is a subject about which very loose ideas exist in the minds of very many microscopists, and it is one about which there is not a little difficulty in obtaining specific information from English text-books. I think there is not one of them which gives precisely the information one would like on the subject. Mr. Grant does not seem to have understood the matter, and hence his directions are wrong, and his teaching bad. The matter is a very simple one, and easily remembered. In the first case, the foot-rule must be placed at 10in. distance from the eye of the observer; and in the second, the eye of the observer must be 10in. from the paper. I need not explain why this is so. A little consideration on the part of any one will enable them to see it.

Again another error. In paragraph 5, he says: "To estimate the effect of a given eye*piece*, therefore, first ascertain the amplification of the *eyeglass*, i.e., of the lens nearest the eye. This may be done by ascertaining the length of focus, which is readily obtainable; for in ordinary, i.e., Huyghenian eyepieces, the field-glass *is fixed in the focus* of the eyeglass so that it suffices to measure the distance of the one from the other." Now, I am quite aware that eyepieces are made with the field-glass in the focus of the eyeglass; notably some of Messrs. Beck and Beck's eyepieces, sent out with their cheaper forms of instruments, are so. The negative eyepiece of Ramsden has even the focus of the eyeglass beyond the field-glass. The Kellner orthoscopic, as usually made, has also the field lens in the focus of the eyeglass. But these are exceptions to the general rule, and cannot be adduced as evidence that Mr. Grant's statement is right. I say it is utterly wrong.

These are a few of the erroneous statements which have struck me in glancing over Mr. Grant's letter, and they are quite enough to teach him to be a little more cautious in future.

Since I have mentioned Kellner's orthoscopic eyepieces, perhaps you will allow me to express some surprise that none of our leading opticians make B Kellners. A great many years ago, when the microscope of the then late Mr. Grant, of Elchies, was sold, I saw he had a B Kellner by Mr. Dallmeyer. I was so delighted with it that I at once ordered one from Mr. Dallmeyer, as well as a C. The B is one of the finest eyepieces I have seen; the enormous size of the field, making, as I think Mr. Slack once said, a round diatom—such as Arachnoidiscus—as large as a dinner plate, is something wonderful. Mr. Dallmeyer did not construct them in the same way as other opticians do, for both my Kellners have diaphragms.

Procella.

[24828.]—WITH regard to bubbles at the back of an objective, they interrupt the light going through that part of the objective, and so produce an effect. This effect will become more or less apparent, according to the size of the bubble and its position. A bubble occupying half the area of the back lens would be conspicuous on any object; but a bubble the size of a pin's point would require a test object critically examined before it would be noticed. Again, the position of the bubble has a great deal to do with it, for if the bubble is in the marginal zone of the back lens it would never interfere with light when the objective is used for general work—*i.e.*, work requiring small central pencils of light with or without a condenser. If the bubble is in the centre, it will do a great deal more mischief, as it would always interfere with the light when the objective was used for ordinary work. So it will be easily understood that a small bubble in the centre will do more damage, and be more readily noticed, than a larger bubble off the centre or a much larger bubble at the margin. I have had several experiences of this kind, and have sent the objectives to the *maker* to have the bubbles removed.

Re Amphipleura Pellucida.—The first question to be answered is, What is Amphipleura pellucida? I am told that there is an Amphipleura pellucida with striæ on it as coarse as Cherryfield Navicula rhomboides, about 60,000 to the inch. I have never seen one of them, however. I have seen an Amphipleura Danica, which had very coarse striæ (65,000 or 70,000 per inch); its outward form was not like that of Amphipleura pellucida. I have never seen a valve of what I should call an Amphipleura pellucida with so few striæ as 91,000 per inch, or so many as 99,000.

The late Dr. Woodward, of U.S., has counted them up to 102,000 per inch. The average I find lies between 92,000 and 96,000 per inch. I have resolved the Amphipleura pellucida 96,000 striæ per inch mounted in Prof. Smith's medium ref. index 2·4 with an old dry $\frac{1}{12}$ of Powell and Lealand (date 1857), of N.A. ·94 about 140° (I am nearly certain about this angle, but cannot be quite so, not having my notebook with me). Of course, it had to be coaxed by using sunlight heliostat and a suitable condenser. With all that the lines were exceedingly faint, and could only be detected by a practised eye. My experience is that the striæ always appear faint unless the green of the first diff. sprectrum is well grasped by the objective. With regard to the Abbe theory (theoretical limit of resolving power of objectives as tabulated on cover of "R. M. S." journal), I find it in practice absolutely correct. I also believe the law on which it depends is as certainly proved as is the law of gravitation. The visibility of the flagellum of a bacterium has nothing to do with it. You can *see* the flagellum, but you cannot *define* it. By the term *define*, I mean the seeing the two edges which inclose a space. Fig. 1 illustrates seeing, Fig. 2 defining. I have alluded to this before in these columns when treating of the method employed to determine the visual angle—viz., the visual angle under which a hair might be seen; also that under which two might be separated, this being the visual angle of definition.

FIG. 1

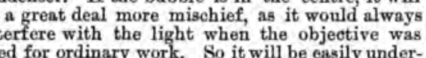
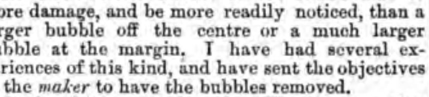


FIG. 2



What is the law which governs the power of seeing minute flagella with a microscope I do not know; but the definition of the flagella comes under the Abbe theory. Francis Grant's letter (24766) will be of the greatest value to all microscopical students, as the story is told in such clear and easily understood language (an art which few writers possess).

Allow me, however, to point out three small slips which in themselves contain important issues.

1st. The magnifying power is determined by placing the paper at 10in. from the eye, whatever may be the length of the tube.

2nd. The field-glass of the Huyghenian is not placed in the focus of the eye lens, but the diaphragm between the lenses should be. The distance between the lenses should be half the sum of their focal lengths.

3rd. The N.A. is not "the sine of half the angle of aperture," but the sine of half the angle multiplied by the refractive index of the medium. He has taken the refractive index of the medium into account in the case of water and oil immersion objectives, but has not done so with dry lenses. As the refractive index of air is unity, the value of his results will remain unaltered; but by multiplying the sine of half the angle by 1 for dry lenses the formula is made intelligible. I am sure Mr. Francis Grant will not object to my pointing out these slips.

Edward M. Nelson.

Shetland, Sept. 21st.

MEASUREMENT OF POWER OF MICROSCOPE OBJECTIVES.

[24829.]—IT occasionally happens that the amateur has offered to him for sale an objective which is stated to be of a certain power and angular aperture, when he naturally wishes to test the correctness of the statements made before he invests his money in the purchase. In such cases it is desirable to avoid the use of an eyepiece, which is likely to be objected to as not being of the magnifying power you may claim for it.

The power of the objective in question may be measured thus:—Remove the eyepiece from the microscope; adjust the length of the tube of the microscope by means of the draw-tube to exactly 10in. from the back lens of the objective (this may conveniently be done by dropping a straw cut to 10in. in length into the tube, allowing the lower end of it to rest on the back lens). Place a stage micrometer divided into hundredths and thousandths of an inch, on the stage of the microscope. Hold a finely-ground slip of glass on the top of the draw-tube. Focus until the divisions of the stage-micrometer are clearly visible on the ground-glass slip; when they can be marked on the slip with a pencil. The extent to which the divisions of the micrometer are magnified on the glass slip indicates the power of the objective. An inch objective should magnify ten times; a quarter, forty times; a tenth, one hundred times; and so on. If one-hundredth of an inch on the micrometer shows as one inch on the glass slip, the objective under measurement is a one-tenth.

If the objective has a screw-collar adjustment, it should be measured with the collar open and closed, and the mean taken. I have an objective which is a one-fifth with the collar screwed over to the right, and a one-seventh when put over to the left—it was sold as a seventh. Take care that your stage-micrometer is correct. I have found some wrong. They can be compared on the stage of the microscope, side by side with a standard scale, such as is used by civil engineers.

The angular aperture of the objective may be ascertained thus:—Place the microscope with its tube in a vertical position, on a table having a dark-coloured cover. Take out the eyepiece. Rack down the tube until the front of the objective is level with, or below, the underside of the stage. All substage fittings must be removed. Take two pieces of white card and place them on the table right and left of the microscope. Look down the tube, and move the pieces of card until you can just see the extreme edge of each piece of card mirrored on each side of the field of the objective on the extreme edge of the circle of the field. Now measure the distance apart of the two pieces of card (their inside edges) and the distance from the table of the front lens of the objective. Draw the first-mentioned distance on a sheet of paper as a horizontal line; and set up the latter distance from the middle of this line, and perpendicular to it. Draw two lines from the ends of the horizontal distance to the top of the perpendicular one—when the angle formed by these two lines will be the angular aperture of the objective, or a close approximation to it. Some persons require the aid of a spectacle lens to see the pieces of card clearly.

I have found the power and aperture of the objective of our best makers, as stated in their price lists, to correspond closely with measurements made by these methods; but some time since a German lens was offered me on approval, which was stated to be a one-twentieth, and turned out on being measured to be a one-twelfth, while its aperture was much less than stated by the vendor; so that the measurements I have described are far from being superfluous when costly foreign objectives are being bought.

In measuring the aperture of wide-angle objectives it is necessary to be careful that the view of the pieces of card is not obstructed by any part of the stand or stage of the microscope.

E. D. W.

THE CONTINUOUS BRAKES RETURN.

[24830.]—THE continuous brakes return (c. 4565) for the first half of the present year has just been issued; but, as upon many previous occasions, the information contained therein furnishes evidence that there is no immediate prospect of the adoption of any general system; it is, however, satisfactory that the brakes recently fitted are, or are said to be, automatic in their action.

The following Table shows the total amount of stock fitted and unfitted on the 30th June, 1885:—

—	Engines Fitted with Brakes.	Engines Fitted with Apparatus for Working the Brakes.	Carriages, &c., Fitted with Brakes.	Carriages, &c., Fitted with Pipes or Chains only.
Total amount of stock returned as fitted with brakes which appear to comply with conditions of Board of Trade	2,726	670	20,086	4,104
Total fitted with brakes which do not comply.	1,190	626	13,274	3,388
Total fitted	5,212		40,852	
Not fitted with any continuous brake	1,765		10,707	
Total passenger rolling stock therefore	6,977		51,559	

The above amount of fitted rolling stock is provided with brakes as follows, *exclusive* of those vehicles which have through pipes or connections only.

Name of Brake.	Engines Fitted with Brakes.	Engines Fitted with Apparatus for Working the Brakes.	Vehicles Fitted with Brakes.
Automatic vacuum	*630	579	6,395
Heberlein	1	1	4
Smith's automatic vacuum	573	1	2,290
Steel-McInnes	3	...	29
Wstnghouse automatic.	1,434	89	10,795
Clark's chain **Clark and Webb's chain** **Wilkin & Clark's chain**	†85	...	3,922
Fay's **Fay and Newall's** **Newall's**	...	...	2,164
W. P. Smith's	...	...	3
Smith's vacuum	1,142	89	5,530
Vacuum (Webb's)	...	537	1,878
Westinghouse pressure.	48	...	350
Total	3,916	1,296	33,360

* These engines are placed under the wrong heading, they having only steam brakes and "apparatus for working" the vacuum brake.

† Eighty-five engines on the North London are recordedin the wrong column, being only provided with hydraulic brake and cord.

These totals do not include 129 goods engines

the North-Eastern Railway, fitted with the Westinghouse brake.

In consequence of the different systems used by companies which exchange traffic, it has been necessary to fit no less than 784 vehicles with double apparatus; but they are, of course, only included once in the above details.

The following table shows the amount of rolling stock fitted with two complete systems of brakes, so that both act on the same block:

Railway, N.E.	Ten Engines.	Westinghouse automatic. Smith's Vacuum.
	vehicles.	
West Coast Joint S. Caledonian L. and N.W.	275 15 68	Westinghouse automatic and Webb vacuum.
Midland S.J.S. " G. and S.W.	85 114 *	Westinghouse automatic—automatic vacuum.
East Coast Joint S. N.E.	89 44	Westinghouse automatic — Smith's vacuum.
G.W.	73	Fay and Sanders' vacuum.
N.E.	13	Westinghouse automatic — Midland vacuum.
N.E.	8	Westinghouse automatic — L. and N.W. vacuum.
Total	784	

* G. and S.W. Co. number not given.

Fifty-one engines on the North-Eastern Railway are also fitted with appliances for working two brakes, and a very large number of vehicles have two or even three kinds of connecting pipes.

The following Table shows the total number of engines and vehicles which were fitted with each system during the half-year ending June 30, 1885:

	Engines.	Vehicles.
Westinghouse automatic	90	586*
Automatic vacuum	64	353
Smith's automatic vacuum	109	491
" vacuum	70	224
Vacuum, L. and N.W.	4	952
Heberlein	—	6
Fay	—	9
Chain brake	4	—
Total	341	2621

* Exclusive of L. and N.W. vehicles fitted with two brakes.

The progress made during the half-year cannot be considered satisfactory; the total stock fitted shows but a small increase; many of the brakes fitted are inefficient, for instance, the "leak-off" and the simple vacuum, and in the case of the London and North-Western vacuum, the large nominal increase is not progress, but simply the change of brakes from the chain to the vacuum. To remove one brake and fit another which does not fulfil the Board of Trade conditions is but a useless waste of money, as a still further alteration must ultimately be made.

A comparison of the two last Board of Trade returns shows that during the half-year, the undermentioned brakes were removed or changed.

Brake.	Railway	Engines.	Vehicles with Brakes.	Vehicles having Chains, Pipes, &c.
Clark and Webb chain	L. and N.W.	—	761	301
Clark's chain.	Belfst C.	2	—	
Fay's	L. & Y.	—	9	
Fay and Newall's	L. & Y.	—	5	
Smith's Vacuum	G.E.	5	33	12
Smith's Vacuum	Taff V.	2	19	1
Total		9	827	314
			1141	

The fact that in six months companies should have taken off such a large number of inefficient brakes shows the absurdity of money having been thrown away in fitting them.

Out of a total of 6,977 engines and 51,557 vehicles only 2,726 engines and 20,086 vehicles have brakes which even "appear" to fulfil the conditions, and, to quote the words of the return, "some of the brakes but very imperfectly fulfil that designation."

[illegible] unsatisfactory part of the return is [illegible]tion relating to the "failures." The information furnished is in many cases incorrect, and in some absolutely false.

It is a well-known fact (in support of which your own columns furnish ample evidence) that there have been numbers of failures, especially upon the Midland Railway, yet under the head of failures or partial failures the word *nil* is recorded. Such a return is clearly misleading, especially when it is remembered that during the six months in question the accident at Swadlincote occurred.

Taking the figures as they stand, the following details can be obtained. No case is recorded under Class 1 of actual failure when required in case of an accident to a train, or a collision between trains being imminent.

Under Class 2, failure to act under ordinary circumstances, the following are given:—

—	Railway	Class 1	Class 2
Smith's vacuum ...	C.L.C.	nil.	5
" " ...	G.N.	...	22
" " ...	L.C.D.	...	2
" " ...	M.S.L.	...	2
" " ...	Met.	...	4
" " ...	Mid.	...	1
" " ...	N.E.	...	1
" " ...	S.E.	...	8
" " ...	D.W.W. of I.	...	1
" " ...	G.S.W. of I.	...	2
			—48
Newall	L. and Y.	...	1
			— 1
Westinghouse automatic	G.E.	...	1
Westinghouse automatic	Mid.	...	1
			— 2
Smith's automatic vacuum	L. and S.W.	...	1
			— 1
Total	... ...	...	52

The Great Southern and Western Company of Ireland also report a case under the wrong heading, in which Smith's vacuum pipe became uncoupled, and a train ran 100 yards past Limerick Junction Station. From these figures it will be seen that non-automatic brakes *failed to act* no less than 49 times in running 22,072,882 miles, whereas automatic brakes only have three cases in 31,573,582 miles. Now, with reference to these three instances, one is a neglect of the coupler when attaching the engine, another was a defective washer which affected the engine wheels alone, and the third case on the London and South-Western is not clearly explained; the main vacuum pipe broke, but it is not stated whether the train overran Reading Station or not. A number of delays are recorded; those relating to automatic brakes, however, are the best possible proof that they are in proper working order, and the fact that good automatic brakes will not permit a train to be run with a brake out of order is not a defect, but the greatest proof of their efficiency and safety.

It would be of the greatest advantage if the returns contained a summary showing each incident under one of the three heads: (1) Failure in case of emergency; (2) failure under ordinary circumstances; and (3) cases of delay, clearly showing if the failure was due to defective material or the faults of servants. All instances in which continuous brakes avoided or mitigated accidents should also be recorded in the returns.

Clement E. Stretton, C.E.,
Leicester. Hon. Mem. A.S.R.S.

VACUUM BRAKE.

[24831.]—PERHAPS some of our readers could inform me about the newest kind of vacuum brake like the one in the Exhibition. Is that one, as shown there, in use on the railway, or in practice do they use a cylinder with a sleeve round the piston-rod as on the L. and S. W. and L. and Y.? Is that brake supposed to fulfil the Board of Trade conditions, and does it leak off or not?

Engineman.

THE HERNE HILL ACCIDENT.

[24832.]—I NOTICE in *Engineer* this week a note disagreeing with the conclusion of the Board of Trade inspector in above accident. The line was tight to gauge, and as the carriages had new tires, they were thrown off the rails. Everybody who knows about the case knows that to be true: but as the *Engineer* says, without sufficient evidence the blame has been put on the signalman: the inspector thinks he must have moved the points. The case is giving much dissatisfaction on the "Chatham and Dover," and it shows pretty well that there ought to be some railway servants with experience put in as inspectors. I should like to know what our railway correspondents have to say on the case. And perhaps at the same time they would say what **they think of a signalman being committed for manslaughter last week upon the death of a man** hurt in a collision last April between Liverpool and Manchester. It seems the signalman was not the guilty party. **Railway Servant.**

THE EARL'S COURT ACCIDENT—G.N. SPEED.

[24833.]—THE failure of signals has again caused another accident—namely, the Earl's Court accident. Here the rod which connects the signal arm with the balance weight broke, and the arm at once fell into the off position by its own weight, and the line thus appeared clear for the district train.

This accident could not have happened with the signals used by the G. N. R. The arms are suspended nearly in the middle, just so that the arm itself tends to keep in the "on" position, and if the rod breaks the signal would not go down if it were up, and if it were down it would go up at once, and of course the weight of the rod alone would help to pull it up. Therefore, I think it would be a great deal better if these signals were adopted on other lines. The objection has been made that it is rather difficult to tell whether they are up or down. In certain lights, it is true, it is difficult to determine their position from a distance; but when they are up there is no uncertainty, though when *down* one cannot be quite sure that they are not up. This, however, only occurs rarely, and it is not as if they appeared *down* when they really were *up*.

Mr. Martin's letter in your last issue was very interesting, and I hope he will soon give us some more of the contents of his pocket-book. For my part, I should be glad to have the whole of the part of it about railways.

There are two quick G. N. runs which I have noticed, between Hitchin and Peterborough. The first was a year ago, by the 3.15 p.m. from King's Cross, which was stopped by signal at Hitchin, and ran from there to Peterborough (44¼ miles) with 16 coaches in 47 minutes. The engine was No. 48. The other was two years ago, by the 1.15 from King's Cross (now 1.30), when 547 brought it into Peterborough 45 minutes after passing Hitchin, notwithstanding being stopped at Fletton Junction, the signal-box before Peterborough. I do not know the exact number of coaches, but it was from ten to twelve. This, I think, is the finest run I have met. **Gulliver.**

BRAKES.

[24834.]—HAVING read some remarks made by Mr. Clement E. Stretton on the subject of the Continuous Brake Returns, and noticing how he makes an analysis of and how, in his opinion, he considers the returns should enumerate, he mentions: Firstly, "Failure under cases of emergency"; secondly, "Failure under ordinary circumstances"; thirdly, "Cases of delay."

With reference to the second clause, What is the meaning of "ordinary circumstances"?

Does it mean burst hose, pulling up trains on certain dangerous parts of the line when not wanted? Does it mean the extensive renewal of certain classes of brake where on certain lines it is reported that some thousands of hose have to be renewed yearly because of their being subjected to a pressure that deteriorates the material, and consequently must be a grave defect?

Is the writer of this letter perfectly unprejudiced in his views in bringing forward this second clause? If he is, would it not be well if he would let the public know his interpretation of this clause?

To my mind, there is no limit to what this clause could be extended to, and it is a mistake to alter Board of Trade forms without having some very clear and definite reason.

Henry Prince, M.S.A.

THE FERROUS OXALATE DEVELOPER.

[24835.]—I NOTICE in last week's issue, at pp. 87 and 88, that R. Bennett falls foul of the ferrous oxalate developer. I am glad to see that he is careful to state that his dislike may be quite a personal equation, for he says, "the ferrous oxalate is an awful spoiler of negatives, *at least, in my hands*."

Now, I can take a good picture with any known developer, and I have come to the conclusion that photographers and their developers stand in very much the same relation as sempstresses and sewing machines; each swearing by what he or she may be most accustomed to work with. As a matter of fact, the ferrous oxalate is perfectly under control; will bring out a picture when no other developer will; can be used over and over again to the last drop; can be depended on never to stain or fog or veil a plate; and is, in point of fact, the only developer which can be used for transparencies, as the pyro-developer is so liable to stain, discolour, or veil the picture, that no one ever uses it for such a purpose, except for experiment only. I have worked much with developers, and have written the result of my experience in the pages of the *Photographic News*, in the last three months' numbers. I therein offered, and herein repeat the offer, to develop, by ferrous oxalate, any half of an exposed plate, of which the other half is to be retained by the sender, and developed by him with any developer other than ferrous oxalate. I do not require to know the exposure; I only stipulate that the plate shall be sent me in an unfogged condition, that is to say, that it shall not have been subjected to the action of light or chemicals, before or after the camera exposure.

The results of both methods of development (ferrous oxalate and pyro or other) shall be laid before the editor for comparison and adjudication.

S. Bottone.

SPEED FOR TURNING METALS.

[24836.]—IT having occurred to me to look up the opinions of experts on the correct speed at which to turn metals, I find the following anomalous results:—

In a book called the "Metal Turner's Handbook," it says:—"Wrought-iron shafting was turned at a speed of fully 40ft. per minute, the feed being 1-16in.; 16ft. of shafting, 2½in. in diameter, may be turned at this rate in an hour. The following rates of speed are recommended by Mr. Joshua Rose. Supposing the work to be 1in. in diameter, the number of revolutions per minute should be—Brass, 450; cast iron, 145; wrought iron, 135; steel, 75. The same materials 3in. in diameter, should be turned at 100, 45, 30, and 25ft. per minute respectively. These speeds are for average work on average materials, using the best tools in the slide rest."

Mr. T. Greenwood says, in his "Turners' and Fitters' Handbook, "A table is given of what is generally acknowledged to be the average of cast iron. Wrought iron is about a quarter quicker, and brass the same as cast-iron, or a quarter slower." In the table which follows it is stated that a 1in. bar of cast iron should be turned at 50 revolutions per minute, a 4in. bar at 12·5 revolutions, and so on in the same proportion. This is only about 13ft. per minute.

Can any of your readers say who is right, and explain the great differences of opinion?

F. P. L.

"SNARES AND PITFALLS."

[24837.]—"COUNTRY CABINET MAKER" being a professional, I willingly accept his fiat in respect to the safer plan of squaring the fourth side back from number one. At the same time, it ought to be predicated that a carpenter's square is correct, and if so, and if the sides *are* truly worked, each from that last finished, the result should be satisfactory. Practically, I do myself test again *all* the angles in case error may have crept in.

O. J. L.

ORGAN AT THE INVENTIONS.

[24838.]—As the inventor and exhibitor of the only organ in which there is anything really new in general design, I venture to think that your notice of it is rather inadequate. I must also claim your support for myself, as the only amateur exhibitor in this department.

In common with the organ of Mr. Gern, my organ has no sliders; the pedal pipes are borrowed to a great extent by the separate pneumatic pallets, as described in my "Modern Organ," written in 1882. Messrs. Wadsworth's organ is an ordinary slider instrument, and has not separate pallets.

The principles of my inventions have secured the support of Mr. Best, Mr. Stimpson, and many other eminent organists. Your old correspondent, Mr. G. A. Audsley, considers my organ the distinctive typical organ of the 19th century, and every sign is given that in no long time the system must revolutionise the present unsystematic, arbitary, and illogical way of building.

My system commenced with the pedal organ, as regards which the dilemma is that (1) either the pedal stops are few in number, and easy to manipulate, or else (2) they are numerous and impossible to manipulate with sufficient speed; the result in either case is that the pedal bass is monotonous and inappropriate.

I entirely overcome this serious artistic difficulty, and that by extremely simple means. The invention consists in providing a separate pedal organ for each manual organ, any such pedal organ being attachable, to the exclusion of the others, to the one pedal keyboard, on touching a stud under its manual keyboard. The couplers which unite the manual keyboards to the pedals find their places, and if drawn come in and out of action with their respective pedal organs. The mere touch of a stud therefore enables the performer to change his pedal organs with the utmost rapidity and convenience.

I have applied this invention to the organ at St. Mary's Church, Denbigh, which is the first organ ever provided with appropriate and controllable pedal basses.

The mechanism designed will, as has been pointed out, attach one or more of several organs with separate couplers at will to one *pedal* keyboard. Having established the mechanical principle, it occurred to me to apply it to *manual* organs to produce even more important results.

I took out a second patent, and proceeded to build an organ for the "Inventions" Exhibition. This instrument, which is to illustrate both patents, has five manual divisions, viz.:—

Great organ }
Choir ,, } Lower keyboard.
Solo ,, }
Swell ,, } Upper keyboard.
Echo ,, }

each division having its own pedal organ.

Each manual division is attached to its keyboard by touching a stud or "help" under that keyboard —e.g., touching a stud labelled "choir" converts the lower keyboard into choir organ, bringing on all manual stops and couplers drawn in the choir stop group, and completely throwing off the great and solo groups.

The one coupling action which unites the upper keyboard to the lower draws and works separately with each division of the latter, giving the coupling drawstops,

1. Upper organ to great.
2. ,, ,, choir.
3. ,, ,, solo.

But the upper organ may be swell or echo, or both, therefore this one coupling action gives nine coupling effects.

Again, a simple arrangement allows of the choir organ being brought on simultaneously with the great, on touching the great "help," though the choir "help" can bring on the choir alone. This constitutes the coupling drawstop

4 Choir to great.

Similar mechanism gives us

5 Solo to great.
6 Echo to swell.

Again, the *two* pedal coupling actions draw separately for the five pedal divisions, thus giving

7 Great to pedal
8 Choir ,, ,,
9 Solo ,, ,,
10 Swell ,, ,,
11 Echo ,, ,,

That is to say, that though there are only three coupling actions there are eleven coupling stops, producing some seventeen coupling effects.

Couplers are situated in the stop-group *to the resources of which they add*, and if drawn they come in and out of action with their stop-group— e.g., "upper to choir" works as a choir *stop*; "great to pedal" as a *stop* of the great pedal organ.

Under each manual is a help labelled "pedalier." This, if touched, attaches to the pedals the pedal stop-group of any manual division then attached or coupled to that manual.

Such combination actions as may be adopted are to act upon an entire stop-group. Thus the manual and pedal stops and couplers are always under systematic control.

Those conversant with organ-playing will perceive that I obtain with an organ of *two* manuals all the combination preparations possible on an ordinary organ with *five*. Not, indeed, *all* the effects; but, as an addition, the pedal stops and couplers give no trouble, I contend that this two-manual organ is the more useful. It must be conceded that at least I have added enormously to the resources of a comparatively small organ; but I do not necessarily confine myself to two manuals; I may have five, each of the five with several divisions, and each division with a separate pedal organ; the addition to the resources of a large organ is thus beyond calculation.

Some idea may be formed of the great simplification of the mechanism by the following comparison. The exhibition organ with

2 Manual actions,
1 Pedal action,
1 Manual coupling action,
2 Pedal ,, ,,
—
6 Trains of mechanism
—

has all the combination preparations of an ordinary organ with

5 Manual actions,
5 Pedal ,,
11 Manual coupling actions,
5 Pedal ,, ,,
—
26 Trains of mechanism
—

The exhibition organ is divided, or "antiphonal," the performer being seated between the two parts. All the drawstop and key action is tubular pneumatic, on the system of Mr. Roosevelt, a gentleman to whom I am deeply indebted for courteous assistance in this part of the work.

The systematic sub-division of the organ is an important feature, affording great relief to the performer's memory.

Organ divided into

West or Lower divided into
Great (Group A) Choir (Group B) Solo (Group C)

East or Upper divided into
Swell (Group D) Echo (Group E)

Each of these five stop-groups is again divided into manual and pedal group, and each of these again into sounding and coupling stops.

	Manual			Pedal		
	Sounding.		Coupling.	Sounding.		Coupling.
Group A—	1. Bourdon	16	7. Upper to Great.	10. Acoustic.........	32	Great to Pedal.
	2. Op. Diapason	8	8. Choir to Great.	11. Op. Diapason...	16	
	3. Hohlflöte ...	8	9. Solo to Great.	Spare		
	4. Principal ...	4				
	5. Mixture	II.				
	6. Mixture	V.				
„ B—	13. Dulciana......	8	17. Upper to Choir.	18. Dulciana.........	16	19. Choir to Pedal.
	14. Gedackt	8				
	15. Waldflöte ...	4				
	16. Hautboy......	8				
„ C—	20. Posaune	8	21. Upper to Solo.	22. Posaune	16	23. Solo to Pedal.
„ D—	24. Bourdon......	16	30. Echo to Swell.	*31. Subbass	16	33. Swell to Pedal.
	25. Viol............	8		*32. Trombone	16	34. Lower Pedalier to Upper.
	26. Harmonic Flute	8				
	27. Gemshorn ...	4				
	28. Mixture	III.				
	29. Trumpet......	8				
	Spare					
	Do.					
	Do.					
„ E—	35. Flute	8		38. Sub-bass.........	16	39. Echo to Pedal.
	36. Voix Célestes	8				
	37. Cor Morne ...	8				
	Spare.					
	Do.					
	Tremulant (By Pedal).					

*In Swell-box.

No. 10 (acoustic) is a quint in the bottom octave, the remainder taken from No. 1 in actual 32ft. pitch.

No. 11 has 1 octave of pipes, remainder from 2.
No. 22 „ „ „ 20.
No. 32 „ „ „ 29.

No. 18 is omitted at present, the stop acting on 38.

GENERALLY—
5 manual helps.
2 pedal helps.
(Helps, when touched, remain in to show what is attached, the released helps coming out simultaneously.)
3 composition pedals to great stop-group.
3 composition pedals to swell stop-group.

The pedals are "wind-coupled," a contrivance invented in 1883, by which the pneumatic current passes from the pedal valves to the manual tubes without disturbing the manual action. All that is necessary for coupling and uncoupling is the movement of a small valve.

Denbigh, 15th Sept. **Thomas Casson.**

MODERN MAN-FLIGHT AND AERIAL NAVIGATION.

[24839.]—I AM afraid the machine designed by "Norfolk" (letter 24747) is quite useless in helping to solve the problem of man-flight. "Norfolk" makes the common error of attempting to get more power out of the machine than is put into it. The atmospheric pressure is not in the least available for his purpose, and the whole power to flap the wings must be provided by the man in the machine, who could not with such wings as those exert sufficient power to raise himself, not [illegible] mention the weight of the machine with which he would be encumbered. The difference in specific gravity between the human body and atmospheric air is too great to permit a man to support himself in air by his own exertions. He must, it seems to me, resort to some means for establishing a condition of equilibrium; then he may by the strength of [illegible]wn body move himself in different directions. [illegible]hen a lighter gas is made use of to gain a [illegible]r of flotation in the air, we leave the problem of man-flight pure and simple, and enter into the province of aërial navigation, which, in my opinion, offers a much better field for study and experiment than any system of individual flight by muscular exertion.

In aërial navigation the great stumbling-block appears to be the mechanical means of propulsion. Buoyancy and shape have been reduced within the range of practical mechanics. Hydrogen gas contained in an elongated balloon supporting a car carrying the cargo and motive power has been the accepted form for many years; but mechan[illegible]l engineering seems, as yet, unable to provide a suitable motor.

Dr. Pole, in a paper published in the minutes of *Proceedings* of the Inst. C.E., says that "M. Giffard ascended from Paris on the 24th Se[illegible]ber, 1852. Having arrived at a co[illegible] h[illegible]he started his engine, and the [illegible] produced thereby became at once evident by the prompt obedience of the balloon to the action of the rudder. It was 'under way,' and could be steered like a ship at sea. He found that the screw gave an independent velocity through the air of from 2 to 3 mètres a second, or 4½ to 6¾ miles an hour."

Now, if this was really effected by M. Giffard with a balloon 12 mètres diameter and 44 mètres long, driven by a 3 H.P. steam-engine, working a two-bladed screw 3·4 mètres diameter with a maximum speed of 110 revolutions per minute, we have a basis for experiment which certainly ought to be followed up.

I am afraid that a screw-propeller to give a satisfactory independent velocity to the craft would have to be so large as to seriously interfere with the management of the balloon. But I have an idea that a fairly good speed might be attained on a calm day by means of air currents ejected with high velocities against the surrounding atmosphere at the stern of the vessel, such currents being supplied by a suitable "blower" carried in the car.

Although I have watched the subject for some years, I have not seen any accounts of experiments with air jets for this purpose; and if, sir, you will allow this subject to be again discussed in your valuable columns, I should be glad to learn if any readers of "Ours" have made any such experiments in their endeavours to solve this "the most interesting problem offered by nature."

Silex Seadrift.

"100 TO THE INCH," AND MATTERS RELATIVE THERETO—THE AFTER-GLOW, AND ASSOCIATED PHENOMENA — B 464 — B 448 — B 298 — T[illegible] NOVA IN THE ANDROMEDA N[illegible]A.

[24840.]—IN connection with what has been recently written in "Ours" by Mr. Holmes concerning the question of "100 to the inch" brought forward by Mr. Franks, I would like to point out that in "Ours" for Dec. 2nd, 1881, there is a letter from the late Mr. Webb concerning observations of γ^2 Andromedæ at Washington, and presumably made with the 26in. there, and that it is stated "The power used throughout being 888." As to what Mr. Holmes says about the inability of a 26in. to stand 1,800, being, in his opinion, a proof of its defective character, is not this a statement or opinion of the same nature as that made in these columns a few years since by Mr. Burnham: that if, under any circumstances, a telescope performed better with reduced than with full aperture, it was defective? That declaration was controverted in "Ours" at the time, and did not, I fancy, gain general assent. But is not Mr. Holmes's statement something of the same sort? As to what Mr. Holmes says about 2in. telescopes, I wonder if he has used one, or ever reduce[illegible] to try what he can see. I never used [illegible]; but I sometimes stop down my 8[illegible] that I can see with that aperture [illegible] my experience does not at all agree with Mr. Holmes's dicta as to what *may not* be seen with 2in. I may say that I have with a power of 145 seen Cassini's division in the *ansæ*, and a part, at least, of the ray system of Proclus with only 2in. [illegible]

The "afterglow" and "daylight glow," and "white sunsets," have been visible here at intervals throughout the summer. Displays of the "daylight glow"—that is, of the white glare edged with a ruddy purple border, seen surrounding the sun—have usually, but by no means always, been followed by displays of the "afterglow." Although much reduced in brilliancy and area, the after- and fore-glows are exact reproductions of the phenomena witnessed after the more splendid displays had ceased. Their appearance, however, has been, and is, very intermittent of late; although the daylight glow has been visible pretty frequently, very little has been seen of the afterglow. On September 8, a slight one was seen, the first for some time. The daylight glows are very variable in brightness, area, and definiteness, but are always exactly the same in character. I have seen more than once the appearances which I presume are referred to when "glows" produced by moonlight are spoken of, but I have never seen a lunar foreglow. I have on more than one occasion during the last few months witnessed displays of colour in the sky somewhat similar to what I described in a letter in "Ours," June 27, 1884. On two occasions a very curious phenomenon was witnessed here. Towards the close of displays of afterglow—in the second case the display was a fine one—there appeared behind the glow, as it seemed, long shafts of light. In the first case three were seen, stretching from above the sun's place southwards, and not inclined at a very great angle to the horizon. In the second case there were four, at considerable angles to the horizon. In each case they were spread out like a fan, and were of exactly the same tint as the glow. They had something of the appearance of the tails of the comet of 1744. The date of the first appearance was July 23rd, the second was in the following week. I have seen nothing of the same sort since. One remarkable thing has been observed here for a considerable time past in connection with the "after glow," and to a considerable extent with the "daylight glows" also. In the vast majority of cases, a display is followed, more or less remotely, by a fall of rain, and generally *very fine* rain. It is to be noted that during the fortnight or so when, at their original appearance, the displays were finest in England, it rained almost continuously here. I still find the definition, as a rule, poor after a display, though not so bad as formerly. The blue of the sky is now much more frequently of a pure and clear tint than before, though it is but seldom deep and dark. On Sept. 19, a fine afterglow, and on the 21st a foreglow, were seen.

I have to thank Mr. Sadler (24539, p. 474 last volume) for the information he gives concerning B 464. From what he says, it seems pretty clear that there is not much ground for considering this star variable. But in connection with his saying that he thinks it more probable that "the star being a bright one, Bessel preferred to observe the fainter star, No. 5, near it, leaving the bright one for other observers"—than that the star was so faint at the time Bessel observed that it escaped him, I think one remark may be made. From one or two entries in Birmingham's "Red Star Catalogue," it may be inferred that Bessel took special note of red stars; and if he did, and if B 464 were bright, and of its present splendid hue when he observed, it is strange he did not notice it. Perhaps Mr. Sadler can throw some light on this surmise. The following are such observations as I have, later than those given in the L.A.S. *Journal*, Part III., December, 1884:—

1884. November 11.—Rich red.

1885. June 9.—Fine ruby-red; but hue does not seem so fine as before.

1885. June 20.—Fine ruby; *lucida* of triangle.

I must also tender my thanks to Mr. Gore for the map of place of B 448, which he gives in letter 24542 (p. 474, last volume). It enabled me to find B 448 with ease, and I hope it has helped others to do the same, for this star is truly a splendid object. In passing, I may remark that I think that "red stars" are often neglected because of an impression that their identification is often very difficult, and their satisfactory observation with small apertures impossible. Both ideas are, in a large number of instances—including a number of the finest—quite wrong. In many cases they are not difficult to find, and are frequently well within the range of even a small instrument. I may give this hint, that the pleasantest way of observing such objects is often not to look for them because you find them noticed in a book, but *to discover them for yourself*. A considerable number of the coloured stars that I have observed I have come across for myself in sweeping, and have afterwards identified. B 464, above, is an instance; I came upon it quite accidentally, one very fine evening. There is this advantage, too, in this plan—it trains the eye to distinguish and discriminate colour, and it gives one confidence in one's own observations. As to B 448 Lyræ, I have got the following observations of it.

August 9, 1885.—Above 9th mag., a magnificent hue: deep glowing red, but difficult to name tint precisely.

August 13.—Not less than 8·7, I think; magnificent fiery red.

August 14.—Magnitude seems less than last night. Rich red, almost crimson.

August 20.—9 mag. deep red, almost crimson.

These observations were made with 45 upon 8½in. (o.g. by Wray).

Upon the 13th of July, while observing in Draco, I came upon a very finely-coloured star of about 7th magnitude. Its hue was deep red orange. On the 20th of August I saw the star again. I entered, "7 magnitude. Orange-red; a fine tint." I then identified it as B 298, R.A. XIIh. 51m. 41s., Dec. + 66° 38·6, D. M. magnitude 7·3. In the notes in Birmingham from d'Arrest we find: "Strikingly reddish; 7 mag. The peculiarly remarkable spectrum consists of brilliant light lines, separated by broad, dark intervals; demands special study; Secchi's type IV." I afterwards found that it is included as No. 388 in Mr. Gore's "Catalogue of Suspected Variable Stars," though the fact is not noted there. Mr. Gore says, "A red star, discovered by Burnham," and cites the magnitudes of Harding and Burnham, each 7 mag. He gives some observations of the star made by himself, which seem to show that it is slightly variable—through a range, perhaps, of a little over a half-magnitude. He compared it with an 8 mag. star preceding. The star is well worthy of observation, both on account of its colour and of its possible variation. To find it, look a little preceding the line joining 8 and 9 Draconis. Its fine hue ought to take the eye at once. Have any observations of the spectrum been recently made?

I have had several opportunities of seeing the Nova in M. 31, though on no occasion were the conditions very good. I have found it very plain, even under most disadvantageous conditions. It is yellow, and small and sharp. The light is, indeed, singularly vivid. At no time has it seemed to me so bright as 7 mag., 7·7 would be the brightest, I think. There is a star at *f.* end of M. 31, marked in the chart given in the L. A. S. *Journal* for March last. This star I make about 9 mag. On Sept. 17, I made the Nova, partly by comparison with this star, 8¼ ±. It is, I think, less in magnitude than it was at first, though the estimates of 5½ and 6 magnitudes which appeared were certainly exaggerations. On the 5th the nebula in the opera-glass seemed equal to 32 Andromedæ, and on the 10th, by opera-glass sequencing, I made it 5·0. I may add that the Nova focusses very sharply, and is as plain in 145 as in 45. I have been comparing the chart above referred to with the sky; but have found the comparison difficult. Some obvious stars are not to be found in the chart, and some stars in the chart cannot be found in the sky. It would seem as though the stars had affected the photographic films in very varying degrees. I may add that on Sept. 17, though conditions were poor, M. 32 seemed very bright.

Glasgow. **S. Maitland Baird Gemmill.**

OPTICAL AND MECHANICAL.

[24841.]—I PRESUME your correspondent, "Retina" (query 57488), has not read the articles on o.g. making by "Prismatique." If not, I would recommend him by all means to get them and thoroughly master their contents. He cannot do better than follow the instructions and curves for making an o.g. of Chance's hard crown and dense flint. As to the focal length, 15 or 16 diameters of the objective is not a bad proportion.

In reply to Mr. Woodside (letter 24805), I do not see any great error in Littrow's tabular formulæ; the error seems to be in Mr. Woodside's interpretation of the term "dispersive ratio." In the example to which your correspondent alludes, the quantities ·014 and ·028 show the dispersions of the two glasses, without taking into consideration the actual displacement of the mean ray. This displacement in the crown lens is represented by the decimal part of the index—viz., ·521; and, therefore, the crown dispersive power is $\frac{14}{521}$. Similarly, that of the flint is $\frac{28}{631}$, so that we have this proportion—

C. disp. power : *f.* disp. power : : $\frac{14}{521} : \frac{28}{631}$;
or, as 631 : 1042.

Or, if that of the flint be called 1, that of the crown will be ·605; which number represents the ratio of the dispersive powers of the two glasses. If the rules are correct, the foci of the lenses should also be in this proportion. I make the focus of the crown to be ·398, and of the flint ·655; dividing the first by the second we get ·607. This does not agree with the former in the third decimal place, because the alteration due to thickness is allowed for; but the approximation is sufficiently near to show that there is no great error in the formulæ.

I must thank "J. H." for kindly noticing my suggestion about engine-making. I have no interest in the matter further than that I thought such a supplement would make his really excellent articles complete, and be of use to anyone who wished to fit up a double-cylinder engine, and was at a loss to know how to proportion the various parts. **Orderic Vital.**

MATCHING CROWN LENS FOR AN O.G.—TO MR. WOODSIDE.

[24842.]—I FEAR there is no method Mr. Woodside can adopt other than actual experiment, unless he knows at least the value of μ for some ray. D is generally given in the lists. If the sp. gr. of the disc be 3·64 (the generally used sort for long focussed o.g.'s), he may with tolerable safety start with a proportion of 5in. to 3in. of the crown lens in focus. He may then deepen or flatten as needed, after testing for aberration and colour. Or the method of our clever correspondent, Mr. W. G. Penny, may serve him—viz., make the flint considerably shorter in focus than the above proportions, and separate the lenses for correction. Without knowing more about the crown, its form, focus, and radii (if it has two differing curves), I cannot advise more fully.

If Mr. Woodside intends to use paper for his polisher, a cork back or "mallett" will be the best for hand work. If he intends to use pitch, or other wet polishing process, a layer of strained p[illegible]h on a light metal back will be the best holder.

The measurements for separation as applied to lenses are taken from the centre of the thickness of each—i.e., half the value of T_1 is deducted, as also half the value of T_2, when the circumferential separation of surfaces is required.

There is no advantage in having a small hole in a polisher, unless it be used for small lenses on the lathe. Then the hole counteracts the tendency to spheroidal error, owing to the abrasion being greater, as it is further carried from the centre of motion. **Prismatique.**

PYROLOGY.

[24843.]—AN apology is due from me to your readers for the somewhat sudden discontinuance of the papers on "Mineral Analysis" hitherto appearing in the ENGLISH MECHANIC; but the fact is, when I had got about half through my cabinet of minerals, I came across a discovery in pyrochemistry, on showing the results of which to a chemist friend, who is connected with some large English and foreign manufacturing works, and has official relations with many others over nearly the whole South of England, he said, "If you can produce these articles a little larger (mentioning the exact size required), I can get you a contract for £20,000."

I have now all but completed this requirement, and as my time will be hereafter wholly taken up by this manufacture, in which my friend has joined me with his capital, connections, and extensive knowledge of practical (i.e., applied) chemistry, it will be evident to those of your readers who have honoured me with their close attention and approval that I must for the present, at all events, discontinue my articles upon the "Examination of Minerals before the Blowpipe"; and, with the warmest thanks and gratitude to you and them for the opportunities afforded me of explaining and publishing to the world the results of 25 years' hard work (otherwise unrecognised in England) in "the first scientific paper in London"—this is the expression of the cleverest professor in the Royal School of Mines—I now, most regretfully, bid you all adieu.

By the way, I am wrong when I say my labours have been wholly (otherwise) unrecognised in England. The International Inventions Council have awarded me a bronze medal [illegible]hich I am perfectly satisfied, as recognit[illegible] all I wished for), and Messrs. Clowes have been so good as to print me the following placard, which I have placed above my "case" at the Exhibition:—

"International Inventions Exhibition, 1885.
"BRONZE MEDAL,
"The only Medal ever awarded
"For Blowpipe Analysis.
"Exegi Monumentum *ære* perennius.*—HOR."

W. A. Ross.

CLAMP v. CRAMP.

[24844.]—I SEE another letter (p. 85) on the use of these words, and beg to say that I do not trust much in such a case as this to dictionary authority, any more than to catalogues. In the Imperial Dictionary, under "clamp," there is no indication, as far as I can see, in any of the explanations of the term, of the *forcible motion* that, in my "idea," is inseparable from a cramp. But in the appendix of that work there is described an "instrument made of wood or metal, with a screw at one end, generally used by joiners for holding pieces of timber closely together until the glue hardens." Now, I contend that that is a "cramp," and I do not believe in its ever being called anything else by anyone whose authority is worth considering.

Another strange use of "clamp" lies before me—viz., in the table of wheels used for cutting various pitches by one of the exhibitors at the "Inventions." What most people call either the "radial arm" or the "wheel-plate" is spoken of as the "adjusting clamp." I should not now wonder if somebody called a bootjack an "extracting clamp." Mind, extra here means to pull off as well as to pull out.

After all, I do not object to the use of the word so much as I do to the practice of clamping work hard down to the table of the planing machine with a view to preventing its fetching *way*, or, as some people call it, "weigh," with as much good reason as cramp is called clamp. It is this objectionable practice that so constantly makes the work, when released, go all "in winding," however true it may have appeared whilst still in the machine, and "in chancery," as I have heard the putting on of cramps called. **J. K. P.**

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[57037.]—**Sewing-Machine Work.**—This is rather vague; but many k[illegible] of sewing—quilting, for instance—are done with [illegible]e aid of guides, &c. attached to the machine for the purpose. An experienced machinist will easily sew at e[illegible]al distances, using the presser foot as a guide, assisted by a practised eye. If this is not enough for you, write again, stating more particulars, and I will try and give you further information.—J. L. S.

[57199.]—**Gas-Engine.**—Thanks to A. Sieger. 2-man engine came from Messrs. Hills, of York; its piston is 4in. dia. with 8in. stroke. The piston simply sucks gas and air in a little more than one-third of its stroke, and is then ignited by a small automatic flap-valve, which, on the explosion taking place, it closes, and prevents explosion passing out. If, in case the engine does not act, I make it suck gas and air one length of the stroke, compress it on the return stroke (allowing a space behind cylinder to compress in), and igni[illegible] directly it is over the centre for out[illegible] will it have any more power? [illegible] respecting this will be thankf[illegible]—G. G.

[57210.]—**Tar.**—In reply to "Nun. Dor.," I beg to say that I am perfectly "serious" in making the query. Is *he* "serious" when he states that Stockholm tar will get as black as coal tar if kept "long enough"? If he will obtain samples of the two and compare their respective colour, he will see that there is a "serious" d[illegible]rence between them. The first, however, is solub[illegible] linseed oil and turpentine, the latter is not. The want of good colour in the former is one of the greatest drawbacks to the varnish industries, yet nature changes the brown of the one to the black of the other; but she is "long enough" about it, and spoils it in other ways.—DANDIE DINMONT.

[57[illegible]11.]—**Steam Launch.**—Although I[illegible] not seen previous correspondence on this que[illegible], I conclude, from part of "Essar's" reply—[illegible], "But this idea of building a launch to suit [illegible] engine is rich indeed"—that he means it is ab[illegible] May I sug[illegible], for "Essar's" edification, that [illegible] quite pra[illegible]able, as I have had one built [illegible] good results, and shall be glad to send particulars, if Editor will allow me?—WINDERMERE.

[Please send.—ED.]

[57280.]—**Spring Bell for Till.**—I should think there is no difficulty about this; but it would be absurd to waste space without more d[illegible] The querist could fit an electric bell to [illegible] long as the till is open, or he could have [illegible] mechanical action, if it will suffice for the [illegible] ring only when the till is drawn out. He m[illegible] get some useful hints by looking in the index [illegible] Vol. XL., and referring to the pages indicated under the head of "till."—J. T. M.

[57283.]—**Cold-Air Machinery.**—It is quite possible to produce cold air on the small scale: but what motive-power has the querist? On p. 8[illegible], No. 914, there is an illustration of Lightfoot's simple air refrigerator, which is possibly made in a size small enough for the querist.—ESSAR.

[57219.]—**Screw-Cutting.**—TO "T. W. B."—Being only a subscriber since January, I have not seen anything pertaining to what I want in any number since then. Affixed I give a table for one of Norman and Clinkskills', of Glasgow, lathes, which is of two threads per inch, and is very handy to have, and if "T. W. B." could give me one for a lathe of four threads per inch on leading-screw, I ink it would be a great benefit to others as ell as myself.

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* I have completed a monument more lasting than bronze.

Mandrel.	Wheel.	Pinion.	Screw.	Threads per inch.
20	80	20	90	36
20	80	25	100	32
20	80	24	90	30
20	70	25	100	28
20	63	25	100	26
20	80	30	90	24
20	55	23	100	22
20	70	30	90	21
24	80	30	90	20
40	80	20	90	18
40	80	25	100	16
40	80	24	90	15
40	70	20	80	14
20	65	50	100	13
40	80	30	90	12
40	55	25	100	11
40	80	40	100	10
40	90	50	100	9
40	80	30	100	8
40	70	50	100	7
40	80	60	90	6
40	—	—	100	5
40	—	—	80	4
40	—	—	60	3
40	—	—	40	2
40	—	—	20	1
30	—	—	40	⅜
50	—	—	40	⅝
60	—	—	40	¾
70	—	—	40	⅞
50	—	—	20	1¼
55	—	—	20	1⅜
60	—	—	20	1½
63	—	—	20	1⅝
70	—	—	20	1¾
80	—	—	20	2

-Busby.

[57294.]—**Haydon's Cutter Bar.**—An article n which the method of grinding the cutters is lescribed, appears in this week's number.—Ed.

[57297.]—**Boiler.**—The fault is in the injector; out what it is cannot be determined without an nspection, or at least a scale drawing of the interior. —Essar.

[57302.]—**Scraping Metal.**—The short answer o this query is that the operator does not know ıow to do the work. Probably, he takes too short strokes. Let him persevere, and he will no doubt succeed.—C. T.

[57305.]—**Bronze.**—I should have thought that "Electra" would have looked in back numbers, or given at least some definite idea of what is meant by "brownish" colour. However, let him try the following:—Twelve parts hydrochloric acid, one part white arsenic, and one part oxide of iron, or sulphate of iron will do. Mix, and when the pieces have been thoroughly cleaned by dipping in aquafortis and rinsing in water, drop them into the mixture, or apply it with a brush. When dark enough, oil well, and when dry lacquer.—Nun. Dor.

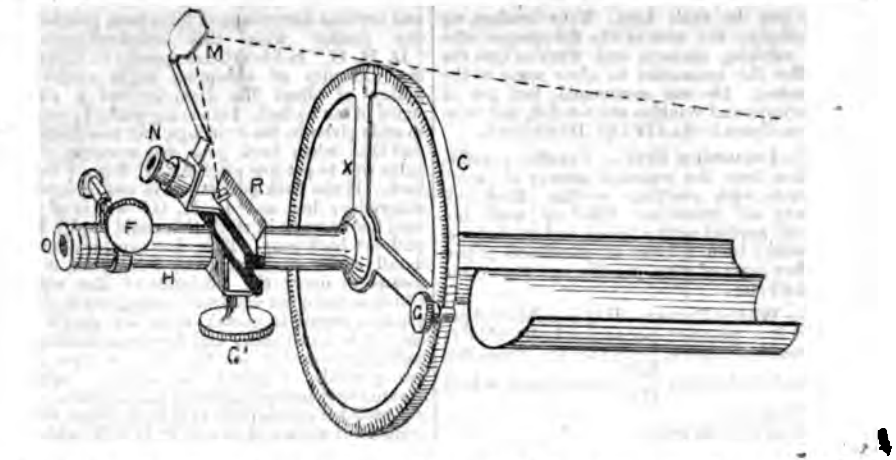
[57308.]—**Water Microscopes.**—Is not the account given June 5, p. 299, sufficiently explicit, or what is the difficulty of the querist?—G. E. D.

[57311.]—**Flour.**—The grittiness of which "P. W. R." complains is probably only fine dust from the millstones. He can roughly estimate the quantity of gluten by putting some of the flour in a muslin bag, and washing out the starch.—[illegible]

[57324.]—**Wire on F.M.'s.**—In a series-wound lynamo, the resistance of the field-magnet coils should be ¾ that of the armature. In a shunt-wound dynamo the resistance of the F.M. coils should be at least 200 times that of the armature. I am afraid Mr. Bottone has got a little "mixed" [illegible] in his reply to "Tubal Cain."—Electrical [illegible]er.

[[illegible].]—**Diffraction Grating.**—If "Rosicrucian" could get to see a copy of "Madeira Spectroscopic," by Piazzi Smyth, the Astronomer-Royal for Scotland, he would, I think, find what he wants about diffraction grating.—H. A.

[57341.]—**Polariscope.**—Annexed is sketch of arrangement by Laurent for combining the Penombré and Duboscq instruments. The polariser and bichromate plate are arranged as in the Penombré instrument; but between the circular scale C and the analyser O H, the ordinary bi-quartz and the rectilinear scale of Duboscq are inserted G¹.R.N.M. When using the bi-quartz and a white light, remove the bichromate plate, clamp the movable arm G to the circular scale by a screw (not shown in sketch), adjust the zero on the scale R to the neutral tint by the screw F. The instrument is now ready for use, and is manipulated like a Duboscq polariscope. When using the Penombré and sodium lamp, replace the bichromate plate, clamp the bi-quartz with the screw (not shown in sketch), release the arm G, replace the mirror M and the lens N upon the movable arm X to illuminate the circular scale C, adjust the zero on the scale C to the neutral point by the screw F. The instrument is now ready for use, and is manipulated like Laurent's polarimeter.—Dextrose.



[57401.]—**Loco. Slide Valves.**—I cannot do better than refer you to back numbers. See "Loco. Slide Valves. How to Set Them," Vol. XXXVII. p. 601, and Vol. XXXVIII. p. 343, for instance. If you have not these volumes, send for Nos. 962 and 978. The centres of eccentric rods may be from 5 to 7 times the throw of eccentric apart, measured on quadrant.—Glatton.

[57423.]—**Blowpipe for Soldering.**—What "Country Watchmaker" wants is, I think, one of Hacking's patent combined blowpipe, with flame attachment for soldering purposes. Spirit is used, and it does perfectly clean work. If "Watchmaker" cannot get one at a local tradesman, and he will send me his address, I will send him one for trial. —W. W. Hacking, Mount-street, Nottingham.

[57433.]—**Hydraulics.**—Certainly it is. Without knowing diameter of your ram, I cannot tell you the necessary water pressure per square inch; but you can easily estimate the total load required. Taking the shearing strength of iron at 50,000lb., we have to shear a strip of iron $\frac{1}{16}$in. and (6 × 3·1416) inches long—.

$$\frac{6 \times 3{\cdot}1416 \times 3 \times 50{,}000}{16} = 177{,}000\text{lb.}$$

If you make the face of punch to slope a little, so that one edge begins to cut first, you will save power, wear, and tear.—Glatton.

[57434.]—**Engine.**—If "Engineer" will note the weight, &c., of those flywheels which come under his notice, he can make a rule for himself. Thus,

$$K = \frac{W\,R^3\,D^2}{\text{I.H.P.}},$$

where K is a constant to be found from practice,

W = weight of flywheel rim,
R = revolutions per minute,
D = mean diameter of flywheel rim in ft.,
I.H.P. = indicated horse-power.

Having found K for three or four engines, take the mean value for it, and then

$$W = K\,\frac{\text{I.H.P.}}{R^3\,D^2}.$$

W may be taken in lb., cwts., or tons; but whichever unit is selected must be adhered to throughout. Rankine's rule, from which I have modified the above, is as follows:—

$$w = \frac{m\,g \triangle E}{v^2},$$

where w = weight of rim in lb.,
v = velocity of rim in ft. per second,
$\frac{1}{m}$ = fraction of mean number of revolutions which engine is allowed to vary by (= from $\frac{1}{32}$ to $\frac{1}{60}$),
g = 32·2,
$\triangle E$ = difference between maximum and minimum rate of putting every wheel into motion during the course of one revolution (= ft.-lb. per revolution × ·16) for an ordinary engine cutting off at half-stroke.

Taking $m\,g$ = 1,000, the weight for an ordinary engine cutting off at half-stroke,

$$= \frac{160 \times \text{ft.-lb. per revolution}}{\text{[illegible]}}\ \text{pounds.}$$

There are s[illegible]s, but they are mostly empirical. [illegible]etter take an engine running sa[illegible] is proposed conditions, find K from it, and use the second formula which I have given.—Glatton.

[57429.]—**Double Frame for Lathe.**—I have not one of these lathes, but I will try and obtain the sizes of wood for one of Holtzapffel's older lathes, if that will do. Perhaps Dr. Edmunds will kindly reply? I fancy a sketch has already appeared in these pages: does anyone remember?—Glatton.

[57436.]—**Siphon Lubricator.**—Take a piece of wick, soak it in water, and hang it over the edge of a tumblerful of water; one end in the water, the other outside and below the level of the liquid. You will see the wick acts like a siphon, and draws off the water. It does the same with the oil.—Glatton.

[57439.]—**Gas Supply.**—Molesworth gives the rule—

$$\text{Cubic ft. per hour} = 1{,}000\sqrt{\frac{D^5\,H}{G\,L}}.$$

D = diameter of pipe in inches.
L = length of pipe in yards.
H = pressure of gas in inches of water.
G = specific gravity of gas as compared with air (= about ·45, air being 1).

—Glatton.

[57449.]—**Sanitary.**—"X." entirely misses the point in dispute. His personal experiences of dustmen are, no doubt, interesting; but as the sanitary inspector said that there was nothing in his dustbin which the dustmen were not required to take away, it follows that the only reason they had for refusing was because the usual "beer money" was not forthcoming. It is usual to look for a trifle, I believe, where servants are kept, though I do not suppose "X." would have helped on beer-drinking if he had parted with 2d. It does not follow that "beer money" is spent in beer. "X." would have done more to help towards a settlement of this matter if he had said in what parish in London he lives. Some parishes do their own scavenging, and in that case the dustmen take anything; but where contractors are employed, something at least depends on the conditions of their contracts. The term used is, I believe, "house refuse," and if your correspondent can give a definition of what is to be understood by that, he will do more than has been done yet. The Public Health Act, 1875, sec. 42, provides that "Every local authority may, and when required by order of the Local Government Board shall, themselves undertake or contract for the removal of house refuse from premises," &c. The Act does not define "house refuse" or "premises," consequently such cases as have arisen have left the law in a condition which would not be tolerated if the "nation" only knew what a tangle it is in. Dust and ashes are clearly house refuse when burned in a private house; the local authority is not bound to remove them, however, when they are produced by a steam boiler in a factory. Several cases have settled that point; but the only one I can find about improper articles goes so far merely as to state that local authorities are not bound to remove articles improperly placed in a dustbin, such as "broken glass, shoes, and other things which it might not be convenient otherwise to get rid of." This decision was obtained in what some might consider a curious way; for the plaintiff was a contractor who sued a metropolitan vestry because some of their servants had abstracted from dustbins articles which he considered of value to him. He lost his case, the judge deciding that the local authority were not bound to remove such articles, and the contractor could not claim compensation. Of course, old boots and glass have a decided commercial value compared with the average contents of a dustbin. Perhaps some of your readers may know of other cases in which it has been positively decided what is "house refuse." There are many shopkeepers in London who would be glad to know how much trade refuse they may put in their bins. Your readers, no doubt, remember the case of the fishmonger who threw his stinking shrimps and winkles into the roadway for the contractor to clear away at the public expense. He was summoned, but got off because shrimps and winkles are not fish, but crustacea and mollusca!—SANITARY DUSTHOLE.

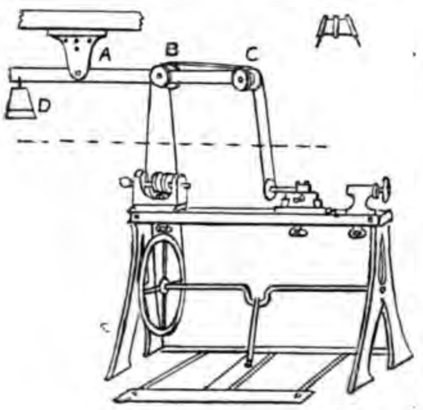
[57450.]—**Induction Coil.**—"Paraffin, paraffin, paraffin," has been the constant answer of "our" electricians to such questions as this. Each coil should have all interstices filled up with hot paraffin wax, applied with a brush and made level with the wire; then a layer of paraffined paper, then another layer of wire, paraffin, and paper, and so on.—GLATTON.

[57452.]—**Water-Power.**—If Q = cubic feet per second, and P = pressure per square inch, ·262 P Q = theoretical horse-power; call this E. From this has to be deducted ·00025 $\frac{LE^3}{D^5P^3}$ horse-power, which is lost by friction—

L = length of pipe in feet.
D = dia. of pipe in feet.
P = pressure in lbs. per square inch at entrance.

I take the above from Professor Perry's Cantor lectures on Hydraulic Machinery. (See p. 245, Vol. XXXVI. of ENGLISH MECHANIC). As length of pipe is not given, I cannot estimate the loss in your case. If driving a water-pressure engine, the speed of water is generally limited to 400ft. per minute. In a turbine the orifice is contracted so as to get the highest velocity available. How do you get 20lb. pressure with only 3ft. fall? 20lb. = 46ft. head. I do not think proposed contraction would help you.—GLATTON.

[57453.]—**Lathe Overhead.**—Not seeing any reply to above queries, I beg to send a diagram of an overhead I used thirty years ago to drive an eccentric cutter. I found it most efficient, and see no reason why it should not drive an eccentric chuck just as well. The lathe was made by Kennan, and the cutter by Grub (both of Dublin), but by which house the overhead was supplied I really do not remember. A, overhead attachment; B and C the four V-pulleys for gut; D, counterpoise; E, section of pulleys set on a bevel to angle of driving wheel.—T. HUGHES.



[57453.]—**Lathe Overhead.**—In reply to above "A. F. H." will find the description of "D. H. G.'s" overhead in a series of articles by "J. L." in the ENGLISH MECHANIC, commencing in the number for Friday, Nov. 5, 1875. As it was owing to a letter from me to the "E. M.," in which I rather dogmatically asserted my disbelief in any system for screw-cutting, in which reliance was placed on cords or pulleys, that "D. H. G." was induced to reply, stating that he had succeeded by the above means in producing practically perfect screws, I feel it due to that talented amateur to state that after so many years I have at last had leisure in which to complete an overhead according to his design, and, so far as I have at present experimented with it, I believe it is capable of doing all that is asserted for it by "J. L." in the articles mentioned, and by "D. H. G." himself in a subsequent series of articles in the "E. M.," commencing on Friday, Feb. 11, 1876. This overhead is certainly the most complete for all purposes, from ornamental work to heavy metal turning, that I have seen, heard, or read of; doubtless, it entails a considerable amount of labour, but it is within the scope of most handy amateurs who are capable of a fair amount of cabinet-makers' and fitters' work. "A. F. H." will probably be able to obtain the volumes in which "D. H. G.'s" overhead is described by advertisement in the "Sale Column." It is a double staff overhead, worked by a cord from the mandrel pulley, the frame of overhead being wholly detached from the lathe itself, and capable of adjustment in the horizontal and vertical directions. I have been puzzled about one matter with this overhead—viz., that "D. H. G." in his articles appears to lay stress on the difficulty of obtaining rapid pitches with pulleys of about 9in. diameter and a slide-rest screw of ten to inch. I made my pulleys pretty close to scale given in the drawings, and was surprised to find that when back gear was working, the difficulty was to get low pitches, say, from 8 to 20 per inch. If the back gear is not in use, of course it is otherwise; but as "D. H. G." writes of cutting very heavy work in steel, this could hardly be done without back gear. This, however, is a matter of detail easily overcome, and I mention it by no means to decry the efficiency of the overhead, which is really an admirable construction. To the amateur turner in metal, even for simple sliding only, it is invaluable; and for screw-cutting it has certainly answered for the short screws, such as are generally required for ordinary apparatus. Having only lately completed this overhead, I have not tested it extensively in this direction, but have turned out screws of 19 and 12 to inch, which were accurate enough to be finished off by the comb tool. This shows that the thread was fairly correct, enough, at least, for ordinary purposes. If "D. H. G." had favoured us amateurs with a few articles on screw-cutting, and on the best form of V-tool for the purpose, detailing the methods of obtaining the proper rake, and the setting-in and setting-on of the tool, I feel certain that they would be highly appreciated. Were his various articles on mechanical subjects published in a complete manner and duly illustrated, they would be a boon to many—even to professional workers. Few writers in the "E. M." have been more valued than "D. H. G." for striking originality and thorough acquaintance with their subjects, and amongst the many talented contributors how few there are who can equal him in his particular line. It was with deep regret I heard some time since that he was debarred from further work by illness: that it may not be of a permanent nature everyone who has studied his writings must earnestly hope. Why lathe-makers do not make this overhead at a reasonable price I am not able to understand, unless it is that it enables the amateur to turn out for himself all the odd pitches with which some of them delight to worry him, and which they only can re-duplicate.—R. W. F.

[57470.]—**Brush Dynamo.**—Judging from the data you have given me, I should say: 1st, The insulation on the armature must be defective, for 6 sections of No. 20 wire would certainly have a higher resistance than 0·350 of an ohm. 2nd, Supposing the insulation is right, the wire on armature is presenting far too great a resistance, for the running resistance of an armature having a total resistance of 0·350 is only 0·087. Now the resistance of fields should be only a little more than this, and yet you say it is 1·48, or about 17 times as great as it should be. 3rd, It is also just possible you may have connected wrongly to commutator strips. I should test the armature for insulation, and if that is defective, rewind with No. 16 instead of No. 20, using enough to balance F.M.—S. BOTTONE.

[57481.]—**Water Motor.**—Ascertain how much water will flow out of your $\frac{1}{2}$in. pipe per minute. Let me know this in pounds, and I will see what I can do for you.—GLATTON.

[57482.]—**Warm Water for Bath.**—Imagine a U-shaped pipe 5 or 6in. diameter, so placed that the two ends of the U project above the water. A lamp or charcoal fire is lit in one, and the air to feed fire descends in the other. This is the principle of many bath heaters; the shape is varied to obtain more heating surface. All are dangerous: as the fumes are deadly, they should be carried off by a funnel.—GLATTON.

[57493.]—**Screwdriver.**—To the good replies given let me add that an entirely round handle is easier and more effective in use than one flat at sides. Also, that the advice given some time ago by a correspondent, to bevel only one side of the edge of blade, as in a chisel, is good.—FISHERMAN.

[57516.]—**Tube Well.**—Thanks to F. M. Rogers and "Bream's-buildings" for their replies to my queries: it is not exactly what I require. I do not want the addresses of professional tube sinkers, I want the advice of those who have bought their experience. I have been told that the regular tube sinkers do not warrant a success. The depth of regular brick wells now is 60ft. to 70ft.; they get a good supply. F. M. Rogers, in his reply, speaks of the water rising in the tube to within 28ft. of surface; of course, that would mean a suck pump on the surface. I want to know how they get the water up the tube from 70ft. to 100ft. deep? Is the pump inclosed in the tube and driven down at the same time? If it is a force-pump, it must be at the bottom, or how? A description of this, and any practical advice on 70ft. tube wells, will be gladly received.—J. W. E.

[57495.]—**Stern Tube for Launch.**—
T = iron tube.
R = brass ring brazed on.
N = brass nut, jamming stern-post between it and R. It also fixes the bush containing white metal bearing W. If you have a bulkhead, as at B, it is a good plan to pour pitch into the space between it and the stern-post, so as to cover stern tubes. A bit of grummet should be twisted round tube where it enters the wood.—GLATTON.

FIG. 1

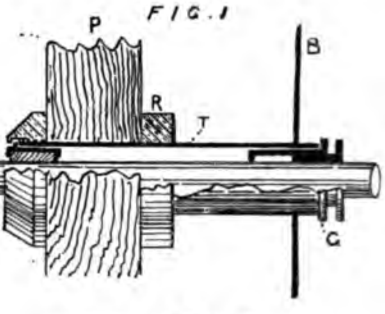
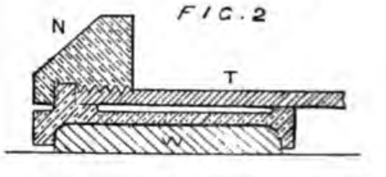
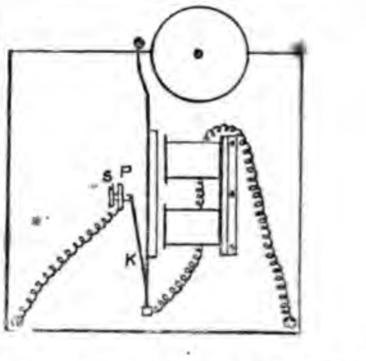


FIG. 2

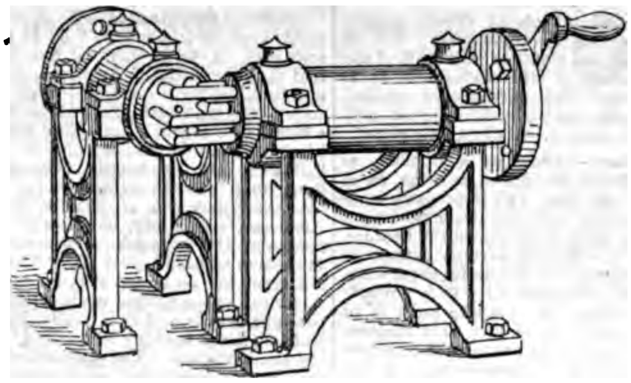


[57521.]—**Paper Wrapper.**—Patent by J. McDonald, Sept. 11th, 1872. Specification No. 2695.—R. B. W.

[57522.]—**Bell Ringing.**—From the way in which I read your query, I should think you have no contact breaker, for if the hammer is attracted, and you have a contact breaker, it cannot help but ring. If you have no contact breaker, the inclosed sketch may help you to make one. P is a pillar through which passes a platinum-tipped screw, S; against the screw presses lightly a platinum-tipped spring, K, which is riveted to the hammer spring, as in the sketch. One end of the coils of the electro-magnet is connected to the hammer spring, and the other end of the coils to one binding screw. The pillar, P, is then connected to the other binding screw. Now, when the hammer is attracted it causes the spring to leave the screw, S, and so breaks the current, whereupon the hammer springs back and makes contact, and so on.—A. W. J. LAUNDY, Stratford, Essex.



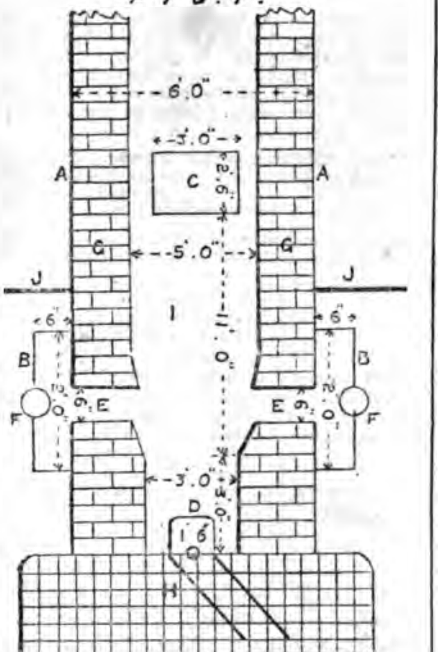
[57529.]—**Cupola.**—The principal dimensions of an ordinary type of cupola to melt 6 tons of cast-iron per hour may be: Outside diameter, 4ft. 9in.; height above the hearth, 15ft.; inside diameter for about 4ft. near the hearth, 3ft. 8in., tapering slightly upwards to 3ft. at level of charging platform; Tuyére nozzles, 7in. diameter, 2ft. 6in. above the base plate, and second row of 5in. diameter about 15in. above these. The cupola may be plated with $\frac{1}{16}$in. iron plates, and lined with best firebrick, not less than 9in. thick. Everything considered, the advantage lies with the method of running the metal as melted into the ladles. Either blower is decidedly better than a fan; but the choice between Root's and Baker's must be mainly decided by difference in cost and economy in repairs and working, for as far as regularity of supply is concerned the difference must be [illegible] Pressure of blast may be between $\frac{3}{4}$lb. and [illegible] square inch. The amount of coke [illegible] condition of the cupola, care in [illegible] quality of coke. Under favoura[illegible] tons of metal may be melted [illegible] coke. I do not know where [illegible] used, and so cannot say whe[illegible] success or not.—TEMERAIRE.



[57508.]—**Backlash in Gearing.**—A method gearing, of which I send photo, and which tirely obviates backlash, is illustrated by a rking model at the International Inventions hibition (exhibit 1,286, south gallery, north art). The gearing is effected by rods instead of th.—D. R. CAMERON.

[57529.]—**Cupola.**—I herewith send a sketch of pola, size taken from one I have often cast out as the dimensions are given. Of course, you nt a blower. I have been accustomed to have 30ft. Fig. 1, front view; Fig. 2, section; A A, shell of cupola; B B, air belt; C is charging door; D, tapping hole; E E, tuyeres; F F, peephole; G G, brick lining; H, brick bed; I, inside of furnace; J J, furnace stage lined with firebrick, and damped with Sheffield ganister and ground fireclay. Fig. 2, G G, brick lining; B B, air belt. Inside the blast pipes ought to be about 12in. dia., two of them into the belt; casing to be about ½in. wrought iron.—SAND RAT.

FIG. 1.



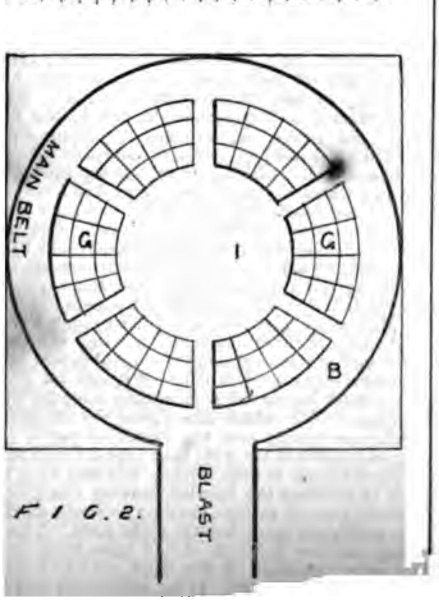


FIG. 2.

[57529.]—**Cupola.**—I omitted in my last week's answer to "Cupola" to give him the dimensions of Root's blowers, so I have sent an account of Root's and Baker's blowers.

Root's

Number.	Tons per Hour.	Size of Cupola.
2	2½	26in. to 30in.
3	4½	30in. to 36in.
4	8	36in. to 48in.
6	16	48in. to 60in.

Baker's

Number.	Tons per Hour.	Size of Cupola.
3	¾	18in. to 22in.
6	1¼	22in. to 27in.
9	2	27in. to 30in.
13	2½	30in. to 34in.
17	3¼	34in. to 40in.
25	5	40in. to 48in.
30	8	48in. to 52in.
60	10	52in. to 84in.

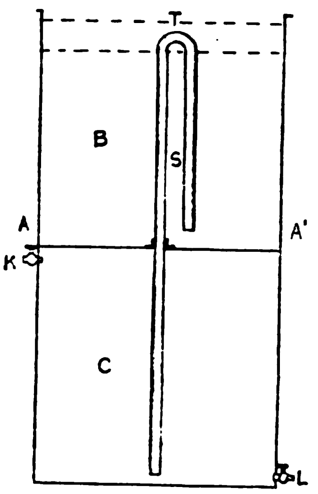
—SAND RAT.

[57531.]—**Pulleys.**—The proper size of pulley required is 30·24in., or 30¼in., as given by "J. P." in last issue, is near enough for all practical purposes. "H. L. C.'s" reply of 31½in. is quite wrong. —SURVEYOR.

[57536.]—**Tin Scrap.**—I have tried to consider the query from a practical and monetary point of view, and think it best to dispose of the tin scrap as it is. Several patents exist for the recovery of tin by the action of chemical reagents, with or without the aid of electrolysis, several of them very good; but the necessary apparatus and reagents might be found to be too costly, besides there being practical difficulties in carrying out the process.—TEMERAIRE.

[57544.]—**Harmonium.**—In my reply to this query, which appears on p. 87, for the word "devise," read "deride."—G. FRYER.

[57547.]—**Gas Tank.**—In the tank described on page 525, Feb. 13, 1885, the pressure would not be equal until the gas was all consumed, owing to the decreasing weight of water above. "Nemo" is right: it would require a great pressure on the gas to force the water into the top chamber. I send sketch of a design of mine for overcoming the difficulty of pressure. A A is a tank having two chambers, B and C. Through the bottom of chamber B passes one leg of a siphon, S, nearly to the bottom of chamber C. The bend of the siphon must come within an inch or so of the top of chamber B, and the small leg nearly to the bottom. To charge the tank with gas, first fill the bottom chamber C with water, and also the top chamber B to within a short distance of the bend T. Then [illegible] tap K to the retort, and turn on tap L; [illegible] will flow out as the gas flows in. [illegible] B [illegible] and above the bend T, [illegible] the [illegible] the top chamber. The tube of the siphon should be about twice the size of the bore of the tap K. I should like the criticism of the readers of the



"E.M.", as I have not made one, and I cannot speak as to the efficiency of the apparatus.—A. W. J. LAUNDY, Stratford, Essex.

[57549.]—**Chemical Calculation.**—

$$\frac{\text{Caustic, 70 p.c.} - \text{10 p.c. caustic}}{\text{Coustic, 10 p.c.} - \text{0 p.c. caustic}} = \frac{\text{60 parts of ash } \textit{weak} \text{ in caustic}}{\text{10 parts of ash } \textit{strong} \text{ in caustic}} = \text{70 parts}$$

of mixed alkali. And these 70 parts of mixed alkali consist of—

		Pts.			lb.
Sodium carbonate,		60 =	85·7143 p.c. =		1,920
" caustic	Na_2CO_3,	8 =	4·2857 p.c. =		96
	NaHO,	7 =	10,0000 p.c. =		224
		70	100·0000	=	2,244
				=	1 ton.

—GARNGAD ROAD.

[57561.]—**Phosphorus and Silicon in Steel.**—If "Novice" will get an iron plate, say, 18in. by 9in., and ¼in. thick, support it in any convenient way, and heat it by means of a couple of Bunsen burners, he will find he can evaporate his solutions of steel on it with considerable rapidity, and the "confounded nuisance" will be reduced to a minimum. Does he use dishes or beakers? I find good-sized beakers (not less than 20oz.) most convenient. He should have the burners nearer one end of the plate than the other, so that he can move his evaporations to a cooler place when they show signs of spirting.—MERCURIUS, F.I.C.

[57569.]—**Electric Light.**—Leclanché cells are of no use for this purpose whatever, and the fairy lamps at 7d. are most likely mere rubbish. Have nothing to do with them. You had better invest in a composite candle.—C. D. R.

[57569.]—**Electric Light.**—The Leclanché is not suitable, not maintaining a constant current, which is essential for the production of electric light. You will at the least require two 5-c.p. lamps, and six or seven Bunsen cells to light your window well (as described in answer to query 57403). The probable cost about 15s. if the batteries are constructed by yourself. The fairy lamps, as advertised, are 1 c.p., and are constructed for artificial flowers, breastpins, &c.—W. HABGOOD.

[57569.]—**Electric Light.**—Leclanché batteries are of no use whatever for electric lighting. The most suitable are Bunsens, Groves, and bichromates. If you require to have the batteries indoors, the bichromate will be most convenient; both Bunsens and Groves give off nitrous fumes, which, to say the least, are very unpleasant. The lamp you mention would not be of any service; the light would be too small, and, again, a good lamp cannot be got at anything like that price. If a very small window, you might have a low-resistance carbon lamp, as advertised in Sale Column, of 10 c.p., that could be lighted by six or seven cells. These you could make yourself, if you decide on either Bunsen or bichromate.—E. THORNTON.

[57570.]—**Defective Flue.**—In consequence of the fire and sweeping, the flue may be a little larger than it was at first, causing more air space at bottom. I have cured a similar case of smoky chimney by curtailing the bottom space with a sheet of iron. It rests on the edge of the hobs and passes up under the front of fireplace, fitting as close to the flue as possible. Perhaps the fire in the [illegible] has caused it to evolve carbonic acid gas, being a heavy gas, and acted upon by the cold above, would naturally fall into the room. If that is the case, you had better have the flue swept clean and limewash the inside.—Verax.

[57574.]—**Reversing Gear for Electro-Motor.**—I am sorry "B. W. L." cannot understand the sketch in No. 1066. Thinking it self-explanatory, in my haste I omitted to letter and describe the parts. In the sketch an eight-part collector is shown, on either side is a brush-holder pivoted at its middle and having two brushes. As shown, one pair of brushes is in contact, touching opposite strips of the collector; if the handle and lever be moved towards the left the rollers will slide on the brush holders, which will turn on their pivots, raising one pair of brushes and bringing the other pair of brushes in contact at a different place on the collector, thus giving a lead in the opposite direction.—Eugene Brown.

[57576.]—**Battery for Electric Light.**—To Mr. Bottone.—Mix equal parts of common hydrochloric acid and water. Add to the mixture as much powdered bichromate of potash as it will take up. An excess will do no harm. Pour off the clear solution into the battery. You will require nearly six quarts. The F.M. of this cell is nearly two volts. The resistance of a 5-candle lamp (Swan) is about eight or ten ohms. Hence, $6 \times 2 = 12 \div 8 = 1\frac{1}{2}$ ampère. The six cells arranged in one series will give the best results.—S. Bottone.

[57578.]—**G.W. Engine.**—No. "9" is quite a new type of G.W. narrow gauge engines. It is not a compound, as there are none working on the line. It was built in Sept., 1884, and has, till just lately, been working between Swindon and Bristol. It has inside cylinders, 18in. by 24in., and outside eccentrics. The steam chests are placed above the cylinders, and this accounts for the great increase in height of the boiler. The driving wheels are 7ft. 8in., and leaders and trailers 3ft. 10in; wheels on tender 3ft. 6in. The tender is much larger than those of the old 7ft. singles. The total length of engine from buffer to buffer is 51ft. 8in. According to the driver, she steams "excellent," but runs "rather uneven."—F. J. P.

[57580.] — **Dentistry.** — If this querist will procure the catalogue issued by Messrs. Churchill, of New Burlington-street, W., he will find a tolerably long list of works on the various branches of dentistry; and no doubt if he visited them they would allow him to look at the books, in order that he might make a selection. I daresay other publishers issue works of a similar character; but I think he will find all he wants in Churchill's catalogue.—A. Mallard.

[57580.]—**Dentistry.**—In answer to "Reflex," let me say that any information I can afford will be given with pleasure; but preparation for the L.D.S. degree means a great deal more than study of books, and of this the following regulations of the General Medical Council, now in force, will give an idea:—(*a*) Dental students must be registered; (*b*) no person shall be allowed to be registered as a medical or dental student unless he shall have previously passed a preliminary education examination in the subjects of general education, as specified in the following list:—1. English language, including grammar and composition. 2. English history. 3. Modern geography. 4. Latin, including translation from the original and grammar. 5. Elements of mathematics, comprising (*a*) arithmetic, including vulgar and decimal fractions; (*b*) algebra, including simple equations; (*c*) geometry, including the first two books of Euclid, or the subjects thereof. 6. Elementary mechanics of solids and fluids, comprising the elements of statics, dynamics, and hydrostatics. 7. One of the following optional subjects: (*a*) Greek; (*b*) French; (*c*) German; (*d*) Italian; (*e*) any other modern language; (*f*) logic; (*g*) botany; (*h*) elementary chemistry. List of examining bodies and registration forms obtainable at Medical Council office, Oxford-street, London. (*c*) Students must pass four years in professional study after registration; (*d*) one year's bonâ-fide apprenticeship with a registered dental practitioner, after being registered as a dental student may be counted, as one of the four years of professional study; (*e*) three years of instruction in mechanical dentistry. These or any part of them may be taken by the dental student either before or after registration as a student, but no year of such mechanical instruction shall be counted as one of the four years of professional study unless taken after registration. The professional study referred to in Clause C embraces attendance upon courses of lectures and classes as follows: Anatomy, physiology, surgery, medicine, chemistry, materia medica, dissections and demonstrations, practical chemistry and metallurgy, practice of surgery and clinical lectures, dental anatomy and physiology, dental surgery, and dental mechanics. The student must also attend for two years the practice of dental surgery in a recognised dental hospital, or in the dental department of a recognised general hospital. The total fees amount to about £75, spread over the four years. The deans of any of the London or provincial schools of dental surgery will furnish prospectus on application; but if "Reflex" desires it, and states in what part of the kingdom he is resident, I will advise him as to choice of school, &c. The purchase of medical and dental class books had better be deferred until he is registered as a student.—Dental Reform.

[57583.]—**Dynamo.**—Although a dynamo so wound would not do for continuous working, as so fine a wire would get hot; yet, if properly insulated, it would certainly light ten 10-candle lamps. Of course it cannot light properly one 3, because, being series-wound, sufficient current cannot go round the field magnets to magnetise them when only one lamp is on. Perhaps, also, it is wrongly coupled up, and then the 3-candle lamp is lit by the residual magnetism of the field magnets only. The laminated armature would improve matters only inasmuch as it keeps cooler. A 100 c.p. dynamo could not be driven from a lathe properly. It would absorb at least half h.p.—S. Bottone.

[57584.] — **Dynamo, Books on.** — Dredge's "Electric Illumination"; S. Bottone's "The Dynamo: How Made and how Used"; and Cassell's "Electrician's Pocket-Book."—S. Bottone.

[57586.]—**Elwell-Parker Accumulator.**—I have no practical acquaintance with these, and can therefore give no reliable advice.—S. Bottone.

[57587.]—**Glycerine Barometer.**—Varnish all over top of cork and round tube with hard spirit varnish, and you will easily overcome your difficulty.—Surveyor.

[57589.]—**Incandescent Lamps: Platinum.** My advice is that of *Punch* anent matrimony—viz., Don't; but if you are determined to try, read the method of procedure and causes of failure in Dredge's "Electric Illumination."—S. Bottone.

[57590.]—**Piano (Strings for).**—The rusting of the strings does not materially affect the instrument; change them as they break. Use the best steel wire only (made by Smith, of Warrigton; London agent, Goddard, of Tottenham Court-road). Silver strings are never used for pianos: they are much too soft.—S. Bottone.

[57590.]—**Piano.**—Silver strings are no good for a piano. There are most likely five different sizes of wire on your piano, perhaps from No. 12 to No. 17. If you have no wire gauge, take a string of each size and send it to Messrs. Goddard, Tottenham Court-road, London. They will send what you require, from ¼lb. to any amount at 2s. 6d. per lb. You want about 3lb. If you want to renew the covered strings in the bass, take them off, but keep each note separate by interlacing a string, and send them there also. The whole set of covered strings will cost about 12s.—J. H. Schucht.

[57591.]—**Photography.**—The negative evidently did not require intensification, and the bichloride of mercury solution was used too strong; try soaking it in water for an hour, then soaking for some time in a weak solution of bichloride of mercury until quite white. Do not apply any ammonia; perhaps this will reduce the density somewhat.—S. Bottone.

[57592.]—**Electric Motors.**—Except where steam or gas-engines are not procurable, the electric motor is not to be recommended for lathe driving, as it is costly and requires skilled attention: but where steam or gas is inadmissible, the electric engine, actuated by a battery or accumulator, will be found an excellent substitute.—S. Bottone.

[57593.]—**Straightening Sheet-Iron Plates**—You cannot remove the buckles from your sheets 24in. square, 24 gauge, by striking them in any particular place with a hammer. The process is cold rolling, after which you would have to reanneal them. It would cost you hundreds of pounds to put down a plant for this description of work. Your best plan is, in ordering your iron, specify *flat sheets*. You should have no difficulty in getting them. Buckles in sheet iron are caused by improper manufacture, which renders the sheets defective.—J. Vivian Harris.

[57593.]—**Straightening Iron Plates.**—A "buckled" plate means that some part or parts of the plate are bound round by other parts, having too small an area to allow the inner parts to lie flat, and force them to take a curved form on the principle that the chord is shorter than the arc; or the marginal parts may be too large for the inner parts, which is just the reverse case. These distortions may be pretty regular, or quite local. Of course, the remedy is to balance the parts by gently and carefully stretching, by means of the hammer, the small or "tight" parts. If there are a number of small places, throw them into one regular form, and then reduce equally, which in the end saves time. Your 24-gauge iron is light and sensitive, and you require to be able to use a planishing hammer well to do this work properly.—Ed. Stuckey.

[57596.]—**Orguinette.**—It is not quite clear what kind of instrument "A. B. C." requires to construct. I think that he has been previously told that the ordinary American cavity boards are not suitable for automatical musical instruments such as the orguinette, &c. If he wishes to make a barrel reed organ, I am quite willing to render him all possible assistance. If the space for bellows is 24in. in length, 15in. wide, and 24in. deep, that will be sufficient for three rows of 3½ octaves, but out of pity for the ingenuity of American machinery, don't spoil a good 3½ row cavity-board for the sake of so mean an instrument as the one surmised. "A. B. C." may not (or does not seem to) be aware that he can easily obtain American organ suction reeds, without purchasing the tube boards, and it is really a pity, and a very bad judgment, to think of spoiling the latter under the circumstances. The most suitable material for making the suction bellows is rubber cloth, which, if good, is thoroughly air-tight. The ordinary American cloth is not suitable for bellows work. Sometimes (but not often) the suction bellows are made similar to that of harmoniums, that is, with ribs and suitable sheepskin, but a suction bellows made of good rubber cloth is preferable, for more reasons than one. If the editor will grant me sufficient space in the "E. M.," I shall be pleased to give instructions (with necessary diagrams) how to make a good and reliable suction bellows.—G. Fryer.

[57603.]—**G.W.R. Broad Gauge.**—For photographs of these engines "Great Britain" should write to F. Moore, of 1, Naas-road, Wood-green, who almost constantly advertises in "Our Sale Column." I would also recommend "A. F. O. R." (query 57618) to do the same; as, if I remember rightly, an engraving of a B. and E. 9ft. tank has already appeared in the "E. M.," and it is hardly fair to ask our Editor to repeat these illustrations when a photograph can be procured, as above, for a few pence. Diameter of boiler of Great Britain (G.W.R.) is 4ft. 6in.—Z. Y. X.

[57605.]—**Difference of Power.**—Supposing the length of stroke to be, in the first instance, 30in., and, in the second instance, $\frac{94{\cdot}4}{2} = 47{\cdot}2$in. As all the conditions are the same, except the length of stroke, the difference of power may be expressed by the ratio $\frac{47{\cdot}2}{30} = 1{\cdot}57$, the actual horse-power may be obtained by the formula

$$\text{h.p.} = \frac{2\,S\,R\,A\,P}{33{,}000},$$

where S = length of stroke in feet, R = number of revolutions per minute, A = area of piston in square inches, P = mean pressure in cylinder. Then, in the first instance:

$$\frac{5 \times 80 \times \frac{12^2}{{\cdot}7854} \times 40}{33{,}000} = 54{\cdot}8 \text{ h.p.}$$

In the second instance

$$\frac{7{\cdot}85 \times 80 \times \frac{12^2}{{\cdot}7854} \times 40}{33{,}000} = 86.04 \text{ h.p.}, \quad 54{\cdot}8$$

$\times\ 1{\cdot}57 = 86{\cdot}04$. The same rules will apply to water pressure.—Eugene Brown, Newcastle.

[57608.]—**Polisher's Glaze.**—To make glaze, take ½lb. of benzoin, pound it small, put into an empty wine bottle (1½ pint), fill the bottle nearly full of methylated spirit, cork up, shaking or stirring occasionally; set aside till next day; afterwards strain off into another clean bottle; it is then ready for use. Now for the couch: The cause of the cissing, as it is termed, is due to the fact of the old polish or varnish not having been softened; the peeling off was probably due to dampness. All polishing or varnishing should be done in a warm, dry room, free from dust. If the back of the couch was one of the ordinary plain ones, free from carving, a "Country Cabinet-maker" should have first of all washed it in weak soda water, to remove all dirt, furniture cream, &c. (which, by the way, may have been the cause of half his trouble), when perfectly dry, papered with fine glass paper, polishing and spiriting out in the usual way. If there was much carving, the work (after washing and papering of course) should have had two or more good rubbers of polish all over; then varnish the carved work, setting aside for 10 or 15 minutes, after which take a good wet rubber of polish, pass smartly over the varnished parts, setting aside again if too wet; then repeat the rubber, simply thinning it with spirits; this will have the effect of levelling the varnish, leaving when dry a perfectly smooth surface, showing no brush marks; then polish and spirit out the plain parts. I have, so far, said how the work should have been done. The sorry spectacle of the work, as left by our friend, I am sorry for. If he wishes to make a creditable job of it, I would suggest two courses as open to him: either scrape all the old polish off, and repolish, or strip the old polish off with plenty of spirits and glass-paper. Then proceed as I advised, and again respectfully I say: K off large or flat surfaces; in its right useful, such as chamfer edges, mouldings, uch like. Even then a wet spirit rubber be passed smartly over it, to give it the ance, as nearly as possible, of spirited work. in be of further service to you, the Editor, or iders, I shall be glad at some future time to an article, or series of short articles, on h polishing.—LIFE BOAT.

509.]—**Dynamo Construction.**—TO MR. ONE.—Not knowing exactly what form you e giving to the F.M.'s, I am not able to give measurement of the top coupling piece. See 07 for a plan to scale, which can be enlarged it. The pole pieces should embrace about quarters of the whole circle.—S. BOTTONE.

518.]—**Construction of Formula.**—The ring answer may probably be what "Glatton" es:—The numbers given in the question isly $2^3{\cdot}3^3$, $2^3{\cdot}5^3$, $2^3{\cdot}6^3$, $2^3{\cdot}9^3$, it is easy to see that re of the form—

$$N = (2\,n)^3$$

there were a set of numbers, related as in the on, but with less indication of the manner in they were connected, it might reasonably be ed that they were included in the formula

$$N = (f.\,n)^x$$

f is an unknown factor, and x an unknown And, first, let us suppose that the formula iired for the numbers given, in which the co-at f is known to be 2, but the index x is un-, or the formula to be

$$N = (2n)^x$$

g logarithms, we have—

$$\text{Log. } N = x\,(\text{log. } 2 + \text{log. } n);$$

ore—

$$x = \frac{\text{log. } N}{\text{log. } 2 + \text{log. } n}.$$

lustration, take any pair of numbers given in estion, say, N = 1728, and $n = 6$; then we

$$x = \frac{\text{log. } 1728}{\text{log. } 2 + \text{log. } 6} = \frac{3{\cdot}23754}{1{\cdot}07918} = 3.$$

in the particular set of numbers given we y know to be the index required. Next, se that in the formula

$$N = (f\cdot n)^x$$

and x are to be found. For this purpose, ist know two pairs of the set; let these be d n_1, N_2 and n_2. Substituting these succes- in the formula, and taking logarithms, we

$$\text{Log. } N_1 = x\,(\text{log.} f + \text{log. } n_1)$$
$$\text{and log. } N_2 = x\,(\text{log.} f + \text{log. } n_2).$$

which we have—

$$x = \frac{\text{log. } N_1 - \text{log. } N_2}{\text{log. } n_1 - \text{log. } n_2}$$

$$\text{and log. } f = \frac{\text{log. } N_1}{x} - \text{log. } n_1$$

example, let two pairs of numbers be—

$$N_1 = 869 \quad n_1 = 6$$
$$N_2 = 763 \quad n_2 = 5;$$

$$\therefore \quad x = \frac{\text{log. } 869 - \text{log. } 763}{\text{log. } 6 - \text{log. } 5}$$
$$= \frac{{\cdot}05650}{{\cdot}07918} = {\cdot}7135 \;.$$

$$\text{Log. } f = \frac{\text{log. } 869}{{\cdot}7135} - \text{log. } 6$$
$$= \frac{2{\cdot}93902}{{\cdot}7135} - {\cdot}77815$$
$$= 3{\cdot}34101.$$

the set of numbers, related in the same way se that have been given, would all be in- l in the formula—

$$N = (3{\cdot}34101 \times n)^{{\cdot}77815}$$

logarithms—

$$\text{Log. } N = {\cdot}77815\,[\text{log. } 3{\cdot}34101 + \text{log. } n].$$

isual, when a set of numbers are to be com-, to compare with others obtained from obser-s, to use the formula $N = A\,(n)^x$, which is nother form of the one given above.—MIL-ON.

615.]—**Coals and Fraud.**—Of what is ed—

h ton consists of 0·979 coals + 0·021 ton of fraud.
00 " " 979·17 " + 20·83 "
ton contains £1·10156 coals + £0·02344 "
00 " " £1,101·56 " + £23·44 "

$$\frac{23{\cdot}44 \times 100}{£1{,}125} = 2{\cdot}08 \text{ per cent. fraud};$$

$$\frac{\times\ 2{\cdot}08}{00} = £{\cdot}02342 = 0{\cdot}56 \text{ pence increase per}$$

GARNGAD ROAD.

611.]—**Shunt.**—TO. MR. BOTTONE.— fnly, of [illegible] so doing you lose some of [illegible] of th [illegible] you are sure that the dynamo will not "reverse" as it might otherwise do. I should advise you not to insert so great a resistance; about 60 times that of the armature would be ample.—S. BOTTONE.

[57626.]—**Calculation.**—The quickest way is take two-thirds of the kos. per square mm., and diminish the result by 5 per cent. Thus 32 × ⅔ = 21·333, deduct 5 per cent. = 1·066, which gives 20·266 tons per square inch, the correct amount being 20·3143. If you often want to make the calculation, draw a scale by setting out 203¼mm. on one side of a straight line, marking each mm. and every tenth mm. Divide this length into 32 equal parts on the other side of the line. Then simple inspection will give French in English or English in French. You can extend the scale to double its length and value if you wish.—J. S. C.

[57626.]—**Calculation.**—The unit in question is of the same dimensions as velocity; weight and area being substituted for length and time. The numerical magnitude of a velocity varies inversely as the unit of length and directly as the unit of time; hence we have—

$$\frac{\text{kilos.}}{(\text{millimetre})^2} : \frac{\text{tons}}{(\text{each})^2} :: 1 : \frac{645{\cdot}16}{1016} = {\cdot}635.$$

∴ kilos. per sq. mm. × ·635 = tons per sq. inch.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[57626.]—**Calculation.**—The quickest way to convert kilogrammes per square millimètre into tons per square inch, is to multiply the number of kilogrammes by the factor 0·000,001,525,578. The method of stating the question and working it out to obtain the factor is as follows:—How many tons per square inch is 1 kilogramme per square millmètre equal to, if 0·45359265 kilogramme equals 1lb., 2,240lb. equal 1 ton, and 645·13669 square millimètres equal to 1 square inch?

$$\frac{1}{x \text{ tons} \times 2{,}240 \times 0{\cdot}45359265 \times 645{\cdot}13669} = 0{\cdot}000{,}001{,}525{,}578,$$

and 0·000,001,525,578 × 32 = 0·000,048,82 ton per square inch.—GARNGAD-ROAD.

[57630.]—**Water Gauge.**—Under similar circumstances, only with larger works, we use an electric indicator, which shows on a dial in engine-house the level of water in reservoir. The pressure-gauge on air-vessel will not serve for this purpose, even when working at its best.—SILEX SEADRIFT.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

57074. Lens for Mirror Galvanometer, 462.
57082. Hydraulic Leather Collars, 462.
57085. Heating Surface of Vertical Boilers, 462.
57089. Electric Cement, 462.
57093. Beam Engine Slide-valve, 462.
57095. Photography. To Mr. Lancaster, 462.
57105. Street Coil, 463.
57114. Cylinder for Reservoir, 463.
57117. East Coast Express, 463.

57275. King's College Dynamo, p. 551.
57285. Focus of Lens, 551.
57287. Angular Aperture of Micro. Objective, 551.
57293. Razor Grinding, 551.
57299. Steel Castings, 551.
57300. To "Invicta," 551.
57314. Electrical, 552.
57318. Lippmann's Ampèremeter, 551.
57319. Electro-magnet, 551.

Compressed Pyrogallic Acid.—Messrs. Marion and Co. send us a packet of their new compressed pyrogallic acid. Each cake contains 100 grains, and is scored into squares of 4 grains each, which can be easily and cleanly broken off. All photographic workers know the danger of loose pyro. powder, which is very volatile and flies about the dark room, doing no end of mischief amongst the solutions and plates. Messrs. Marion and Co.'s compressed pyro. does away with any risk of this kind, and they guarantee it to be of the best quality.

Pearl Life Assurance Company.—The twenty-first annual general report of this flourishing company, notwithstanding the serious general depression of the past year, reveals a very successful and marked increase in the prosperity of the institution, which all are so proud to serve—an increase which has exceeded that of any year since the incorporation of the company. 337,238 policies were issued during the past twelve months, representing a new [illegible] premium income of £119,894 10s. 11d. [illegible] income for the past financial year [illegible] 107 1s. 1½d., and exceeded th[illegible] us year by £19,389 12s. 7½d.

QUERIES.

[57631.]—**Electro-Plating.**—TO S. BOTTONE AND OTHERS.—How is it I cannot plate an article properly? I use three pint Daniells, and bring the current from a shed in the garden to the other end on insulator, a distance of about 20ft. from plating-bath. When the article is immersed (after a thorough cleaning), it assumes a muddy appearance in the course of a minute; but if I only allow the anode to dip about 1-16in. in bath the deposit appears of a dull brickdust colour. I have tried connecting up the battery for quantity and intensity. I took one cell off, but still the deposit is the same muddy colour, and comes off when a brisk rubbing is applied with a leather. Moving the article about has no effect whatever. When the whole of the anode is immersed it is covered with a reddish film after it has been working for about five or ten minutes. My solution is made thus: Nitrate of silver dissolved in about one pint of water and precipitated with a clear solution of lime water, afterwards well washed, and enough cyanide of potassium added to dissolve the precipitate with a little in excess, and enough water added to make three quarts. Is there any other better way of preparing a solution than this, and what could I use instead of cyanide of potassium, as it is a great trouble to procure where I live?—DENMARK HILL.

[57632.]—**Technical Education.**—I want to give my son, aged eleven, a thoroughly practical education. My idea is to let him have lessons during the day, or part of it, in some technical school, or in a series of workshops, so that he may learn the use of his hands and of tools, and become proficient in carpentry, turning wood, and, perhaps, metal: brazing, soldering, and some sheet-metal work of light kinds. In the evenings, three or four times a week, he is to have a tutor for Euclid, algebra, mechanics, &c. By such a training I hope to cultivate his power of observation, and the consequent faculty of self-education. My difficulty is to find such means of technical training as I desire. The City of London schools and South Kensington have a minimum limit of 14 years of age, and, besides, their object is to some particular issue, while I wish to wait until the course I propose for my boy has had time to indicate, by some show of special aptitude, what career will be the most suitable? Any limits or advice as to schools or workshops, in W. or N.W. especially, will be most acceptable. I advertised my address in the last number.—THEORIST.

[57633.]—**Acid in Oil.**—How can I tell when oil contains acid; also what kind and quantity?—RERA.

[57634.]—**Photography.**—Will any reader of "Ours" say in what books I shall find an account of a process (patented) for photographs to be transferred to a copper plate, the plate etcher leaving the subject raised ready to be printed from?—CHROMO-LITHOGRAPHER.

[57635.]—**Milk Analysis.**—TO MR. ALLEN, OR MR. GREY.—Will either of these gentlemen give a description (with a rough sketch, if possible) of the apparatus generally employed for the determination of the albuminoids in milk? All the information I can get is that there is a funnel with a return cooler.—YOUNG CHEMIST.

[57636.]—**To Mr. Bottone.**—I am making an electro-motor. F.M.'s are two plates of wrought iron, 26in. by 8in. by ⅞in., wound for 4in. of their height (8in.), with four layers of No. 14 c.c. wire. They are joined by a similar plate at the top. The diameter of the groove in the pole-pieces is 4⅛in. Kindly say what thickness of laminations and what length and shape should be used for A; and also size and number of turns of wire to produce best results, so that it could also be used as a dynamo. Please state number of cells required to obtain best effects.—W. B. L.

[57637.]—**Belting.**—What is the least width of leather belting that will transmit 3½ H.P., with pulleys 20in. dia.? Also may I ask how much chloride of silver will be required to cover a 3in. by 1½in. silver plate (both sides)? Would that sized plate do for working a medical coil, and how should the chloride be melted on; should it be spread on the plate and then melted, or how?—IGNORANT.

[57638.]—**Limelight.**—Will a friend assist me? I wish to know if I can place the cistern on the floor containing the ether and attach a branch indiarubber pipe from gas bag to cistern and another to jet? Will the ether destroy the tubing? I cannot have the cistern close to jet, because I have to tilt the jet much for my purpose, and, I am afraid, would cause ether to run down pipe. Has any one tried Marey's hydrocarbon gas generator, of Philadelphia? If so, with what result? Information on this matter will favour.—PORTABLE.

[57639.]—**Privet.**—My neighbour has raised a portion of his garden, and I wish to raise a privet hedge to his level, with a stone-faced, or rockery, foundation, to prevent his elevation from tumbling through my hedge. What is the right time for transplanting privet, and how far would it be safe to fill up around any of the stems (which are about 4ft. high) without transplanting to a higher level?—FISHERMAN.

[57640.]—**Carbonic Acid Gas.**—I use vitriol and whiting for generating carbonic acid gas for aërated water purposes, the resulting product being thick, which chokes up drains, and is always incurring expenses. There is a (new to me) process for making the gas from hydrochloric acid and limestone, which, I think, from description, will be a great saving every way, the product in this case being a liquid, and is easily run away. But what I want to know is: if the carbonic acid gas is equally as pure with hydrochloric acid and limestone as with vitriol and whiting, as I have been told that, in spite of washing, this gas still contains chlorinated compounds, which imparts to the gas a taste and odour which no washing will remove? Any information on above from an experienced reader of "Ours" will oblige—MINERAL WATER.

[57641.]—**To Mr. Bottone.**—Noticing your reply (p. 66), in which you give sizes for columns of dynamo field magnets to suit a Pacinotti ring, described in the previous number, and, being engaged on a similar dynamo, such as you described in the issue of July 11th of last year, and in which, for a larger ring, you give considerable less iron, both in body and length, for the fields, I am, therefore, led to ask why the discrepancy in weight of iron to be employed in the exciting systems? as I fear, judging from your recent answer to another correspondent, that mine of 1884 design will be too slight in the fields? I also notice for the smaller ring, No. 14 wire is suggested for its field, and in the larger ring (of July 11th, 1884) No. 16 wire is recommended for its smaller fields.—ANOTHER AMATEUR.

[57642.]—**Electro-Motor for Model Boat.**—Mr. Bottone promised, some time ago, to favour us with instructions for making an electro-motor suitable for driving a model boat. I feel seel sure many of "Ours" would be very pleased for this information, and that many wish to make an electric boat. Will Mr. Bottone kindly say if he will be able to fulfil his promise early?—E. H.

[57643.]—**Mechanical Singing Bird.**—To "COSMOPOLITAN."—In Vol. XXXII., of 1880, you gave a very lucid explanation of the construction of the gearing for a mechanical singing bird, but the construction of the whistle is not quite clear; will you kindly oblige by a detailed description of same?—C. R. H.

[57644.]—**Pottery Glazes.**—I notice the reply of "Pottery Tech," to an inquiry for glazes for pottery, and if he will kindly give me instructions for the treatment of common red ware I shall be greatly obliged. Will he also say if an ordinary arch kiln, such as is used for the burning of drain tiles, &c., would do for burning glazed goods?—POTTER'S WHEEL.

[57645.]—**Removing Blacklead from Brass.**—Can anyone tell me the way to remove the blacklead coating from a brass fire-grate? It has been blackleaded for years, to save labour in polishing I presume, and the coating will not come off with water.—R. W. F.

[57646.]—**Steam-Engine Formula.**—I should be obliged if some correspondent will kindly assist me to solve the following formula, which appears in Rankine, on the Steam-engine. In table 4, page 564, the fifth column is headed L, which is the latent heat in ft.-pounds per cub. ft. of space; and on page 325 it explains how these figures in column L are obtained, and gives the following formula:

$$L = \frac{H}{v - v^1}$$

The question is what is $v - v^1$? Then, again, it puts the question in another form—viz., $L = p \left(\frac{B}{T} + \frac{2C}{T2} \right)$ hyp. log. 10; and it further states that the values of B and C are explained on page 237, which, however, I fail to understand. Will some correspondent work one out; say, for instance, a pressure of 33·7lb. per sq. in.—C. O.

[57647.]—**Pietermaritzburg.**—I propose going to Natal. Could any of your readers inform me about the population of Pietermaritzburg; if English is mainly spoken? Is it a good business place for a grocer's assistant? Are the coal-mines working, or is it still agricultural? What is the best month to go out? Is it a good place to go as a permanent settlement?—EMIGRANT.

[57648.]—**Star Photographs.**—In the enlarged photo. of Mr. Common's photo. of the nebula in Orion (both are to be seen at the Inventions), the stars appear as perfect discs of various sizes, the largest being about 1-12in. in dia. I understand that with the best and largest telescopes, and with favourable atmosphere, the stars are seen only as very small discs, or, rather, specks of light, more or less bright. What is the reason why they are seen in the photo. so perfect and so large as compared with the nebula?—J. S. C.

[57649.]—**Air Compressors.**—To "LYONS."—As you have had great experience with these machines, will you please favour me with the rules for making calculations in designing an air compressor, and give a worked-out example of one; size not particular, only to illustrate the rules?—OLD SUBSCRIBER.

[57650.]—**Dynamometer.**—Will some correspondent please give sketch, with dimensions, of a friction brake to test a 20 horse-power engine?—A SWALLOW.

[57651.]—**Defective Electric Pen.**—I have an Edison electric pen, porous cell bichromate battery, two cells of which sufficed to work my electric pen. It has (the battery) not been in use for some years, until about six months ago, when I found that it would not work the pen at all. The solution was good, the pen was perfect, and yet no current. I tried it again yesterday, with good solution, without the porous pots, yet no current. I notice that the iron clamps that hold the carbons are very rusty. I should be very glad if someone would tell me how to make it work all right.—AMATEUR ELECTRICIAN.

[57652.]—**Brass Steam Tap.**—I have a brass 2in. steam tap, and I want it to revolve round continually, but I find it wears away very much. What is the best material to make it of? It will be hot, as there is gas burning under it, but it will be well lubricated.—A NOVICE.

[57653.]—**Scale in Boilers of Portable Engines.**—I have two portable engines, engaged at present thrashing in two different districts, and to keep them clean I must wash out the boilers every fortnight. Can any reader of the "E. M." say if the use of any of the scale-preventing compounds would materially reduce the amount of sediment? I have been recommended to put a little soda crystals in the feed-water tank. Would this be beneficial, and, if so, what quantity should be used per day in ordinary 4 h.-p. portable agricultural engines? I may add that one engine works in a district where almost all water contains lime, the other in one where every stagnant pool deposits a rusty iron sediment.—A NEW SUBSCRIBER.

[57654.]—**Electric Light.**—Can any reader enlighten me on the following? I have an engine engaged thrashing, and it would often be a great advantage to work for an hour or two after dark, and I have thought of getting up an electric light. I have ample power in engine to run a dynamo to light five or six lamps, but the speed is not regular, varying from 140 to 170 revolutions per minute. Would this variation materially interfere with the light? What speed should the dynamo have to work well? What would be probable cost of the scheme? The engine and threshing machine are portable, and work for hire generally in the open air. My idea was to suspend the lamps on the machine, and fix the dynamo to the front part of engine, working direct from crank shaft of engine with strap, or gut band. I assume I should use guttapercha-covered wire to be independent of the weather, and also provide a weather-tight box for the dynamo? I have scarcely any practical knowledge of the working of electric lights, but have a fair knowledge of electricity theoretically. I have a lathe, and can use the tools well, so I could, perhaps, with competent instruction, make a dynamo; fail or succeed, I would attempt it.—NOVICE.

[57655.]—**Plating Dynamo.**—To MR. BOTTONE.—From information kindly given on former occasions, I constructed a dynamo for electro-plating. Thanks to your instructions, I got the machine to do some very useful work; but I find that, although it gilds all kinds of flat surfaces very well, it is almost useless for any article with a concave side. Take a smelling-bottle top, for instance, the convex gets well gilt, but the concave remains as it was; take a bracelet, the outside becomes gilt, but the inside, especially if belcher or hollow, remains as it was. I was so annoyed with a bracelet showing the above peculiarity, that, instead of continuing with the dynamo, I rigged up two old disused batteries, and brought them to bear on it, when, *mirabile dictu!* in two minutes, both concave and convex surfaces were well gilt. This was with a pair of weak sulphuric acid batteries in series, and my dynamo, with 1lb. 2oz. of No. 16 silk-covered wire, on H armature, and F.M.'s weighing 30lb., and wound with 10lb. of No. 14 c.c. wire, could not do it. I could scarcely get a spark from batteries, and the dynamo not only gives large sparks, but almost knocks me down with the shock, especially if the hands are wet with the cyanide and solution. What is the cause of this failure to gild hollow surfaces? Is it a want of volts? Kindly tell me how to get out of this difficulty, as I feel that I would be making a retrograde movement if I have to go back to the battery again. The dynamo is shunt wound, as it gives poor results in series. There is plenty of room on F.M.'s for more wire, but the armature is filled.—NOVOLTS.

[57656.]—**Locomotive Slide Valves.**—What is lap and lead, and what is the cause and effect of such? How would the valve stand over the ports, having a ⅛ lead and ⅞ lap? What is the best way to set the valves, and what is the best way to find the position of each eccentric on the crank axle for such a lap and lead? If any friend would give a sketch and simple set of rules to be understood by a young fitter, he would oblige. What are the best and easiest works to get instructions about the above, and what is the price of same?—BRIGHTON.

[57657.]—**Gunstock.**—I am fitting a new stock to my gun. Would someone tell me how to do the roughing at the grip? Would it be possible for me to convert a muzzle-loader into a breech-loader? How best to go about it?—GUNSMITH.

[57658.]—**Balloons.**—Can any of "ours" inform me how the indiarubber balloons are made which are generally sold in the streets by ragmen? Full particulars will oblige—REYERT INNOMINATA.

[57659.]—**Celestial Photography.**—I want to get an image of the moon, 4in. in diameter. What would the focal length of such a lens be? Would an object-glass of an astronomical telescope do? About what focal length do these lenses generally run to? If a lens had a focal length of 6ft., what size image would it throw on a screen?—REYERT INNOMINATA.

[57660.]—**Seaweed Paper.**—I read the other day of a Japanese taking out a patent for making a paper from seaweed, which was almost as transparent as glass. Can any reader inform me as to its manufacture?—REYERT INNOMINATA.

[57661.]—**To Mr. John Grey, or other Correspondents.**—What is formed when oxalic acid is added to a solution of hypochlorite of calcium, the two substances being in equal proportions? Please explain by chemical formulæ.—REYERT INNOMINATA.

[57662.]—**Colouring Photographs.**—I should feel obliged to any correspondent who would be kind enough to give instructions for colouring an ordinary photograph to resemble an oil painting. I have seen some on wood and painter's pallet, executed with great effect, and, I am told, with very little knowledge of the painter's art.—DUILIO.

[57663.]—**Test for Silver in Lead.**—How can the presence of silver in old lead be ascertained easily?—KUZ.

[57664.]—**Blacking Brass.**—I shall feel much obliged for information as to the best method of blacking brass with bichloride of platinum. Should the salt be in a neutral or acid condition? Any work I have done has turned out in a blotched condition, the deposit apparently varying in thickness and colour.—OLD SUBSCRIBER.

[57665.]—**Hints on Silvering on Glass.**—Does Mr. C. L. Woodside (24805, page 82) know of any process by which the chloride of platinum may be substituted for the nitrate of silver, and will he kindly impart that knowledge? Also if the solution of chloride of siver in hyposulphite of soda can in any way be used for silvering on glass.—COUNTRYMAN.

[57666.]—**A Cheap Way to Charge Storage Battery.**—Have any of your correspondents tried charging these batteries by means of a large earth battery, as it may be called, made by spreading, say, a ton of coke, or carbon, in a shallow pit (the larger the better), about a foot deep, for the positive pole, the negative pole being the cast-iron water main? Wires could be led from these to the storage cells connected in parallel circuit.—H. B.

[57667.]—**Russian Names.**—In these days of questions and problems, mostly Eastern, we are continually coming in contact with names of Russian persons and places. Could any correspondent give some general hints in the matter of pronunciation? I am sure they would be of value. For example, I have heard that the terminal "off" is sounded 'ow"; is this so?—ARTHUR MEE.

[57668.]—**Lunar Glaciation.**—Allow me to put a question to Mr. Peal in connection with his very interesting theory, summarised in letter 24669. On his hypothesis, how does he explain the formation of isolated lunar mountains, such as Pico? Also, how does he account for the variations and changes in the streaks seen within Plato and other walled-plains?—ARTHUR MEE.

[57669.]—**Plating.**—Will "Goldsmith" please answer the two following questions? (1) How to prepare a cornet for the bath—that is, am I to withdraw all the valves and pistons and stop up all holes, or dip instrument as it is? (2) How oxidising is produced, and how it should appear when properly done?—LANTERN.

[57670.]—**Glycerine Barometer.**—I have made two of these from instructions given recently. I find the instrument answers beautifully as a thermometer, going up about 4in. or 5in. when held in the warm hand, but does
not seem to register any difference in the press
atmosphere. Will anyone tell me if it would ansv
if I bury the bottle in sawdust, and how thin s
sawdust would do, as I don't want it to look clum
how am I to arrange the scale, from readings wi
mometer? In wet weather, is the air pressure
lighter, and how far would the column probs
between extreme variations? I cannot think it w
far.—SURVEYOR.

[57671.]—**Curve of Stability.**—Will son
readers inform me of the method of obtaining th
stability of a vessel? Also formula for calcula
of vessels?—CHIEF.

[57672.]—**To W. H. Eaves, Coventry**
just finished a design of a dynamo to light 10 t
lamps of 20 c.-p., and would like, before I begi
the machine, to have your much-esteemed advic
on the machine, but more particularly as r
quantity and sizes of wires on F.M.'s for compoun
The sheet-iron discs of the A, which is of th
type (and which is somewhat like the one i
lighter), are 5in. outside dia. and 3½in. inside
leaving 1¾in. to wind the wire on. The A., wit
will be nearly 5½in. dia. by 5½in. long, and if wo
B.W.G., it will take a little over 60 yards, or ab
silk-covered. The total resistance of this wire i
and suppose the A., when running, would be
ohm. I have taken care to have room in the c
for ventilating purposes. I am adopting F.
Edison Hopkinson style, which I think will be
machine of this style, as F.M.'s like Mather a
have a double magnetic circuit, which, I believ
reduces the efficiency. The cores are 3½in. dia.
8¼in. long, will be made from the best Swedish
iron bar, and are intended to hold both togeth
40lb. to 50lb. of wire. The pole-pieces embraci
are very massive, being 4¾in. thick, and the top
necting the pole-pieces together, measures 13in
by 4¾in., and will be over ¾cwt. My motor
Crossley Brothers' new ½ H.P. gas-engines, ind
H.P. I should also like to know size of wire for
leads.—J. M. C.

[57673.]—**Oil Stoves.**—What is the best oil
warming a small room, say 12ft. by 15ft.? P
will oblige—PAISLEY.

[57674.]—**Watchmaking and Jewellery**
are the best books for a young man learning the
to read up, to give him a more general idea of m
makes, &c., than come before him in a small
PAISLEY.

[57675.]—**Dynamo.**—To MR. BOTTONE.—I
finished making one of Mr. Jones' 16 c.-p. laminat
ture dynamos. The F.M.'s are wound with 3lb.
double cotton-covered wire, and the armature wi
¼lb. same gauge. After magnetising the magnet
pint bichromate battery, I connected the machi
shunt, but could only get about the same current
quart Daniell cell; just enough to ring a bell, wo
2oz. of 28 wire, feebly. The field magnets do not se
sufficiently magnetised, as the magnetism is not s
when the machine is worked as when they are
the battery. I have not got two poles alike, as
them with a compass. Could you suggest where
is?—LAMINATED.

[57676.]—**To Mr. Shakespear, Dresd**
Others.—I intend going to South Germany nex
to live. Will you kindly tell me if there is a hea
to pay on lathes, &c., being the contents of my w
and having been used? Whether carriage and
charges are heavy?—R.N.

[57677.]—**Travelling Light.**—Will any
pioneers in electricity kindly tell me a good a che
of fastening, and also insulating, a flat brass rod,
1-16in. and about 100ft. long, to a brick wall or t
frame-work, in which slides a hoist? I wish to
low incandescent lamp of 16 candle-power to tra
the hoist. I shall feel obliged if someone could
what to plug the wall with, that screws would hol
be insulated.—J. J., Ashton.

[57678.]—**Cement.**—Will some kind reader rec
a cement which will set hard in oil and not crumbl
—J. J., Ashton.

[57679.]—**Ball Bearings.**—Will any fellow
say if I can convert the plain bearing of my tric
ball bearing? I think I have got plenty of roo
hubs. Could I do it by turning a little off th
and a little off the hub? Please say what size
are made, and I can tell how many I shall wa
information will greatly oblige—A FITTER'S LA

[57680.]—**Distillation of Essences from**
—Can someone give me directions to make a stil
purpose? Diameter and depth of vessels, kind o
of copper or tin, length of worm, &c., to be us
junction with a Fletcher's gas burner?—E. B. J.

[57681.]—**Acetous Fermentation.**—D
acid added to treacle develop or retard acetous
tion?—M. M.

[57682.]—**Working Single Lines of**
by Staff.—Can any of your readers state upon
this plan first originated, and how it was devised

[57683.]—**Int. Science Exam. of Lon**
any reader recommend a book or books to cover t
ments of the syllabus for general biology in
examination? Huxley and Martin and Parker
practical work, except in botany; but what
work for the theoretical portions of the subje
is necessary for the practical work in botany
GRADUATE.

[57684.]—**Roman Arithmetic.**—Can
spondent inform me how the Romans perfor
matical calculations? Example: multiply XC
—ROSICRUCIAN.

[57685.]—**G.E.R. Locos.**—Would any re
give the principal dimensions of G.E.R. 7ft.
engine and tender, including length of frames
centre to centre of axles, the length and diame
including smoke box, and stroke of piston
READER.

[57686.]—**Glucose.**—Could any reader give
way for solidifying glucose without injuring its
—W. T.

:RS TO CORRESPONDENTS.

munications should be addressed to the EDITOR
H MECHANIC, 332, *Strand, W.C.*

INTS TO CORRESPONDENTS.

one side of the paper only, and put drawings
ıs on separate pieces of paper. 2. Put titles
l when answering queries put the numbers
e titles of the queries to which the replies
:harge is made for inserting letters, queries,
Letters or queries asking for addresses of
or correspondents, or where tools or other
purchased, or replies giving such informa-
e inserted except as advertisements. 5. No
ıg for educational or scientific information
hrough the post. 6. Letters sent to corre-
ler cover to the Editor, are not forwarded,
:s of correspondents are not given to in-

ɔn is especially drawn to hint No. 4. The
to letters, queries, and replies is meant for
od, and it is not fair to occupy it with ques-
are indicated above, which are only of indi-
:, and which, if not advertisements in them-
replies which are. The "Sixpenny Sale
's a cheap means of obtaining such informa-
:ust our readers will avail themselves of it.

BACK NUMBERS.

many queries asking for directions how to
instruments and appliances which have been
ıed in back volumes, that we have compiled a
ve shall insert in this column at intervals, of
'requently sent, and as the numbers are still
v subscribers should consult the list before
r questions.
No. 613.
.nes: Nos. 1,009, 1,025.
ts: Nos. 772.
. 866.
ıg: Nos. 938, 941, 943, 945, 948, 950, 952, 954,
3, 959, 962, 963, 969, 974, 978, 986, 989, 993,
0, 1,001, 1,003, 1,004, 1,008, 1,009, 1,010.
: No. 1,009, 1,010.
ɔs. 478, 619, 675, 723, 775.

: are the initials, &c., of letters to hand up
ay evening, Sept. 30, and unacknowledged

MOTT, AND Co.—J. and W. Archbutt.—
ıcis.—N. G. Willcocks.—J. Derry.—Fred
M.—A. Freyer Evans.—T. E. F.—R. E. H.—
A Constant Reader.—Queenslander.—W. H.
Cousin Benedict.—Lyons.—Dr. Roy ton-
ctrical Engineer.—Girder.—J. W. Dean.—
Richardson.—One in a Fog.—Telegraphist.
3., Photo.—Serra.—C. L. Hett.—F. H. Wen-
'. A. M.—J. Wimshurst.

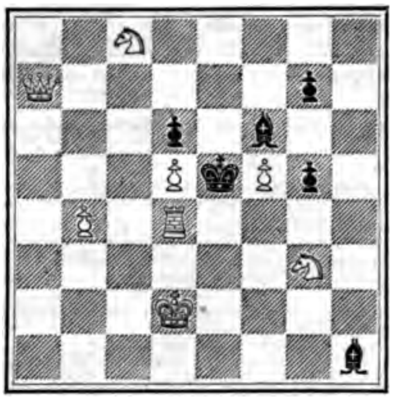
AN. (On the contrary, we do not think that
)01 per cent. of our readers are interested in
Lyra is not the nearest visible star. See
976, and any textbook on Astronomy.)—
(Frequently answered. The iron must be
ı sand, pickled in acid, washed with water,
lipped into a bath of molten zinc.)—DAF.
from Mr. Fletcher, Thynne-street, Warring-
J. (Surely you can easily try for yourself
ıe paraffin oil to the colza.)—LEO, Trieste.
ır *Photographer* is published at 2A, Bucking-
Strand, W.C.; the *Tricyclist* at 152, Fleet-
—A. D., Newcastle. (By a spark between
two wires, or by rendering a piece of fine
ire red-hot. It is connected to the copper
ɔy the great resistance it offers to the pas-
:urrent, it becomes so hot as to fire the pri-
e.)—FARMERS. (It depends much on what
do with them; but they can be raised at
n suitable places. If you intend to cultivate
ɔmmercial purposes, procure a little book
e *Journal of Horticulture* office, Fleet-street,
UERER. (Such recipes have been given
:r again. There is a useful article on Bronz-
15. The articles are scrubbed clean with
solution of soda, and are pickled in dilute
—TSAFLEB. (You would find many useful
ck volumes. "Model Yachts and Boats,"
t 170, Strand, W.C., would suit you. For
:t the materials, consult the advertisement
BRITISH ASSOCIATION. (The papers are
ı the annual volume. For particulars, apply
retary, 22, Albemarle-street, W.)—C. D.
missible. Procure a list from Mr. Fletcher,
et, Warrington.)—VIOLA. (The vanes of
ıot set properly, perhaps; they should offer
the motion of the spring and wheels. The
und is probably due to one of the little
:r the tongues being loose. See the indices
ɔints; but it really should be seen by some
ıderstands it, or should be described with
:ness.)—KUZ. (Insufficient description; but
is of little interest to any one but the owner.)
(The answer was given last week—as soon as
r receipt of your letter. See p. 90. Poppy-
o render the pictures transparent; starch
xing to the glass; but see No. 936, which
ıctical directions.)—VESPER. (We do not
you; boiling is the usual method.)—W. P.
'ee recent numbers. The query is not suited
.)—J. W. (Query of no interest to anyone
.er. The usual method is to appoint agents.)
'The "best" way is by means of a gas-engine
escent lamps. See p. 531, No. 1,065.)—
Of what interest would it be to any other
ESIDERATUM. (We answered you before.
lescribe the stone. The simplest method
to crush the stone, treat it with mercury
silver is dissolved, and then distil the mer-
ıble retorts until the silver is left behind.)—
'RT. (It is simply steeped in water until
-F. W. G. (Surely it is cheaper to employ an
o visit the countries personally, which is the
—ENQUIRER. (What do you mean by
:s of American patent agents for obtaining
patents in this country"? "Communicated" surely explains itself; it means that the invention is not that of the person to whom the patent has been granted, but has been communicated to him by somebody else who is named. They are patent agents. 2. Best pale copal; coachmakers' japan, we presume, or else asphaltum varnish.)—OPIFEX. (Much better buy your emery wheels than attempt to make them. An emery wheel is a nasty thing when it happens to fly asunder or burst.)—A. D., Manchester. (Why not look in a book of tables? One cubic foot of water is equal very nearly to 6¼gals., and as there are four quarts to the gallon—that will be approximately 25 quarts. You can make the other calculation easily.)—JOINER. (No; but it could be done if the bottom of the tank were below the level of the waggon. The action would cease as soon as the levels became the same.)—A READER 246. (You had better use a primary battery instead of losing 50 per cent. in a secondary. See recent numbers.)—X. X. (At that hour when the sun is hottest. 2. The fact that salts washed out of the earth by rain accumulate in the sea, because they are not evaporated with the water.)—FIRST DYNAMO. (If you are a "five years' reader," Mr. Bottone thinks—and we agree with him—that you must have read his recent articles on "How to Make a Dynamo," which anticipate all the questions you have addressed to him privately.)—SAND RAT. (A simple notice, "All rights reserved," will do while the articles are appearing; but the book, when separately published, must be entered at Stationers' Hall, which will cost you 5s.)—SHOP-FITTER. (You had certainly better pay his claim, and then sue for yours.)—E. D. W. (Not of the slightest use to anybody.)—IGNORANT. (You want a ram. Write John Blake, Oxford-street Works, Accrington, for prices and particulars.)—FLEET SURGEON PALMER. (The date given is invariably 1825; but the best way to settle the point would be to search in the newspapers of the time.)—A. E. B., Tas, F. C. (In type.)

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLIX.—SALUTATION.

Black.



White. [8 + 6

White to play and mate in two moves.

SOLUTION TO 957.

White.	*Black.*
1. R-Q R 7	1. Anything
2. Kt mates	

(Four variations).

NOTICES TO CORRESPONDENTS.

As problem 956 was, as published, impossible of solution, it will be cancelled in both problem and solution tourneys.

AUTHOR'S SOLUTIONS to 946, by E. Stanley Follwell and H. Culmer.

To 957, by Rev. W. Anderson (Old Romney), T. C. Rye, A. Bolus, A. A. E. Leeluse.

A. S. OLVER.—Your objection seems sound as to Black Pawn at Q-R 2. There seems no reason, however, against a White one at Q-Kt 6.

ENGLISH MECHANIC TOURNEY.—Game between Messrs. Nash (*White*) and Vincent (*Black*).

(King's Gambit declined.)

1. P-K 4, P-K 4 / 2. P-K B 4, P-Q 4 / 3. P takes Q-P, P takes P / 4. B-Kt 5 (ch), B-Q 2 / 5. Q-K 2 (ch), Q-K 2 / 6. Kt-Q B 3, Kt-K B 3 / 7. B takes 18 (ch), Q-Kt takes B / 8. P-Q 4, castles / 9. Q takes Q, B takes Q / 10. B takes P, Kt-Kt 3 / 11. K Kt-K 2, K-Kt takes P / 12. Kt takes Kt, Kt takes Kt / 13. Castles (K-R), K R-K sq / 14. Kt-Kt 3, Kt takes B / 15. R takes Kt, B-Kt 4 / 16. R takes P, B-K 6 (ch) / 17. K-R sq, B takes P / 18. P-B 3, B-K 4 / 19. Q R-K B sq, B takes Kt / 20. P takes B, R-Q 2 / 21. K-R 2, R-K 7 / 22. P-Q Kt 4, R takes R-P / 23. R takes R, K takes R / 24. R-B 7 (ch), K-Q 3 / 25. R takes Kt-P, R-Q B 7 / 26. R takes R-P, R takes B-P / 27. P-Kt 4, R-B 5 / 28. K-R 3, R takes Q Kt-P / 29. P-Kt 5, R-K 5 / 30. P-Kt 6, R-K sq / 31. P-Kt 4, P-R 4 / 32. K-R 4, P-Kt 4 / 33. K-Kt 5, P-Kt 5 / 34. P-Kt 7, R-K Kt sq / 35. K-B 6, P-Kt 6 / 36. R-R 8, R takes P / 37. K takes R, P-R 5 (*a*) / 38. R-Q 8 (ch), K-B 4 (*b*) / 39. R-Q Kt 8, K-B 5 / 40. P-Kt 5, P-R 6 / 41. P-Kt 6, P-R 7 / 42. K-B 7, P, Q's / 43. P-Kt 7, Q-K B 8 (ch) / 44. K-K 7, Q-K 7 (ch) / 45. K-B 7, Q-B 6 (ch) / 46. K-K 7, Q-K 5 (ch) / 47. K-B 7, Q-B 4 (ch) / 48. K-K 7, Q-K 4 (ch) / 49. K-B 7 (*c*). Drawn game.

NOTES, by Mr. Nash.

(*a*) 37. $\frac{\qquad}{\text{P-B 4}}$ would have won.

(*b*) If 38——K-K 2 / 39. R-Q Kt 8, P-B 4 / 40. P-Kt 5, P-B 5 / 41. P-Kt 6, P-B 6 / 42. R-Kt 7, ch K-Q 8 / 43. K-B 8, P-B 7 / 44. P-Kt 7, P-Q's / 45. P-Q's, Q checks, R interposes and draws. If 41——P-R 6 / 42. R-Kt 7 (ch), K-Q 3 / 43. K-B 7, &c.

(*c*) Mr. Vincent did not like to risk 49——P-B 4. 50. P-Q 5, K-B 6, and I think he was wise, as white has a certain draw and a chance of a win.

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Offers wanted for **Tricycle** in good exchange.—3, Stanhope-street, off Winwick-road, Warrington.

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Write for **King, Mendham, and Co.'s** large new and reduced Price List, post free 4 stamps.

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Photo. Repairs.—Burnishers repolished and adjusted, rollers turned and roughed.—BRIGHT, 55, Castle-street, East, W.

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Hard **Vulcanised Fibre** for all kinds of insulation.—MOSSES and MITCHELL, 68A, Chiswell-street, London, E.C.

International Inventions Exhibition, East Avenue, Group 21, Stand 1683.—MOSSES and MITCHELL, 68A, Chiswell-street, London, E.C.

For sale, English Silver, Roman **Brass**, and other Coins.—For particulars address, 125, Coltman-street, Hull.

Lubricating Oil, 978 degrees. Nothing cheaper, nothing better.—Terms and particulars from J. M., 6, Hamlet-street, Bootle, Liverpool.

Opera and Field-Glasses. Specialities. Illustrated list free.—J. B. DANCER, 53, Hamstead-road, Handsworth, Birmingham.

Microscopic Pin-hole **Photographs**, four hundred subjects. Lists free.—Miss DANCER, 53, Hamstead-road, Handsworth, Birmingham.

Powerful Iron Screw **Press**. Seen I. I. Exhibition, [illegible] Old London. Cheap, or exchange.—21, Spring-street, Paddington, [illegible]

The Keyless Combination Surface Lock, adapted for cupboards, drawers, &c. Solid brass, ornamental, easily fixed; strong, secret, and interchangeable. 3s. 6d.—[illegible], Whitechapel, Preston.

Indiarubber Stamps. Latest novelties. Splendid workmanship. Satisfaction guaranteed. Designs, 1d. stamp.—A. E. PASHLEY, 160, London-road, Sheffield.

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Tudsbury and Sons' Improved "High-tension" **Wimshurst Machine**, with their new Compound Ebonite Plates.—Edwinstowe, Newark.

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4½ **Lathe**, single or back-geared, all iron, 4ft. bed planed.—J. RESIDE, Brighouse, Yorks.

Two H.-P. **Launch Boiler**, new, cheap.—RESIDE, Brighouse, Yorks.

The **Unique Hand and Power Drill**. Amateur Drills, 25s., or Castings for Drills, Lathes, Engines, &c.

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Splendid fashionable **Double Breechloader**, by eminent London maker, the property of an officer, only used once, price £3 15s.—Further particulars, 93, Broadway, Sandgate, Kent.

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Galvanometers, 2s. 6d. Ditto Delicate Astatic, [illegible] Ditto, Tangents, with glass shade, 10s. Am-meters, 5s. Voltmeters, 5s.—BOTTONE.

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Mica or Talc.—RICHARD BAKER and Co., 9, Mincing-lane, London.

52in. Bicycle, cheap; magnificent-toned Violoncello, machine head; must be sold. Taken for debt. Stamp for reply.—D. BLAGROVE, High-street, Lewes.

Your Character Revealed.—Send Outline of hand showing lines, &c., with 7 stamps to H. DYKE, 2, North-street, Taunton.

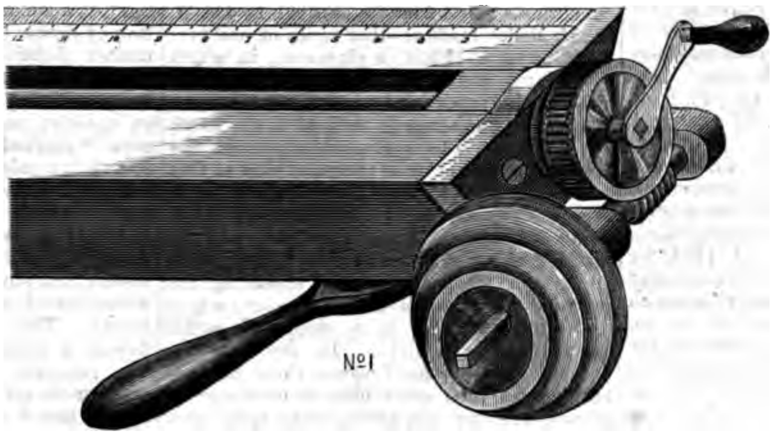
44in. Bicycle, Coventry make, good running order, stout rubbers, 24s.—W. SAUNDERS, Photo, Dickleburgh, Norfolk.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, OCTOBER 9, 1885.

SOME RECENT IMPROVEMENTS IN APPARATUS FOR ORNAMENTAL TURNING.

BY J. H. EVANS.

I AM desirous of drawing the attention of those who are interested in the art of ornamental turning to several valuable improvements and additions to the apparatus of the lathe, whereby a greater facility in working is obtained, combined with a delicate accuracy that has not hitherto been attainable, except with the greatest skill and care.



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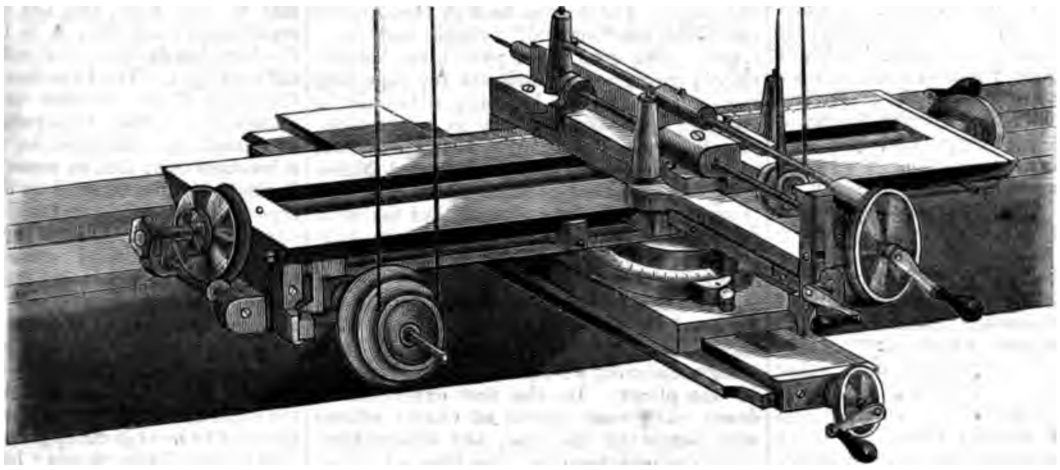


Before proceeding further, I must mention that the several appliances I intend to describe were designed by T. J. Ashton, Esq., an amateur of considerable mechanical ingenuity, and who, for several years, has fully tested their applicability.

There are few amateur turners who have not felt that the continual rotating of the winch handle of the leading screw for a series of long flutes is neither an interesting nor a highly scientific proceeding, and, moreover, each consecutive cut requires care when approaching the fluting stop, which must also be very securely fixed, or the beauty of the work is marred by the flutes not being all exactly of the same length. The first attempt to obviate these objections I carried out for Mr. Ashton in April, 1878, as seen by the engraving. His design consisted in an entirely new arrangement of the method of throwing in and out of gear the tangent screw which works in the worm wheel on the end of the leading screw.

This was originally placed in gear either by an eccentric cam or fixed by a screw. These actions were at once discarded, and to the under side of the T-piece a cranked lever was attached by its fulcrum, one arm of the lever passed through a horizontal slot in the end plate, with its end fitting accurately into a curved groove in the frame which holds the tangent-screw. By this arrangement the screw could be raised or lowered, thus throwing it in and out of gear with the worm-wheel. The end of the lever by which it is worked will be seen by the engraving to be well to the front on the right-hand side in the most convenient position, and slightly curved. Mr. Ashton found in practice that, although a very considerable advance had been made, that there were still two objections to this arrangement—namely, that the power exerted by the tangent-screw and worm-wheel on the leading-screw of the rest was so great, that the fluting stops were to be overridden; or if firmly fixed, the leading-screw became somewhat jammed, so as to require considerable force to disengage it. He then conceived the idea that these defects would be obviated if the tangent-screw could be thrown out of gear instantaneously when the receptacle containing the tool had traversed the desired length. The following is the very ingenious and simple method designed by him for the purpose. A metal frame carrying the tangent-screw is hinged on a spindle, to one end of which is attached the driving pulley, having various speeds, and to the other end a toothed-wheel gearing into an intermediate one, from thence to a third wheel, which is fixed to the end of the shaft of the tangent-screw, the whole being fitted up on a gun-metal block, which is attached to the T-slide, so that the tangent-screw will fall in and out of gear with the worm-wheel. These actions will be at once seen by reference to the engraving of complete sliderest.

The frame is retained in position by a catch connected with a double lever, and runs the whole length of the T-slide, and is connected with the lever at one end. On the rod at each side of the traversing slide which carries the tool-box is fitted an adjustable stop, which can be fixed at any required point by a set-screw. The action may be thus briefly described. A band from the overhead motion passes to the pulley, and by means of the wheel gearing communicates the motion to the tangent screw, and through the worm wheel to the main screw, thus giving traverse to the tool-box. The stops having been fixed on the rod at the required length of the flute, will, when pressed on by the advancing slide, so act on the lever of the catch that the tangent screw immediately drops out of gear, and although the lathe is not stopped, the tool is at perfect rest. To make the next cut, the band may be twisted on the pulley, and a reverse traverse is the result; but as it is necessary that all finishing cuts should be made in the same direction, it is better to run the frame back by the winch-handle to the starting point, and the frame being placed in gear by raising it with the finger, another cut is commenced. The advantages effected by this arrangement are very great, and have been highly appreciated by those amateurs who have used the self-acting rest. The leading screw being driven from the overhead motion, both hands of the operator are perfectly free; in turning a cylinder the relative speed of the lathe head and the traverse is always the same, whether the flywheel be driven slowly or quickly, and the same remark applies to the use of drills or any of the cutters used in the different instruments, and thus all cuts, flutes, and mouldings are produced with an exactitude scarcely attainable by any other means.

I have recently completed and sent to the Inventions Exhibition at South Kensington one of the most complete self-acting automatic slide-rests yet made, which can be seen at any time, and, when there, I shall have much pleasure in fully explaining its various actions.

The T-slide is 18in. long, and made of Whitworth's compressed steel: it is provided with the self-acting arrangement already described, and improved automatic stop to the tool-box slide also. At the suggestion of Mr.

Ashton I have arranged the self-acting gear on the left hand of the T-piece, thus removing the driving band to a more convenient position.

I intend to give, with the Editor's permission, other articles on the overhead motion and automatic counting apparatus, which I hope will be of interest to our amateur turners. The engravings are taken from the blocks to be used for the illustration of the book on ornamental turning and the various necessary apparatus, which I hope to publish shortly.

EXHALATION OF OZONE BY FLOWERING PLANTS.

UNDER this head, in No. 1,003, we drew attention to the researches of Dr. J. M. Anders, of Philadelphia, into the properties possessed by flowering plants of producing ozone, with the view primarily of settling the vexed question as to the salubrity or insalubrity of "plants in bedrooms." The article we published last week (p. 97), from the pen of Dr. Daniel Draper, of the New York Meteorological Observatory in Central Park, throws some new light on the subject which may be of considerable importance from a hygienic point of view, if his conclusions are supported by further investigations. In the article published June 13, 1884, we were able to say that whatever differences of opinion might exist as to the manner in which ozone is produced, there seemed to be no difference of opinion as to its value in the atmosphere, for the majority of chemists are agreed that it is the "great purifier," and not one can attribute any deleterious influence to it. Little more than a year has passed, and Dr. Daniel Draper, not without evidence, now practically accuses ozone of being the cause, or at least the predisposing cause, of pneumonia—in New York. Pneumonia is a rather indefinite term outside the profession, but it means what is colloquially known as inflammation of the lungs, and has been used as the term designating the cause of death in so many cases recently in New York that there was certainly reason for some scientific investigator to endeavour to find the cause for an effect only too apparent. As stated on p. 97, Dr. Draper finds a connection between the amounts of ozone and the increased death-rate from "pneumonia"—a term which may possibly include pleurisy, pericarditis, and other diseases of the respiratory organs. So far as it goes, Dr. Draper's paper is valuable and suggestive, and it would undoubtedly be of considerable use if a number of ozone observations were available from other sources. Unfortunately, while ozone is tacitly acknowledged to be a somewhat mysterious form of oxygen, there are not many observatories in the world at which carefully made records of its presence are kept, while, so far as we know, no one has suspected ozone of being even a predisposing agent to disease. On the contrary, it has generally been assumed that its presence was beneficial, and, in the articles first mentioned, it was pointed out that those flowers which had been cultivated for their supposed hygienic properties were those which were capable of exhaling the most ozone. In the economy of nature, however, the part played by flowers in the production of ozone is insignificant compared to the effects of lightning discharge, and five minutes' working of, say, a Wimshurst machine would produce more ozone than a whole conservatory of plants would be able to exhale in a month. Ozone is usually found in greatest abundance at the seaside and in country places, but rarely averages more than one-seven-hundred-thousandth part by volume of atmospheric air, the quantity present being greater in spring than in winter. A proportion so small might well be thought to be inappreciable, but small as it is, it makes its presence felt, for in its comparatively pure state ozone acts violently upon the lung tissue, and indeed rapidly oxidises substances which appear to be capable of indefinitely withstanding the action of oxygen. Until Dr. Draper found a connection between the quantity of ozone present in the atmosphere and the increased death-rate from pneumonia in New York, no one, so far as we know, even suspected that ozone could be at the bottom of the mischief, and the majority will hesitate before they accept his suggestions and discard their cherished belief in the virtues of ozone. In the previous article under this heading we stated that Dr. Anders had arrived at the conclusion that it is only flowering plants which exhale ozone, but it should be noted that those possessing odoriferous blossoms have the function in the greatest degree. With the view of confirming or disproving his previous conclusions, Dr. Anders, assisted by Dr. G. M. B. Miller, made another series of observations, using, as before, a glass case, in which the plants were placed, and as tests the Schoenbein paper and papers treated with tincture of guaiacum (8 parts of resin to 90 of alcohol). The guaiacum paper in the presence of ozone turns greenish blue at first and finally a bright blue. Schoenbein paper is made by dissolving one part of pure potassic iodide (free from iodate) in 200 parts of distilled water, thickening it by heating with 10 parts of white starch, and spreading the mixture on slips of unsized paper, which are dried and kept in a stoppered bottle away from the light. In the presence of artificially-prepared ozone, these Schoenbein papers turn quite blue at once, and in atmospheric air containing ozone the degree of colouration will vary with the amount of the ozone. The degrees used by Drs. Anders and Miller are "marked," "slight," and "very slight." We give these particulars because many persons possess facilities for repeating the experiments, and by doing so would be assisting in a useful—it may be, a valuable—investigation. The record of the experiments recently made by Drs. Anders and Miller are given in the September number of the *American Naturalist* at length, but the main facts will serve our present purpose. As it is stated that the presence of any alkaline substance will change the test papers in a manner indistinguishable from the effects produced by ozone, pieces of red litmus were suspended with the test papers, which, after being moistened, were placed on the branches of the plants. In the first experiment a dozen well-grown plants of Coleus blumei were placed in the case, and observations taken during seven days, the time of exposure of the papers varying from eight to eleven hours. Schoenbein papers were also exposed in the open air as a check. Such reactions as were observed in this case were clearly due to the presence of some alkaline substance, for on the same days that "slight" effects were noticed on the Schoenbein papers the red litmus became "marked" blue. The guaiacum papers are not relied upon to any great extent, as they are materially affected by various atmospheric conditions. The result of the experiments supported the previous conclusion, that non-odorous foliage plants do not generate ozone. In the next series, ten flowering plants of Fuchsia globosa and ten periwinkles were inserted in the case, which had a temperature ranging from 80° to 100° Fahr.; and the result of seven days' testing gave one "marked" and three "very slight" reactions, the "marked" being on the day when the Schoenbein paper outside the case gave a negative result. The litmus in these trials gave no indication of the presence of ammonia. Odourless flowering plants, therefore, do not rank as active ozone-generators, but they must be regarded as sharing the function to a slight degree. In the next series odorous flowering plants were tried—viz., seven roses and seven specimens of Lilium longiflorum. The result of eight days' observation, the temperature in the case being 80° to 100° Fahr., gave five "marked" Schoenbein papers, one "slight," and two negative; but with the guaiacum papers there were seven "marked"—curiously one of them being on a day when the Schoenbein gave a negative result, and the only occasion when the litmus was turned blue. These trials support the previous conclusion that odorous flowering plants are energetic ozone producers, and, it appearing that the function was in some way connected with the perfume-making properties of the plants, experiments were made with a number of pelargoniums not in bloom. This series, owing to the prevalence of rainy days, was not deemed satisfactory, it having already been established that sunshine, or at least good diffused light, is a condition essential to the generation of ozone by plants. To determine the matter definitely, experiments were made with the foliage of the Pinus strobus, seven branches being cut and placed in the case in an upright position. The first three days gave "marked" Schoenbein effects, the fourth day only "slight," and the fifth negative, the last two being untrustworthy, as the pine branches had turned brown and the leaves had dropped off. The experiment was repeated for three days with the same results, and similar effects were also obtained when branches of the Norway spruce were tested. The conclusions, then, are that flowering plants, both odorous and inodorous, generate ozone—the former, however, much more actively than the latter; that so far as tested scented foliage possesses the power of producing ozone, especially in the case of the pine and the hemlock (Abies canadensis); and that it is highly probable the function demands the influence of bright diffused light. The hypothesis which traced the origin of the function to a metastasis of phosphorus to the seed-vessels in the form of phosphoric acid must be abandoned, and it becomes clear that in some way the odoriferous principles emitted by flowers or leaves are chiefly concerned in the formation of the ozone given off by plants. Volatile perfumes and strongly scented aromatic substances have the power to convert the oxygen of the atmosphere into ozone; and it may be that a similar function of odorous plants accounts for the objection which many people have to the presence of the more strongly-scented flowers in their sitting and bed rooms. In the outer air the generation of ozone is still believed to be of great hygienic value, notably in the case of pine woods; but whether that belief will persist in spite of the views of Dr. Draper remains to be seen.

ENGINE-MAKING AT HOME.—X.

The Crank and its Bearings.

THE crank shaft (Fig. 114), together with its bearings, and the flywheel, now claim our attention. Cranks of this type are often slotted out of a solid forging. But they are stronger when bent round, because the grain fibres are then continuous. A smith can readily forge such a crank as this out of 1½in. steel bar, roughly flattening it in the bend before bending it round, and upsetting it a trifle in the larger part to allow sufficient to clean up. The straight journals may be drawn down also from the 1½in. size to, say, 1¼in. or 1⅜in., in order to save some of the labour of turning. Even with a good forging the work of finishing will be considerable round the bend of the crank.

The turning is of necessity done in two chuckings, the first one for the journals, and the eccentric and flywheel bearings, the second for the connecting-rod bearing. The turning of the journals comes first, and is done between centres in the usual way with dog and driver. After the end farthest from the headstock is turned, the crank is reversed in the lathe, and the opposite end done. A block

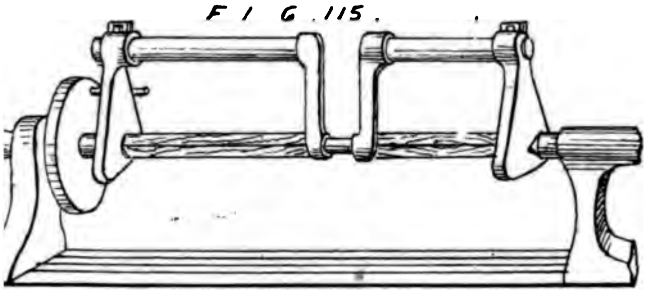


FIG. 115.

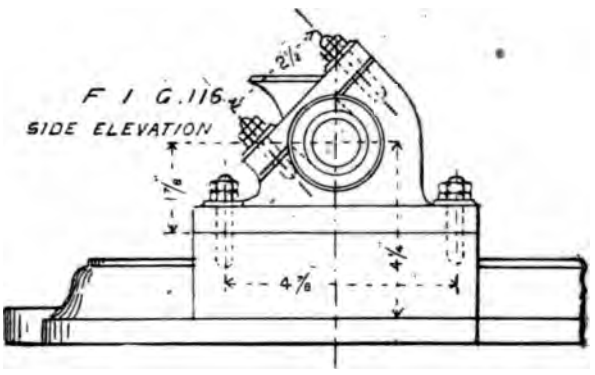


FIG. 116. SIDE ELEVATION

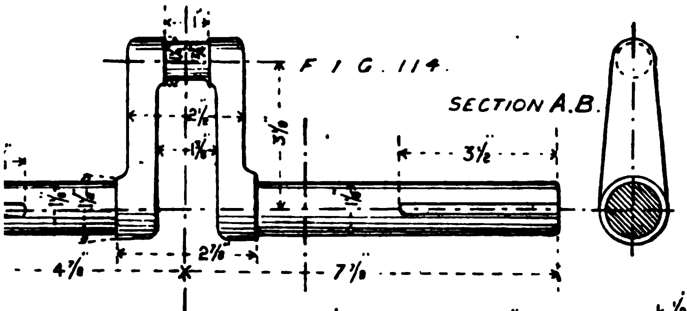
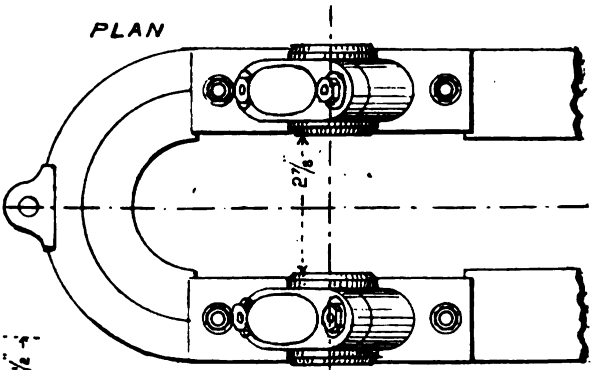


FIG. 114.


PLAN

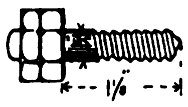


FIG. 117.

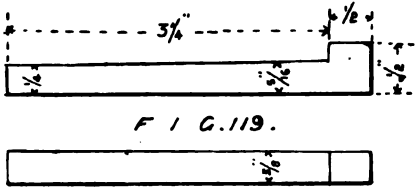


FIG. 119.

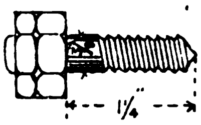


FIG. 118.

d is interposed between the open space l by the bend of the crank, in order to it rigid against the thrust of the during the work of turning. The chucking is also between centres, but ank is rigged up between centre-plates 15). These are castings provided with to clip the ends of the crank and ied upon those ends, either with a split d screw, or by a set screw simply. The are pivoted upon the dead centres in ine with the connecting-rod bearing, and ate nearest the headstock receives its from a driver. Temporary wooden extending from the bend of the crank plates at each end, prevent it from be- bent in by the thrust of the centres. It turned and shouldered for the brasses of nnecting-rod. The introduction of the adii in the sharp angles formed by the ations of the bearings (Fig. 114), is of vital ance. Fracture is very likely to ensue sharp angles are present, while a curve, it be small, adds largely to the strength. of ⅛in. radius will be sufficient in stance, and the brasses will be rounded espond. The flat portions of the cranked ill be filed up to dimensions and polished mery cloth. A key-way is cut at *a*, for wheel, and one at *b*, for the eccentric.

feet of the bearing blocks (Fig. 116) are vel, and then the half brasses are fitted eful filing both to the blocks and the caps. ittle filing will really be required if the ns were made as described. The first ill be to true up the bearing facings l, trying them with calipers; and square he feet; and similarly the shoulders of nges on the brasses, until the latter will tside the former with just the least t of tapping with the hammer. Then, ing them, the rough skin will be filed out bearing block in the recess where the brass bed, a little oil and red lead will be rubbed e bearing surfaces, and the flats of the reduced with a file in those slightly portions indicated by contact with the d, always trying the brasses in, in the lirection relatively to the block. These s apply also to the fitting of the upper into the caps, and of the caps themselves e plummer blocks.

n all are fitted, 5/16in. holes are to be in the caps to 2½in. centres, for tight-fitting 5/16in. studs, and holes ¼in. bare in diameter in the blocks for tapping. Studs (Fig. 117) are screwed into these last, which, standing 1⅛in. above the face of the block, will permit of the employment of lock nuts.

Holes ⅜in. in diameter are also drilled in the feet to 4⅞in. centres. Fit a temporary strip of wood across the holes in the unbored brasses, and marking thereon the approximate centre, set that at a distance of 12½in. from the centre of the slide bars, and while in that position mark the centres of the holes on the blocks which are cast on the bed for the reception of the plummer blocks. These will be drilled to 5/16in. bare diameter by 1in. deep, and studs to Fig. 118 will be provided, and the blocks screwed temporarily in place. A new centre strip should now be bridged across the holes in the brasses flush with their outside faces, upon which to mark the exact centres for boring. If we are assured that the block facings are truly level (Vol. XVI., article VI., Fig. 83) we may then measure up from these to a height of 1⅞in. corresponding with the centre of the cylinder. But if they are not levelled, and parallel with the slide bars, we must take our dimension from the faces of the latter. A distance of 7/16in. measured up from a straightedge laid along those faces will give us the exact height of the centre for the crank-shaft, which height will be scribed on the strip of wood. To get the vertical centres, mark the centres of the slide bars lengthwise, and with a trammel set to 12½in. = to length of connecting-rod, scribe a line from the slide bar centres to the wooden strips fitted in the brasses, cutting the horizontal lines already marked. From the points of intersection thus obtained, strike an 1⅛in. circle on the flanges of each pair of brasses, to which diameter they will have to be bored.

The better way to bore bearings is to do so in place, and in this instance the bed with its bearings might be blocked up on the saddle of a slide-rest, and a small cutter bar be employed to bore the holes and face the flanges. But with much less trouble the blocks could be bolted separately to an angle plate by the bolt holes in the bottom, and their centres set to coincide with the centre of the lathe. When bored and faced on one side, they would need rechucking to face the opposite flange, not forgetting the rounding of the inner edges. Then they will be replaced, the caps and top brasses removed, and the crank tried in to see if any easing is required, in which case a file or a scraper will be employed. An oil hole ⅛in. diameter will be drilled through the top of each cap and its brass, and the brass covers (Fig. 49, p. 95 of the last volume) fitted into the oil boxes.

The flywheel should be turned bright and balanced, not only for the convenience of putting a driving belt upon it, but also for the maintenance of equable motion in so heavy a body, running at a high speed. The hole will be bored to 1⅛in. diameter, on the face-plate, and the bosses faced up. The key-way will be cut to ⅜in. × ³in., with a ,in. of taper in the depth, and a key, Fig. 119, made for it.

If the work to this stage has been done as it should be, then when the connecting-rod has been attached both to the cross head and to the crank, we ought to be able, by turning the flywheel, to pull the piston along, having the rings in it, without slack, and with the least amount of perceptible drag throughout, and it should pass over the dead centres for the return stroke without any backlash.

SIMPLE EXERCISES IN TECHNICAL ANALYSIS.—IX.

BY AN ANALYTICAL CHEMIST.

Section II.—Pigments (*Continued*).

RED PIGMENTS.

(134.) OF these there is a great variety; but only a few are commonly used for paints. Our remarks will be confined to those in common use.

RED LEAD.

(135.) See Art. 50.

The adulterants are:—
Sulphate of baryta.
Chalk.
Insoluble silicates.
Oxide of iron.

CHROME RED (Chinese red).

(136.) This is a basic chromate of lead of variable composition. The lead and chromium should be estimated separately, as described in Art. 54. The formula for chrome red is $PbCrO_4 + PbH_2O_2$; or, according to Dr. Duflos. $2PbO, CrO_3$.

(137.) The adulterants of chrome red are those common to all the lead chrome salts. They are—

Sulphate of lead.
White lead.
Sulphate of potash.
Chromate of potash.
Permanganate of potash.
Sulphate of lime.
Chalk.
Sulphate of baryta.

(138.) In the whole range of colours there are none so subject to serious adulterations as these chromates of lead, and it is on this account, and remembering the high prices charged for so-called genuine samples, that they are treated of at such length in these exercises.

(139.) Whenever a sample of chromate of lead has to be examined—whether it be chrome yellow, chrome orange, or chrome red — it must first be submitted to an exhaustive qualitative examination such as the following :—

(*a*) Boil sample in water; filter. Test filtrate for *lime* by adding ammonia and ammonic oxalate; *Sulphates* by adding acid and a soluble salt of barium. *Soda and potash* by holding in a Bunsen flame a platinum wire moistened with the liquid, and looking for the characteristic *yellow* of soda, or the *purple* of potash when the flame is viewed through a blue glass or a bottle filled with a blue liquid.

Bichromate of Potash.—If this salt is present, the water solution will be highly coloured. When acetic acid and acetate of lead are added chrome yellow is precipitated.

(*b*) Boil sample in acetic acid; filter. Test filtrate for *Lead Salts* by adding chromate or bichromate of potash a ppt. of chrome yellow will be obtained if the sample under examination is chrome orange or chrome red; but in a pure chrome yellow there should be nothing soluble in acetic acid.

The colour of the filtered solution should be observed. If not colourless, some colouring matter other than chromate of lead may be present. The insoluble in acetic acid should next be boiled in potash. All should be soluble.

(*c*) Boil in strong potash solution. All should be soluble.

(*d*) Boil in carbonate of soda solution for half an hour. Filter: Test for sulphates by adding acid till the filtrate has an acid reaction, then a soluble salt of barium. A heavy white ppt. indicates sulphates, due, probably, to sulphate of lead or sulphate of baryta.

(*e*) Add a little water to a portion of the sample, and then a few drops of acid. Carefully observe the surface of the water for bubbles of gas rising from below. If gas is given off, it may be from chalk or white lead.

(*f*) Boil in moderately strong nitric acid. When boiling, add a few drops of strong alcohol. If a heavy white insoluble remain, it is probably sulphate of baryta. Filter. Test at blowpipe or Bunsen for the green barium flame.

(140.) Having ascertained the nature of the sample, the quantitative analysis may be more satisfactorily made. If the sample contain only lead and chromium, it will be sufficient for ordinary purposes to boil a weighed quantity in acetic acid; filter, wash, dry and weigh on a tared filter paper the insoluble chrome yellow. This will give the percentage of chrome yellow in the sample; and 100 − this percentage = the percentage of soluble lead salts in the sample.

(141.) But when greater accuracy is required, or when adulterants are present, the following methods should be employed :—

Insoluble.—Take a weighed quantity, boil in moderately strong nitric acid, when boiling add enough of strong alcohol; if anything remains insoluble, filter, and weigh. Test at blowpipe for the nature of the insoluble.

Total Lead.—To the filtrate add ammonia till just alkaline and hydrochloric till slightly acid, pass SH_2 gas and proceed as directed in Art. 11.

Chromium.—Boil off all SH_2 gas from the last filtrate, and add ammonia to precipitate the chromium. Then proceed as in Art. 46.

Chalk.—To the filtrate after the chromium is removed, add ammonic oxalate, and weigh chalk as in Art. 8.

Total Soluble Sulphates.—After all the chalk has been removed, add to the filtrate hydrochloric acid and chloride of barium; filter, dry and weigh the precipitated sulphate of barium. The percentage of baric sulphate multiplied by 1·3 gives the percentage of lead sulphate in the sample. This should be deducted from the total sulphate of lead found by precipitating the lead; and the remainder, after a further deduction for the weight of sulphate of lead equivalent to the chromate of lead calculated from the oxide of chromium, should be converted into oxide of lead or white lead. An example will make this clear.

Suppose the following weights have been found :—

Sulphate of Lead (Total)......	98·0	per cent.
Oxide of Chromium (Cr_2O_3)	20·0	„
Sulphate of Baryta	5·0	„

The percentage of sulphate of lead equivalent to the two latter must be ascertained: thus :—

$5·0 \times 1·3 = 6·5$ SO_2Pbo''
$20· \times 4·2287 \times ·9366 = 79·2$ „
$= 84·5$ CrO_2Pbo''
And $98 - 6·5 + 79·2 = 12·3$ SO_2Pbo''

Left to be calculated as oxide of lead or white lead.

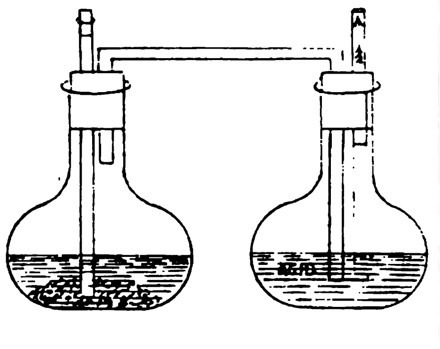
$12·3 \times ·736 = 9·0$ PbO
$\times ·8525 = 10·48$ white lead.

The results would then be :—

Sulphate of lead	6·5	per cent.
Chromate of lead (Normal)	84·5	„
Oxide of lead	9·0	„

When chalk is present as well as white lead, or when white lead is present in an orange or a red chrome, it is necessary, in order to insure greater accuracy, that the amount of carbonic-acid gas present in the sample should be estimated, and after deducting the amount due to the chalk, regard the remainder as representing approximately the amount due to the white lead. It should nearly agree with the amount of white lead taken by difference as described above.

(142.) *Estimation of Carbonic Acid.*—But as the estimation of carbonic acid gas is of frequent importance, it will not be out of place to describe here the process of Will and Fresenius, as the necessary apparatus is so simple that any one may construct it. In large laboratories Schrotter's apparatus will, no doubt, be found more convenient; but for general purposes, the apparatus described here will be found to answer very well. The drawing shows the arrangement. Each of the flasks has a capacity of about 100cc., and they are connected by glass tubing, as shown—the ends of the tubing being all open, and the corks fitting tightly. Into one flask a known weight of the sample is washed with about 30cc. of water, into the other dilute (1 to 2) sulphuric acid is poured, more than sufficient to drive off all the carbonic-acid gas in the sample. About 10cc. of sulphuric acid to each gram of substance taken is an approximate proportion. Having done this, the parts are connected together, carefully dried on the outside, and weighed.



(Before weighing, a caoutchouc stopper is fitted into the straight tube leading from the flask containing the powder, and retained therein until the end of the experiment.) The mouth is then applied to the straight tube in the flask containing the acid, and sufficient air sucked out to allow some of the acid to pass through the bent tube into the flask containing the powder. The carbonic acid which is given off rises through the bent tube, passes through the acid, is dried by it, and finally escapes through the straight tube. When effervescence ceases, the suction is repeated, and continued at intervals until gas ceases to be given off. The caoutchouc stopper is now removed, and a current of air to displace the whole of the carbonic acid in the apparatus is drawn through the same tube as before. The stopper is then replaced, and the apparatus dried and weighed. The loss in weight represents the amount of carbonic acid in the sample taken.

(143.) When the lime is present as sulphate, or when sulphate of potash is present, other precautions, similar to those described above, must be taken. Permanganate of potash is so rarely met with, and, when present, occurs in so small a proportion, seldom exceeding 2 per cent., that it need not be treated specially here; but, when present, other and more serious adulterations may be suspected.

Another Method.

(143a.) The following method is usually more easily worked. In the foregoing (141) the alcohol must be added in sufficient quantity to reduce the whole of the chromic oxide, or on passing SH_2 gas, sulphuric acid will be formed, and the *total sulphates* as subsequently ascertained in the same solution will be too high. Again, the alcohol interferes with the ready precipitation of the chromium.

Insoluble.—Boil, therefore, in concentrated nitric acid until all is dissolved. Sulphate of lead has been found to be soluble in nitric acid in the presence of chromates. If a white insoluble remains, it may be nitrate of lead; but the addition of water will take this into solution. Weigh any insoluble.

Lead.—Neutralise the above solution with ammonia, make just acid with hydrochloric, and pass SH_2 gas. Weigh as sulphate as before.

Chromium.—Boil the filtrate till all SH_2 gas is driven off; then, while boiling, add ammonia, and boil until the liquid above the green precipitate is perfectly colourless. Filter, ignite, and weigh as Cr_2O_3.

Lime.—Add ammonic oxalate, and treat as before.

Total Soluble Sulphates.—Take half a gramme of the sample, dissolve in nitric acid, dilute with water, add nitrate of baryta, filter off the insoluble sulphate of baryta, wash, dry, ignite, and weigh. Or the sulphate of lead present may be estimated by treating a weighed quantity of the sample with a concentrated solution of ammonic acetate made strongly ammoniacal, filtering, and estimating as above the amount of sulphates or the amount of lead salts in solution.

OXIDE OF IRON REDS.

(144.) There are several pigments which owe their red colour to oxide of iron. Some are natural, some artificial. The former are chiefly used for paints, the latter for polishing and burnishing purposes. The composition of natural red oxide of iron varies considerably; the following are the results of the analysis of a large number of samples.

RED OXIDE OF IRON.

(145.)	Oxide of Iron..............	51 to 95	per cent.
	Insoluble silicates about	9	„
	Chalk, maximum.........	41	„
	Moisture, about	2	„

VENETIAN RED.

(146.) The composition of this pigment is approximately as follows :—

Oxide of iron..............	39 to 61	per cent.
Insoluble silicates, about	20	„
Chalk, about	30	„

TURKEY RED.

(147.) This is usually very pure oxide of iron. See also Art. 56.

INDIAN RED.

(148.) See Art. 57.

VERMILION.

(149.) This is a very important and costly red pigment; its analysis is extremely simple. It is usually sufficient to take a weighed quantity and ignite over an Argand burner. The sulphide of mercury being volatile, leaves the impurities behind, which are weighed and estimated in the usual way. Should any volatile impurities be present, special precautions must be taken and a different method of analysis adopted. The percentage of impurities usually varies from ·05 to 1·5. The latter is considered excessive.

(150.) The adulterants usually met with in inferior samples are :

Red Lead.
Oxide of Iron.
Chrome Red.
Gypsum.

Many imitations are put on the market
lly, and sold under fancy names. A
cently examined consisted entirely of
coloured up with a little organic red.

(*To be continued*).

ETECTION OF FATTY OILS IN MINERAL OILS.

ethod of Herr F. Lux is founded upon
different behaviour of the fatty and
ls, when heated with potash, potassium,
odium. For instance, rape oil, when
ith potash or soda to a high temperature
—stirring or shaking promoting the re-
t a temperature of 250° C. rape oil gela-
h potash or soda in five minutes; after
the oil turns brown and solidifies to a
ass. On the other hand, mineral oils
the same way become darker, but do not
state of aggregation. A. Preliminary
ection of larger quantities of fatty oils
per cent. or more). To about 5 c.c. of
der examination, in a test tube, is added
ce of sodium hydrate, the liquid heated
er the flame to boiling, and kept boiling
one to two minutes. Larger quantities
il are detected by the peculiar empyreu-
l given off, and by the solidification of
on slightly cooling. If a negative re-
btained, one proceeds as follows:—B.
tion of smaller quantities of fatty oils
. or less). Two middle-sized beakers are
which the one can be so far pushed into
as to leave a space of about 1—2 cm.
e two. Into the larger beaker is brought
raffin to bring its surface half way up
e sides of the two beakers. The inside
lso filled with paraffin to the same height.
bath constructed in this way cannot be
l. The thermometer, hung in the inner
ould be kept at about 200—210° C. Two
are now filled with a c.c. of the oil; to
added a few shavings of potassium, to
a stick of potassium hydrate, so that the
ds about 1 cm. above the surface of the
wo test-tubes are placed in the bath and
noted, after 15 minutes they are taken
llowed to cool. If the mineral oil con-
ich as 2 per cent. fatty oil, it solidifies in
two test-tubes, generally in both, to a
f.

L v. LARGE TELESCOPES.*

S. W. BURNHAM, F.R.A.S.

has been written recently in some of the
onomical journals on the comparative
large and small apertures for showing
details and other faint celestial objects;
enning has expressed the opinion that
of from 6in. to 8in. seem able to com-
the most powerful instruments ever con-
This novel view is based, to some ex-
st, upon the failure of the Chicago 18½in.
in the hands of Prof. Hough, to show
ails on the surface of Jupiter, alleged
en heretofore seen by various observers
smaller apertures, and also certain re-
convulsions or changes on the surface of
t, which have been so frequently de-
the possessors of portable telescopes.
gh, it should be noted, has specially
is planet, and made micrometrical
ns with this instrument on every avail-
ion during the last five years. The
f such changes usually consists in the in-
ce a spot or marking on one night which
obvious on some immediately preceding
g evening. The argument might have
nded in this direction by also citing
instances of double-stars alleged to have
vered with small telescopes, and these
verified by other observers; but which
istently remained invisible in the re-
the Dearborn Observatory and other
copes. At the time of the supposed dis-
uch instances would have furnished an
text for a discourse on the advantage of
r instrument, though, perhaps, it is too
turn them to any account in that direc-
it would be difficult to find an astronomer
t convinced that these observers, like
rs since, were too hasty in rushing into
scoverers, when, by a little patience, they
satisfied themselves that they had really
ng at all. I have spent a good deal of
and last, which might have been better
in running down these tales of new stars.
ed, at the start, but little faith in their
partly because as a rule the observers
discovered any real objects of that class which were difficult, and partly because the character of the instruments employed was such that it was in the highest degree improbable that even an experienced observer could see any companion stars of the magnitude and distance described which would be overlooked by the skilled observers who had traversed that field. In every instance, and there were many of them, I not only failed utterly to see these alleged stars, but satisfied myself by repeated trials under the most favourable conditions that they were purely imaginary. It never occurred to me that I was labouring under any disadvantage in using a larger aperture than those before employed, or that I could be mistaken in asserting positively, after a fair and thorough investigation with the aid of such an instrument, that the supposed stars were simply due to an excess of imagination on the part of the several writers. Perhaps, if I had not used the telescope in question for the discovery of some hundred of difficult pairs, and in the repeated examinations of the severest stellar and other tests known, I might have had less confidence in my own eyes as well as the telescope. The experience I have had with other telescopes by the same makers, nearly as large and larger, leads me to have the same faith in them and their power to show anything which has been really seen elsewhere, that I have had for a long time in that at the Dearborn Observatory. That I have as much reason, perhaps, as anyone to appreciate the value of small instruments, will be apparent from the work done with the 6in. refractor, and for the further reason that the discoveries thus made will all be found to stand the test of future examination.

I have no doubt Mr. Denning intends to deal with the subject fairly and impartially; but two things are apparent from his communications: First, that his statements are based wholly upon a comparison of small instruments with larger reflectors; and, second, that he has never worked with any first-class reflecting telescope. Speaking of large apertures he says; "While possessing an immense superiority of light over smaller telescopes, they are rendered ineffective by inferior definition." This remark would certainly be absurd if intended to be applied to instruments of the quality of those made by Alvan Clark and Sons. If it relates to reflectors, as it probably does, most readers will agree with him throughout, and in the conclusion that the best definition is rarely, if ever, found in large reflectors. Personally, I have had no experience in using telescopes of this form, but judging from what has been done by the larger reflectors, and more particularly by what has not been done, in departments of work where the most perfect definition attainable is absolutely essential, the conclusion is irresistible that however well they may answer for work on nebulæ, for instance, where there is nothing to define, and where, from the absence of this quality, the picture and text are rendered all the more pleasing and original, or in any class of work where the result is principally descriptive, they are immeasurably inferior to the refractors in work requiring sharp definition. In double-star work, for example, no very close pair has ever been discovered by a large reflector, nor any pair which would be considered a test for the definition of such on aperture. As a matter of fact, practically all the difficult pairs which have any interest as double stars have been discovered, and the measures of this class of stars made, with refracting telescopes; and this will continue to be the case until some radical improvement is made in the reflecting telescope. It is not enough to say that those observers did not wish to do that kind of work; for no observer, with a perfect instrument of twelve or fifteen inches aperture, and upwards, could fail to find something new among the double stars, whatever field of work he might be engaged in. It would be almost impossible to avoid it, and most observers would not fail to mention it, even if their principal interest was in another direction. Let the possessors of such a reflector take a little pains to satisfy himself on this point, and spend an hour or two on some good night in the discovery of a *new* double star with a distance of not more than 0·3″ or 0·4″, if the stars are about equal, or two or three times that distance if there is a difference of at least five magnitudes in the components. If his instrument is approximately equal to a Clark refractor, it will not take him long to verify and prove it in the manner I have suggested; and such proof would almost necessarily be satisfactory to others as well. For this purpose, observations of known pairs are not satisfactory, for we all know how easy it is for many to fancy a thing is seen when it is known beforehand just how it looks and where it is; and descriptions of how test doubles appear in the telescope are as unsuitable to enable others to judge of the performance of the instrument as descriptions of planets, and other observations which cannot be positively verified. This is not intended as a reflection on the good faith of anyone, but it is not too much to say that the "scientific use of the imagination" is brought into exercise as often in astronomical writings as in any other papers. If someone will point out any hitherto unknown close components of a star, using any reflector, however large, or a telescope of any form under 18½in. aperture, which we cannot measure, as well as see, at this Observatory, it will be a legitimate and important if not an unanswerable argument in favour of the value and superiority of reflectors and small apertures generally. Until something of this kind is done, the fact that someone with a 4½in. instrument claims to see a belt on one of the satellites of Mars, or a pale lilac streak on Neptune, will not be likely to discourage those of us who have only large Clark refractors to work with, any more than the alleged discovery and repeated verification of a select assortment of companions to Polaris, Vega, Sirius, &c., have done heretofore.

It seems, from the recent articles alluded to, that it is a common practice with those who use reflectors to cut down the aperture under certain atmospheric conditions, for the purpose of improving the performance of the instruments in definition or otherwise. What more convincing proof could be offered of the inferior character of the instruments? Assuming that an object-glass is of the best quality, it would be preposterous to expect to do with part of it what the whole failed to accomplish. I have never had an opportunity of using a telescope where anything could be gained, under any circumstances, by working with less than the ful aperture, although the experiment has been tried repeatedly. I can readily see how the definition of an imperfect object-glass would be improved by stopping out the exterior portion, and this may be true of all reflectors on poor or average nights; but it certainly is not true of any object-glass of the best workmanship. Perhaps I should mention in this connection that in all I have said here on the subject of refractors, I refer to the telescopes made by Alvan Clark and Sons. I do not intend to disparage the work of other makers, or to make unfavourable comparisons, but my experience has been acquired by the use of half a dozen or more of Clark telescopes; and I think I know, from the class of observations attempted, what can be done with them. That there are refracting telescopes much inferior to them no one will deny. That there are at this time any instruments superior to them will, I think, be maintained by few. Every one knows there are nights so unsteady that practically nothing can be done; and, unfortunately, there are many of them. Then, of course, the larger aperture is of but little advantage: but under no conditions will the reduced aperture reveal what the full aperture fails to show. The larger aperture, other things being equal, is as much superior to the smaller for observing planetary markings as for double-star work, and for precisely the same reason. Prof. Young has fully explained (*Observatory* for June) why the character of details, as shown by a small instrument, is frequently modified or changed under the superior separating power of the larger. If Mr. Denning had ever used the Princeton 23in. or a similar telescope, he probably would not have been "surprised at the advantage which he (Young) claims for the larger instrument on all occasions"; and he would not regard this experience of an "exceptional character," even if the Princeton observers should fail to see, as I have no doubt they will, some of the planetary details that have been the subject of so much remark in the last few years. We have several large refractors in this country, and the opinions of the observers at the Naval, Princeton, McCormick, Dearborn, Warner, and Washburn Observatories on the subject of the value of contracting the apertures of these several Clark refractors can be easily obtained, and also the practice of Struve with the 30in. at Pulkowa.

In view of the criticisms alluded to in regard to the performance of telescopes, it is perhaps not surprising that the author should so obviously misunderstood Professor Hall's letter (*Observatory* for May) concerning the Washington telescope. Prof. Hall says he has seen no remarkable change on the surface of Saturn in the past eleven years (and, so far as his published observations go, he has never recorded any remarkable changes on any of the planets), he has never seen the notch in the shadow of the ball on the ring, although he says that is "now always given in every good book on popular astronomy, and has been seen by several observers"; and even the "square-shouldered" appearance of that planet, which visitors frequently ask for there as they do here, is always missing, as well as the new stars in the Trapezium of Orion, which have been discovered several times in England and elsewhere. In this connection he candidly admits that his "work will confirm Mr. Denning's criticism that the large telescope does not show enough detail."

From all this, Mr. Denning comes to the conclusion that Prof. Hall gives a "thoroughly discouraging report" of the 26in. refractor! And because the Washington observer found that "usually a power of 175 gave the best result" on Mars, the inference is drawn that the definition of the great telescope is imperfect. If there is a practical observer who would not give that as his own experience in any class of work, however high powers he may use at times and places, I have no idea where to find him. Visitors usually wish to see objects with the highest powers, but the working astronomer finds, under ordinary atmospheric conditions, that the lowest power which will show a given object is the best for real work. I have repeatedly used, with advantage, a power of [illegible] on a Clark refractor of only [illegible]; but a power of [illegible] or [illegible] usually gave the best result, and I have no doubt this will be true of any good instrument. It is hardly necessary to say that when a high power can be profitably used on a [illegible] part, there is nothing in the way of observing any planet with it. Such nights, however, are too rare in most latitudes to represent the ordinary working powers.

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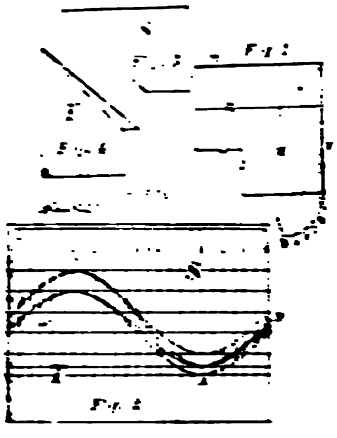
* From the *Sidereal Messenger*.

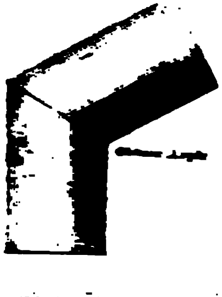
I have no wish to attempt to furnish a commentary on Prof. Hall's communication, for no one writes more plainly and directly on all astronomical subjects. His published work has been singularly free from all padding and fine writing, and he has no wild speculations or marvellous celestial observations to ventilate. I have had no communication with Prof. Hall on this subject, and do not speak with any authority; but I would suggest the propriety of ascertaining, directly from him, if there is any further doubt as to this question, whether he really took a discouraging, melancholy view of his failure to see so many of the wonders revealed by small telescopes, or whether it was not a delicate form of intimating a wholesome want of faith in the existence of the aforesaid marvels.

LAYING OUT SHEET IRON AND BOILER WORK.—IV.*

The Elbow—Acute, Obtuse, or Right-angled.

IN this, as in the preceding paper, first make a sketch of the piece you desire to produce. If a straight elbow of [illegible] four lines will be [illegible]





[illegible]

[illegible]

[illegible]

on the long side; on T flange is on the short side. Sketches 3 and 4 will show the position of flanges when turned, and explain the necessity of their being so placed.

As far as the connecting of the elbow is concerned, both can be made of same diameter; but if there are large and small courses to connect with, it will be necessary to lay out the pieces to suit. In these pieces the lap is shown on the side, and by rolling the pieces, as shown, the laps will be, when connected, on opposite sides. The accompanying figures show an acute and obtuse-angled elbow; they are submitted without explanation, leaving their investigation to the practice of the student.

CHEMISTRY OF PIGMENTS.—IV.*

By J. M. THOMSON, F.R.S.E., F.C.S.,

Demonstrator of Chemistry at King's College, London.

IN my first lecture I considered certain pigments yielding white, red, and yellow colours, describing to you shortly their methods of formation, and in certain of them, the means by which their ordinary impurities might be detected. In this, my second lecture, we will consider some instances taken from the common green and blue pigments; and it is my wish, in the case of some of these substances, to go a little more fully into methods illustrating their examination and analysis.

Green Pigments—Chrome Greens.

As I was speaking in my last lecture of the yellow pigments derived from chromium, I will commence my lecture to-night with the green pigments which are also obtained from compounds of that metal. You will recollect that, in speaking of the yellow pigments containing chromium, I spoke of the chromium being in the acid condition, as chromic acid combined with other metals, such as lead, barium, zinc, &c. The green pigments, however, derived from this metal, except in one or two cases, are all more or less oxides or hydrated oxides, which compounds yield us pigments varying very much in hue, according to the method adopted in preparing them. To show you how much the presence of water combined with these oxides, and the temperature at which the body is formed, may affect the colour, I will here precipitate a substance of this kind, according to the different conditions. For this purpose I use a salt of copper, which metal we shall find yields us various green colours through its compounds. Taking a solution of copper sulphate, and dividing it into two portions, I boil one portion over the lamp, and whilst this is warming I add to the cold portion a solution of caustic potash. You see at once a light blue precipitate is formed, which is apparently perfectly stable in its colour. On filtering this body and drying, it is found on analysis to be a hydrated oxide of copper, represented by the formula $Cu(OH)_2$. Now taking the boiling solution of copper sulphate, and adding to that some warm potash solution, you see a totally different result, the precipitate in this case being of a dense brownish black colour. At the temperature of boiling water, 100° C., the water does not unite with the oxide, which is therefore precipitated as a black body of the composition CuO. This simple instance will, I think, show you how easily the substances may take different colours in their preparation.

The different greens which owe their colour to the chromium oxides, either hydrated or otherwise, are generally prepared by heating some volatile salt of chromium, by which process the chromium oxide remains behind, or by decomposing other more important salts with different reagents. Thus, by heating ammonium bichromate, the ammonia is driven off, and the chromium absorbing oxygen from the air becomes converted into the oxide. The same decomposition takes place when mercury chromate or bichromate is decomposed by heat, which is done by placing this chromate in a retort and raising the temperature. The mercury distils over, and may be collected in suitable vessels, whilst the chromium oxide is left behind as a brilliant green of considerable depth of colour. Bichromate of potassium may also be decomposed by [illegible] and in quantity just sufficient to [illegible] with the potassium, when potassium [illegible] will be formed, and chromium oxide. Such a decomposition may also be carried out by adding sulphur to a boiling strong solution of the [illegible] and [illegible] a hydrated oxide [illegible] this body must [illegible] [illegible] the bichromate [illegible] extracting with water [illegible] [illegible]

left in the retort after potassium bichromate has been treated with sulphuric acid with boiling caustic potash or soda, the chromium oxide being formed. Prepared in this way, the substance has a beautiful green colour of considerable power. "Veridian" is another green of great brilliancy and permanency, also formed from chromium oxide, this body being in the hydrated condition. To form this green, potassium bichromate is decomposed by ammonium sulphate, in the presence of just sufficient warm water to render the mixing of the bodies possible. The material, on cooling, is broken in pieces and heated, for a short time, to a temperature not exceeding 300° C., when the water and ammonia pass off, leaving the hydrated chromium oxide. This powder must be thoroughly washed with water to remove potassium sulphate, but even with many washings the pigment is found still to contain traces of that body. It may also be prepared by calcining potassium bichromate and boracic acid, subsequently lixiviating the broken mass to remove free boracic acid and potassium borate. This form of the pigment is known under the name "Vert de Guignet."

The greens derived from chromium may be regarded as colours of great stability, as they do not decompose other colours, and are themselves unacted upon by sulphuretted hydrogen gas, light, or air.

Scheele's Green.

This pigment I now bring before you as it has been employed in more common painting work, and being of an extremely poisonous character, I wish to show you how materials coloured with this paint may be examined for the poison. This pigment, in a state of purity, is a neutral copper arsenite, but the substance employed in the arts generally contains considerable quantities of copper oxide. The colour cannot be said to be thoroughly permanent, as it is altered by air, more especially in a moist atmosphere, and is entirely decomposed by the action of heat. This paint has been employed to a great extent in the colouring of inferior classes of wall paper, and when so employed has proved extremely deleterious to the health of persons inhabiting rooms so papered. The manner of examining this pigment for the arsenic may be carried out in the following ways. Should the pigment be obtained in the state of powder, it may be introduced into a retort such as you see arranged on the table, and treated with strong hydrochloric acid. The retort should be connected with a condenser and a quill receiver, the end of which dips under a little water. On the application of heat, the volatile arsenic chloride distills over, and is condensed in the water in the receiver. More water is then added to the condensed liquid, and sulphuretted hydrogen gas passed through it, when a precipitate of the yellow arsenic sulphide shows the presence of arsenic. This precipitate may be confirmed for arsenic by treatment with ammonium carbonate in slight excess, when it should entirely dissolve. When the green pigment has been spread on wall paper, a preferable method is, after cutting the paper in small strips, to treat it with a little caustic ammonia, when, should there be Scheele's green in the pigment, the paper will probably turn blue from the action of the ammonia on the copper. After leaving the ammonia to act for a short time, the liquid must be rendered slightly acid with hydrochloric acid, the shreds of paper filtered off, and the solution boiled with some slips of metallic copper. In the slightly acid solution a deposition of metallic arsenic takes place upon the copper, causing it to assume a steel-grey colour. The slips of coated copper may now be removed from the solution, slightly rinsed with cold water, dried by gently pressing between blotting-paper, and heated in a small glass tube closed at one end, when the arsenic becomes converted into arsenious acid, which condenses in small crystals on the sides of the tube. For the direct examination of a pigment such as "King's yellow," which is unacted upon by acids, the best plan is to fuse the substance with some reducing agent, such as sodium carbonate mixed with potassium cyanide or charcoal in a small tube, when the arsenic is evolved, and condenses round the upper portion of the tube as a black ring of metallic lustre. Another pigment, namely, "Schweinfurt green," also contains arsenic, and may be regarded as an "aceto-arsenite of copper," being formed by the treatment of verdigris with acetic and arsenious acids. Both these pigments are highly dangerous to health, especially when they are employed in the colouring of internal walls, as in many cases the paint having been put on with an insufficiency of size, small particles come off, and becoming mixed with the particles of dust are breathed by those inhabiting the rooms.

[illegible] was originally used to a considerable extent as a green pigment, but it can not be recommended, as it undergoes change both by moisture and sulphuretted hydrogen. In certain cases also it has been found to undergo a darkening in colour, probably under the action of reducing agents. It may be regarded as a "sub-acetate of copper," but varies to some extent in its composition among the different varieties that are made. Many other greens containing copper exist, among which the most important are "Mountain green," formed from native malachite or copper carbonate; "Bremen green," or "Mineral green," which are hydrated oxides of copper; and "Brunswick green," which has for its basis copper oxychloride. Most of these pigments, if pure, are of good colour and permanent, but, in the case of Brunswick green, it is to be found frequently formed from a mixture of Prussian blue, chromate of lead, and barium sulphate, which, reacting on one another, cause the original green to assume a brownish tint.

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* [illegible] Lectures [illegible] the Society of Arts.

An extremely beautiful and permanent green, which has received the name of "*Rinman's green*," or "Cobalt green," may be formed by calcining the precipitate produced by sodium carbonate in a mixture of cobalt and zinc sulphates, and consists of a mixture of the oxides of these two metals. Some recommend that the cobalt and zinc salts should be precipitated with potassium phosphate or arseniate, this giving a richer colour with more body. The arsenious acid in this case apparently undergoes volatilisation, and is not retained to any extent by the resulting pigment. Green pigments may also be obtained from the metals manganese, uranium, and titanium, but they are not of much importance.

Blue Pigments.

The blue pigments most commonly employed are derived chiefly from the compounds of iron and cobalt, with the exception of ultramarine—which contains silica and alumina in varying proportion—and one or two blues derived from copper compounds.

Ultramarine.

I bring this colour first under your notice from the great beauty and purity of its tint, and the perfect stability the pigment possesses when mixed with other paints, or in the presence of noxious gases. It consists of silica and alumina, accompanied with smaller quantities of soda and sulphuric acid. From the rarity of the mineral "lapis lazuli," which furnishes the natural ultramarine, this form of the pigment is very expensive, but the "artificial ultramarine" is manufactured in large quantities at a moderate cost, and is very good in colour and stability. The artificial variety is prepared by fusing together white clay, dried sodium carbonate, sulphur, and charcoal, which yields a mass of so-called "green ultramarine." This, however, on being washed, dried, and again roasted in thin layers with sulphur, gradually forms the blue variety. As already stated, the colour may be regarded as a permanent one, except when it comes in contact with acids, which exercise a bleaching action upon it. There are two forms of artificial ultramarine, one of which is termed "Guimet's," and the other "Gahn's."

This latter body is a compound of cobalt oxide and alumina, and does not seem to possess a definite chemical composition. By varying the proportions of cobalt, a more or less decided shade of blue may be produced; but it seems essential that the metals iron or nickel should be absent from the pigment. It mixes well with other colours without producing any deterioration, but is liable to appear of a purple shade when viewed by artificial light.

(*To be continued.*)

Batteries and Electrical Requisites.—Mr. G. G. Blackwell, of Liverpool, sends us the new edition of his illustrated catalogue and price list, which will be found very useful by those who want to set up batteries, fit up bells and telegraphs, &c. Carbon and manganese, sal-ammoniac and bichromate of potash are specialities of Mr. Blackwell's; but his price-list is specially noticeable because it contains a useful paper on the Leclanché battery.

"Burning" Phosphor-Bronze to Iron.—An experienced moulder says that phosphor-bronze will burn fluid to solid the most satisfactorily of any he has knowledge of. In casting the bronze to wrought-iron, should any defects appear, they may be burned solid, and defects in iron castings may be mended in the same way that a moulder mends with iron. The phosphor-bronze appears to penetrate the pores of the iron, making a perfect union, quite free from defects.

Cohen's Bow Drill.—Mr. Cohen, of Kirkgate, Leeds, is introducing a useful little drilling apparatus for driving with the bow. The brass block carrying the spindle can be mounted in the vice, or held by the pincers or hand, and the bow can be placed on the ferrule without disturbing any portion. The drills are carried in a split mandrel nose, which is screw-threaded, and can be made to pinch them tight by means of a nut. A set of six drills up to ½in. are included, and the back end of the spindle is made into a triangular drill for glass and china drilling. Altogether it is a handy, useful, and cheap appliance.

SCIENTIFIC NEWS.

THE death of Mr. John Muirhead, in the 78th year of his age, removes one of the early workers who helped to perfect the telegraph. Commencing his professional career as assistant to Mr. E. Clark, resident engineer of the Conway and Britannia tubular bridges, Mr. Muirhead's attention was directed to telegraphy by his chief, Mr. Robert Stephenson, and he joined the original Electric Telegraph Company when Mr. Edwin Clark was appointed chief engineer. For many years Mr. Muirhead devoted himself to the work of perfecting and extending the telegraphic system, and many of those little details which helped so much to make it successful were devised by him. In conjunction with Mr. Latimer Clark and Mr. Warden, he founded, more than a quarter of a century ago the firm now known as Latimer Clark, Muirhead, and Co., a house which has planted the telegraph in every corner of the globe.

The death is also announced of Mr. D. C. Davies, F.G.S., a well-known geologist and mining engineer, and the author of several works on mines and minerals, the latest of which we reviewed on p. 181 of the last volume. His chief work—on the geology of North Wales—is left unfinished. Mr. Davies was only fifty-eight.

One of the most active students of hygiene in Germany, Dr. Paul Börner, died recently, at the age of fifty-six. He was the founder and editor of a weekly medical paper, and of a year-book of the practice of medicine. A report from his pen on the Berlin Hygienic Exhibition is nearly ready for publication.

In announcing the discovery of a new comet in this column on Sept. 11th, by a slip of the pen we inadvertently stated that Mr. Brooks resided at Rochester, N.Y. His correct address is Red House Observatory, Phelps, N.Y.

The opposition of the military authorities, or rather their refusal to stir in the matter, has left the question of uniform musical pitch to be settled at some unknown time. The *Times*, commenting upon the matter, says that in Italy the Government were ill-advised enough to fix, for some imaginary "scientific" reason, upon a C of 512 vibrations, being six below that of the French standard. The Society of Arts committee recommended a tuning fork giving 528 vibrations, which is said to have the advantage of being divisible by 2 down to 33; but 512 is scientific because it is based on 16, which is the number of vibrations producing the lowest sound audible by human ears.

It is stated that the Telpher line at Glynde will be ready for public opening on the 10th inst. It is expected that a large party of gentlemen interested in this remarkable invention of the late Prof. Fleeming Jenkin will be present, and a special train will leave Victoria at 11.45 a.m., and return from Glynde soon after 3 p.m.

Mr. Horace Lamb, M.A., F.R.S., late Fellow of Trinity College, Cambridge, and Professor of Mathematics in the University of Adelaide, has been appointed Professor of Mathematics at Owens College, Manchester; Mr. Alfred H. Young, M.B., Professor of Anatomy; and Dr. C. J. Cullingworth Professor of Obstetrics.

The Secretary of State for the Home Department has intimated that it is not intended to interfere with the manufacture of small quantities of nitro-glycerine by chemists when such are required for medical purposes; but th[illegible] announcement is not to prejudice any ste[illegible] which it may be expedient to take if the pub[illegible] safety should appear to be endangered. [illegible] sale of nitroglycerine lozenges and tab[illegible] not restricted in any way, as it has been [illegible] that a considerable number would be [illegible] to extract a sufficient amount of expl[illegible] practical purposes.

Mr. Jeans, the secretary of the Iron a[illegible] Institute, is going to publish a wor[illegible] sources of England's prosperity in agr[illegible] industrial, and commercial affairs, [illegible] dangers threatening it.

At the meeting of the San Franc[illegible] scopical Society on August 26, a com[illegible] was received from Prof. George [illegible] the U.S. Geodetic Survey, includi[illegible] of ribbon grass with diatoms in situ, which had been forwarded to him from Allan Island, W. T. Upon examination under the microscope, the grass was found to be incrusted with a rich and almost perfectly pure collection of elegant discoid diatoms, belonging to the genus Arachnoidiscus. Mr. Breckenfeld exhibited specimens of a small but very beautiful lichen *Cladonia bellidiflora*, Ach., which is plentifully found on the large Redwood trees of California. Mr. H. C. Hyde exhibited two electric lamps of one and three candle-power respectively; but they do not appear to be any improvement on those shown by Mr. Stearn, of the R.M.S., and illustrated in No. 933. Mr. Hyde also exhibited the new Zentmayer-Abbe condenser, which he regards as by far the most satisfactory sub-stage illuminator yet produced.

At the meeting of the Edinburgh and Leith Gas Company held recently, Mr. John Reid, manager, gave an interesting *résumé* of the history of gas-lighting in Scotland, in the course of which he stated that Edinburgh was early in the field, and so was the burgh of Leith; and rather curiously we find that both local companies were engaged in manufacturing illuminating gas from oil instead of coal. Whale and fish oils were the raw materials from which the gas was made and supplied to the consumers in both communities. Several years ago, in looking over some papers belonging to the old Leith Gas Company, Mr. Reid fell in with a printed prospectus by that Company, dated 16th April, 1823, containing the rules and conditions under which the oil gas should be supplied and used by the consumers, the price being stated at 5s. per 100 cubic feet (or 50s. per 1,000). He found, also, a similar prospectus of the Oil Gas Company of Edinburgh, along with a list of the directors, of whom Sir Walter Scott was chairman, dated 1824. In this prospectus the price was quoted as 52s. per 1,000ft. Both of these documents are framed, and may now be seen in the board-room of the Edinburgh and Leith Gas Company, St. Andrew-square. The contrast between these prices, and the current price in 1885 of 3s. 6d. per 1,000ft., is remarkable. But it should be observed that the illuminating power of coal-gas, which may average about 25 candle-power, is only about one-half of that from oil, which gas was equal to 48 or 50 standard candles.

From the U.S. Naval Observatory we have received Appendix I., 1881, containing an elaborate paper by Prof. Asaph Hall on the orbits of Oberon and Titania, the outer satellites of Uranus; and Appendix II., containing a paper by the same author, on the orbit of the satellite of Neptune.

Experimental Researches on Cholera.—The results that have been obtained by MM. Chantemesse and Rummo were communicated to the meeting of the Académie de Médecine, held on Sept. 15th (*L'Union Médicale*, Sept. 17th). Two specimens were examined and experimented with. One was brought from Spain by Rummo, and the other was sent direct by M. Ferrán. When the former liquid was injected under the skin of the thigh of guinea-pigs, in doses of one cubic centimetre, no local disturbance was observed; the syringe was sterilised and the skin washed with a solution of corrosive sublimate. If, however, four to eight cubic centimetres were injected, an eschar formed around the bulla due to distension of the cellular tissue. The lesion was healed at the end of [illegible] no other symptoms [illegible] the animal was [illegible] ix days had [illegible] were again [illegible] tomach of [illegible] lus. The [illegible] paration [illegible] opium [illegible] All the [illegible] fluid [illegible] in five to [illegible] epitheli[illegible] liquid [illegible]

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

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THE NEW STAR IN 31 M. ANDROMEDÆ—CELESTIAL PHOTOGRAPHY—SIZE OF THE MOON'S IMAGE WITH OBJECT-GLASSES OF DIFFERENT FOCI.

[24845.]—IN reply to the query with which Mr. Muschamp Perry concludes the second paragraph of his letter (24973) on p. 79, I would say that the evidence in favour of an actual physical connection between the new star in 31 M. Andromedæ, and the nebula on which it is seemingly superposed, appears to me very strong indeed. It may quite possibly be one of the rich stratum of about 1,500 stars spoken of by Bond as forming the foreground of the nebula. With reference to this I should like to remark, in connection with letter 24823 (p. 79), that I spoke of the effect of the star being between us and the nebula as "a purely optical one." For aught I know, it may be immersed in the nebula itself. All that can be definitely predicated of it is that it *looks* as though it were on this side of the nebula. As far as I have heard or read, Mr. Holmes (letter 24798, p. 80) is the solitary observer to whom the new star has seemingly been seen through it. To Mr. Hopkins (letter 24822, p. 99), I would say that I have no doubt whatever as to the colour of the Nova on the night on which I first saw it. Moreover, a lady, with a very keen eye for colour, who was observing with me, exclaimed, "Why, it is like a tiny electric light!" I have had no very recent opportunity of examining this extraordinary object, as I write these lines hundreds of miles from my observatory.

If "J. S. C." (query 57648, p. 110) will reflect for an instant how enormously greater the amount of light emitted by a star is than that emitted by a nebula, he will see that an exposure which would register a star upon a photographic plate perfectly, would be wholly insufficient to afford a trace of a nebula. Hence the stars continue, if I may so speak, to add to their already imprinted images, minutes, if not hours, after they are perfectly impressed upon the plate, and so show as circular "blobs," instead of points.

"Reyert Innominata" (query 57659, p. 110) will have to get a telescope of 36ft. focal length if he proposes to obtain an image of the moon 4in. in diameter in its principal focus. The object-glass of an astronomical telescope of the size referred to might be used; but your correspondent must note that the chemical and visual foci would almost certainly not coincide, so that an image which appeared sharp to the eye would be fuzzy on the plate, and the chemical focus would have to be determined by experiment. The moon's image in the principal focus of an objective of 6ft. focal length would be approximately 0·67in.

A Fellow of the Royal Astronomical Society.

THE NEW STAR IN ANDROMEDA.

[24846.]—THE weather at Eastbourne during dark nights has been unfavourable. On first scanning the new visitor, I was surprised to see a sixth-magnitude star apparently exactly on the old nucleus. It shone so brightly, scarcely any trace of the dark lanes was visible except to one other observer with me at the time. The Kellner eyepiece on my 18¼in. reflector gives about a power of 80, and a field of view of about 37 minutes of arc. With this power and field I counted between 50 and 60 glimpse and other stars interspersed with a few much larger stars. About four minutes following the new star (Nova) I discovered a pair of exceedingly minute stars about the 20th magnitude, and preceding it another much brighter about six minutes in advance. Bond's splendid 15in. refractor at Cambridge (U.S.) showed a mass of minute stars. Webb declares Bond saw the nebula through a rich cluster of stars.

The fact of the fairly equal distribution of these 50 or 60 stars through the field of my telescope renders it extremely probable this cluster has no connection with the nebula whatever, whilst the other fact, that the Nova is just where a star is so often seen in nebulæ, on a nucleus, as also so often seen at each end of a nebula, if oval, in the possible foci of the ellipse, renders it more than probable that the Nova is formed by development of the nucleus, and situated in an abysmal distance beyond the minute clustering stars sprinkled over the field of view.

The next occasion only gave a very hazy view. It is to be hoped, however, that in another month the mysterious object almost southing overhead will present a much more searching scrutiny.

G. W. Royston Pigott.

THE ANDROMEDA NEBULA—100 TO THE INCH AND DOUBLE STARS.

[24847.]—ALLOW me one or two remarks upon the letter of "S. S." (24823). I did not tax "S. S." to give any information but such as his previous letter assumed the possession of. It now appears that, like myself, he knows nothing whatever upon the points referred to, and the principal object of my questions was to protest against the assumption of knowledge where it does not exist.

Referring to his quotation from Herschel, I may remark that more perfect instruments than his have failed to confirm his deductions. Allow me to quote "Celestial Objects":—"No telescope has been able to deal with its nature." "If stellar, it is strange that . . . it can be resolved with certainty nowhere. There is some deep mystery here."

Newcomb merely grants the possibility of its being stars, which is very far from proving it so. The evidence of spectrum analysis can scarcely be regarded as conclusive until far more is known of spectral appearance under conditions we can neither reproduce nor even guess at

Further on, "S. S." asks if I know that the neb. is not more distant than the mass of the stars, and if I know that the stars named are connected with any of the nebula? I certainly *know* nothing of either; but the absence of knowledge on my part does not justify his assumption throughout the rest of his letter of the facts necessary to uphold his previous positions.

The remainder of his letter may be dismissed as based only on supposition, which, of course, "S. S." is as fully entitled as any one else to venture upon. I hope he will take no offence at my remarks. I thought possibly some information existed upon the points I raised with him, and can only regret he should have to say simply that we are all equally ignorant upon the matter.

I saw the new star on Sept. 30th, when it was not more than 9½ mag. Is it possible to conceive that so enormous a body as it is suggested it must be can possibly have degraded in so short a time to such an extent? As Mr. Gemmill's letter 24840 calls me to the front so plainly, perhaps you will allow a few words of comment, and here also I trust the same result will not occur as with Mr. Franks, who evidently was deeply annoyed that so humble an individual as myself should presume to differ from him. If I write plainly, it is to get at truth—not to give offence. Mr. Gemmill may be of sufficient astronomical eminence to traverse Mr. Burnham's opinion; but it would be presumption in me to differ on a question upon which Mr. Burnham's experience is complete and unique. As far as my experience goes, I should undoubtedly regard the fact of a reduced aperture, showing what the whole failed at under good atmospheric conditions, as a proof of defect in the instrument. The questions regarding powers actually used have been settled out of court betwixt Mr. Sadler and Mr. Franks, and as small fry are ignorant of the terms of settlement, therefore I will say nothing upon them. But the air interferes more with high powers than low ones; and when 150 on 3in., or 12in. either, gave good results, 300 might not be practicable. A pleasanter view might be obtained with the smaller instrument, since discs would be raised where the larger would merely show sparkling points which would bring into prominence the defects of the human eye in a very unpleasant manner. I think this point has received very insufficient attention. When a brilliant point is viewed, the want of homogeneity in the humours of the eye causes rays and spoils the vision; therefore, for large apertures, more power must be used to reduce intrinsic brilliancy and thus reduce the eye phenomena. But, of course, in bad air, large aperture and high power mean increased perception of the disturbance yet, although unpleasant. I find a close double star, when it can be seen at all, is always easier to see with 9 "than with 6," and always easier with 600 than with 300.

I think the nova in M. 31 was as bright as 6th mag. on Sept. 5, but I agree with Mr. Gemmill that it is sharp and well-defined; in fact, it is clearer with high powers than low ones.

Mr. Gaudibert (letter 24821) has opened up an interesting subject—there is a very great difference in the difficulty of dividing stars of the same mag. and distance. Possibly, if a list were drawn up, and the stars examined with a powerful spectroscope, some light might be thrown upon the matter.

There is a star 2½′ of arc, immediately preceding χ Aquilæ which is a neat double 4″, 310° ±. Also in field with β Lyræ, 3′ south, is a double, P.A. 290°, D. about ¼″ of the nearer companion to β. This is not the neat double mentioned by Webb, which follows in field. I believe these are new. In Proctor's "Half Hours," page 48, we are told, "In an ordinary telescope Vega appears as a single star, but with a large object-glass two distant small companions are seen. A 9in. glass shows also two small companions within a few seconds of Vega." I should like to know distance and angle of these last-mentioned *comites*, and by whom seen.

Edwin Holmes.

MR. PERRY'S MEASURES OF NOVA 1885 ANDROMEDÆ AND OF DOUBLE STARS.

[24848.]—MR. HERBERT SADLER (letter 24820) has rushed to a conclusion with premature and indecent haste. Let me assure that gentleman that I am not ignorant of the difference between seconds of arc and seconds of time, and, further, that I am fully aware of the fact that Dr. Copeland wrote, in the Dun Echt Circular No. 98, 1·6s. and not 1·6″. Also, I must admit that in my last letter (24798) I am made to say, "Dr. Copeland found it (the new star) to be some 1·6″ preceding and 5″ south of the old nucleus." A reference to my MSS., however, would at once show that it is the printer, and not myself, who is ignorant of the difference between seconds of time and seconds of arc. I wrote it 1·6s., not 1·6″. It is true, a proof was sent to me; but absence from home, in consequence of a death in my family, precluded the possibility of correcting the said proof, and although I saw the mistake at once, I had no time to rectify it before my letter appeared in your columns. I am sorry that the death of my relative should have caused Mr. Sadler inconvenience, and should have made him rush "with some feeling" into your columns; but I suppose that gentleman will be good enough to allow people to die; and if so, I trust he will refrain for the future from visiting his wrath upon the living for any inconvenience which their doing so may cause him. At all events, it would be a little more decent to pause before charging "obvious and gross errors" upon others until he is fully aware of all the facts. And Mr. Sadler's experience surely ought by this time to have taught him that there are such things as printers' errors. Moreover, I wrote a second letter to the *Times*, which, had it appeared, would have saved Mr. Sadler and Mr. Lynn all their trouble; but it either miscarried or was not inserted, for it never saw the light, for which I certainly am not responsible. All this is very "unscientific"; but it should, I think, teach Mr. Sadler how great a mistake it is to introduce "feeling" into a scientific correspondence. It leads inevitably to what Mr. Proctor calls a "feeling of discomfort," which he confesses in his own case compelled him to withdraw from the correspondence columns of the ENGLISH MECHANIC (*vide* "Knowledge," Vol. VIII., No. 201, p. 204), and which has, doubtless, operated in the same direction in other cases also. Finally, let me remark that, as the Dun Echt Circular was correctly quoted in my letter to the *Times*, to which Mr. Sadler refers, I think he might, and ought to, have attributed the mistake in letter 24798, to a printer's error rather than to my supposed ignorance of the difference between seconds of time and seconds of arc; especially when he could plainly see that it was not the only obvious printer's error in that communication—σ Coronæ having been changed into δ Coronæ.

As to my micrometer being in error, that, of course, is quite possible. I do not think it is, as I tested it very carefully to determine the value of a revolution of the screw, which, by the way, I could hardly have done without discovering the difference between seconds of time and seconds of arc: but I will attend to the point again. I do not see, however, that my micrometer should be assumed to be more faulty than Engelmann's. My measures of the distance between the Nova and D'Arrest's star are persistently larger than Engelmann's, my angle differing from his by only 0·92°. This would argue that my distances are too large if Engelmann's are correct, whereas Mr. Saddler asserts that my distance of μ^1 Herculis is about half the true value. That distance is stated by me to be 0·4″, a quantity so minute that even if you were to double it, you would for so difficult an object be quite within the range of fair and legitimate errors in observation. And in 1873·56 OΣ found it to be 0·63″. Gledhill also, in 1874, gives its distance at 0·4″. If Mr. Sadler has had any experience in the measurement of very close and difficult doubles, he must be well aware of the extreme difficulty of measuring with absolute accuracy anything under 1″; and if not, then he should be a little more sparing of hypercritical criticism. At all events, I measured this star in 1882, and found its distance 0·79″, and I certainly find it now much closer and more difficult than it was then. Everybody is liable to slips, and by an oversight I find I have made Σ 2173 revolve the wrong way. Here Mr. Sadler is quite correct; but I do not think that my angle is 19° in error. However, I was only able to secure one measure of this star, and that not a good one. As to δ Cygni, the angle should have been 322·5°, not 332·5°, a mistake which is due to my inability to correct the proof of my last letter, as before explained.

Jevon J. Muschamp Perry.

St. Paul's Vicarage, Alnwick, Oct 2nd.

NOVA ANDROMEDÆ—KLEIN'S OBJECT.

[24849.]—In reply to Mr. Ward (24824), the drawing in Guillemin's "Le Ciel" represents the star positions as shown in my tracing. He does not give the compass points, but his drawing tallies with the Bedford Catalogue one in the star places, and this latter I presume, from the position of M. 32, to be a telescopic one. At least, this, away from home, is my recollection of it. With respect to Klein's object, Mr. Sadler's "turtle" must be a curious creature indeed if it can snap a "nova" on to a map as well as off it. At all events, there it is, as Mr. Wesley's well-known accuracy in copying attests.

J. Rand Capron.

1, Oriental-terrace, Brighton, Oct. 2.

COLOUR OF THE NEW STAR IN ANDROMEDA.

[24850.]—Nearly all the American observers using refractors speak of the new star in Andromeda nebula being in colour "ruddy" or "reddish."

To me, in the silvered-glass reflector, it has from the first appeared of a slightly greenish tint. No report has reached me from any other American observer using a reflector.

It would be of interest to have the evidence of European observers on this point, with a statement of the kind of telescope used.

William R. Brooks.

Red House Observatory, Phelps, N.Y., U.S.A.

THE MILKY WAY IN CYGNUS.

[24851.]—With reference to the gap in the Milky Way, No. 7, described by Mr. Espin (letter 24799), I called attention to this gap in the year 1872, in the pages of the English Mechanic and the *Astronomical Register*. My description of it then was as follows: "If a line be supposed drawn from γ Cygni to α (Deneb) it will pass through this vicinity at about the same distance from α that α is from γ: the small double star numbered 429 (in Proctor's Atlas), is near the southern boundary of this 'coal sack,' from which a dark rift passes across the Milky Way between the stars ξ and ρ Cygni . . . . In the clear air of the Himalayas, at an altitude of 6,000ft. above the sea, this dark spot is particularly noticeable and immediately attracts the eye when directed to that portion of the heavens." The above was dated Sept. 25, 1872, and was, I think, my first published observation. I see Heis in his Atlas shows the "coal sack," but not the "dark rift" between ξ and ρ.

Oct. 1. **J. E. Gore.**

SHADOW OF THE EARTH'S ATMOSPHERE IN LUNAR ECLIPSES.

[24852.]—Several observers have suggested that during an eclipse of the moon the shadow of the earth's atmosphere ought to be visible on the moon's disc, and this has favoured the idea that by observations during eclipses we might obtain some information relating to the absorption of light when passing through great distances of the atmosphere. A little consideration, however, will show that probably the light of the sun which passes through our atmosphere would not be visible on the surface of the moon, on account of the refraction which it would be subject to by the atmosphere. It is well known that light, in passing from space into the atmosphere is refracted; likewise on passing out of the atmosphere, it would suffer a second refraction. The effect of the atmosphere would be therefore similar to that of an enormous lens with the central portion (the solid earth) rendered opaque. Hence I infer that the cone of light after passing through the atmosphere would converge to a focus, probably somewhere between the earth and moon, and after crossing at that point would diverge into space. We can imitate this phenomenon by attaching a circle of paper to the centre of a lens, so as to leave a narrow margin of uncovered glass all round, when, by holding the lens opposite a light, we can trace the cone of refracted light by placing a screen at various distances from the lens. Knowing the refractive index of the atmosphere, and the size of the earth, we ought to be able to arrive at a more definite conclusion by calculation; but I leave the subject to those better able to treat it.

Another subject in reference to atmospheric refraction I should like to mention. In "Roscoe's Spectrum Analysis," p. 32, a method of ascertaining whether the moon has an atmosphere is given, as employed by Dr. Huggins. It consists of examining with a spectroscope the light of a star during its occultation by the moon, when, if a lunar atmosphere existed, it would cause refraction and dispersion of the light of the star; the red rays, being least refracted, would die out soonest (last?). As no refraction of the kind is noticed, it is concluded that the moon has no appreciable atmosphere. Now, if an observer watches the occlusion of a star by the moon (atmosphere included), on entering the lunar atmosphere the light of the star would be immediately diverted by refraction, and hence the dispersion of colour—which is a result of refraction—would not be noticed. Example: Bring the refracting edge of a glass prism between the eye and a light. On crossing the line of vision, the prism acts as an opaque body in obstructing or diverting the light.

F. C.

NEUTRAL SALTS IN DANIELL'S BATTERY.

[24853.]—I am much obliged to "Sigma" for his information that neutral salts had been generally thus used for many years, which was the precise point I wanted to elicit. As he states, in reply to another correspondent, that he has been "much away for some time," he has probably not read (or read hastily) my letter on p. 522, or he would have seen that what I meant by polarisation at the positive plate (if the term is inaccurate I am quite willing to correct it), was precisely what he himself asserts in the words, "Acid acts on the zinc as soon as local circuits are set up by a deposit of copper," from which it follows that acid is unsuitable when occasional currents only are required, as in the case of bells. Only surely local action, however caused, would involve the danger. He appears to think that I ought not to have written on the subject at all without knowing more about it. Considering that he seems to be one of the recognised authorities of the English Mechanic (which I have not always the opportunity of consulting), and that in the letter he quotes I expressly stated that I had probably been anticipated in my use of sulphate of soda, I think the reproof was scarcely called for. I can only add that my first letter (which contained an error in chemical nomenclature, corrected on p. 540) was sent to you on the written suggestion of a gentleman whose competency to give the advice would not be questioned by "Sigma" or any of your readers. I do not mean that he either endorsed or contravened any of my observations: he merely said that they would lead to a useful discussion in the English Mechanic.

Though the use of neutral salt in Daniell's battery may have been long known, I do not think it is found in textbooks. At all events, I do not find it either in Ferguson (Chambers, 1873) or in Silvanus Thompson (Macmillan, 1881), and being original so far as my own practice was concerned, I thought it might not be without interest for others.

As to there being no polarisation of the zinc of the Daniell when in use, I did not assert that there was, and yet I do not see how the rapid corrosion, which certainly occurs when the amalgamation of the zinc is imperfect, could take place without something of that local action which I have rightly or wrongly referred to under the term "polarisation."

What I stated in answer to "Sceptic" was, that if sulphuric acid was used in contact with the negative plate (copper or carbon), and a neutral salt in contact with the positive plate or zinc, there would be a development of bubbles of hydrogen at the former as soon as the circuit was joined. Does "Sigma" mean to contradict that statement? If not, wherein am I wrong? I am perfectly aware that the sulphate of copper is sufficient for the whole action which goes on so long as there is no deposit of copper on the zinc through local currents. I do not see how else my words on p. 522 could be understood—viz.: "The dilute sulphuric acid, which in the usual arrangement of Daniell's battery is in contact with the zinc, serves the purpose of preventing permanent polarisation of the zinc through the deposit of copper, and this is the only purpose which it does serve." That is to say, "Its only purpose is to separate the zinc from the one active liquid, the sulphate of copper," which are "Sigma's" own words. Wherein is the difference? And if my statements are not inaccurate as far as they go, how is the incompleteness of my knowledge to be inferred, except where I have myself solicited further information?

I am not sure, after all, that I quite understand what your correspondent means when he states that "acid acts on the zinc as soon as local circuits are set up by a deposit of copper." I know what I myself intended to convey, and what the general tenour of "Sigma's" letter corroborates as far as it goes—viz., that if the zinc be exposed directly to the action of the copper sulphate, metallic copper will begin to be deposited upon it as soon as the circuit is interrupted. This evil (which I termed "polarisation," and I think rightly so) may be prevented by inclosing the zinc in a porous pot with dilute acid; but in that case (unless the amalgamation of the zinc is very perfect) there will be constant corrosion and waste of metal (attributable to local circuits of some kind), which may be obviated by substituting sulphate of soda for the acid. Nitrate was not suggested by me, whatever I may have experimented with. Sulphate of zinc is generated slowly, and is comparatively insoluble.

Does "Sigma" recommend it as an equally good conductor with saturated solution of sulphate of soda?

Whilst holding, as firmly as "Sigma" does, that sulphate of copper is "the one active liquid" in Daniell's cell, I nevertheless believe it to be an historical fact that the dilute acid within the porous pot was originally regarded as the principal agent, the copper sulphate having been introduced at first merely to prevent the development of hydrogen bubbles on the negative plate. And this is still the ordinary language of textbooks.

A. E. B.

DISEASE GERMS AND THE MICROSCOPE.

[24854.]—Many readers of the "E. M." must be grateful to Mr. F. Grant for the valuable series of papers which he is contributing to these columns on "Mounting Objects for the Microscope," especially those relating to the comparatively recent subjects on Bacteria, &c. There are many amateurs having good instruments who are eager for information on the subject of disease organisms; and in addition to the information contributed by Mr. Grant (which is all that could be desired on the subject of mounting), some information on the identification of the various disease "germs," accompanied with figures, if possible, would be much appreciated. A description of the organisms supposed to be the cause of common disease, such as diphtheria, pneumonia, tuberculosis, variola, relapsing fever, anthracis, glanders, &c., would be very useful and interesting.

Some interesting information on the subject of organisms in impure drinking water has been contributed by Dr. Jabez Hogg, pp. 181, 425, Vol. XXXI. Let us hope that some such able contributor will continue to favour us with similar articles.

In a recent number of the *Australasian*, Dr. J. E. Taylor, in his "Notes on Popular Science," gives the following note relating to the bacillus of phthisis, or "consumption," which may be worth reproduction:—"Here, for instance, is the bacillus of tuberculosis, on which Prof. Sormanni has been experimenting. It out-Herods Herod for defying death—it has a hundred more lives than a cat. You have to boil them for five minutes before they are dead. Only the most healthy of human stomachs kills them by digestion—children and weakly persons have no chance of destroying them thus. They are whisky proof, for alcohol does not affect them. They can lie up in an absolutely dry state for months, and will then survive a treatment of cod-liver oil, ozone, benzoate of soda, salicylate of soda, sulphate of zinc, carbolic acid, iodide of silver, bromide, camphor, &c., and all the other delicacies of the season. Australia appears to have furnished the most deadly enemy to the tubercular bacillus in eucalyptol, which it cannot stand at all." Being an Australian, I may mention that a preparation of eucalyptol, called "eucalyptus oil," has been sold by chemists for years; it is recommended as "a valuable remedy for coughs, colds, &c.," and is used both externally and internally; but of its therapeutic value I have had little experience.

Tas.

THE OPTICAL LANTERN.

[24855.]—Owing to absence from town, I have not seen "Rector's" letter (24782) until lately. I do not see how any of the waste heat he mentions can be further utilised, because in any hydrocarbon flame, the heat of the flame is utilised in the incandescence of carbon particles to the utmost degree, as determined by experiment. Incandescent bodies must themselves radiate heat, but that is not "waste" in the sense meant. We turn on more and more into the flame, until the limit is reached as shown by smoking, and with any given size and heat of the flame, I do not see what more can be done.

As to the objectives, very much improvement has been made very recently by Messrs. Newton, of Temple Bar, who have produced specially for the oil-lantern objectives of 6in. and 4½in. equivalent focus, far superior to anything else available near the price, so far as I have seen. Both have been carefully worked out experimentally for, and with oil-lanterns, and the shorter-focus one was not completed until after 18 months of trials and experiments with various curves and densities; it does all that I think can be done (with oil) in sharpness and flat field. The 6in. lens is not so markedly superior at first sight, for the simple reason that as the oil-light does not "carry" a long screen distance well, all lenses of this focus look more alike in performance. The superior result is, however, plain enough, and with the limelight: I have seen this lens tested against Dallmeyer's celebrated objectives, without anyone being able to say which was which.

The back lenses of both these objectives are just a shade under 2in. diameter, and this is sufficient if the lamp is adjusted. It is of no avail to get in all the apparent cone of light, for the marginal portion is neither fully illuminated, nor passes through the slide. A 2in. lens embraces rather more than all the cone which gets through a slide.

No oil-lamp can give the definition of the limelight, with the very best objectives and management, because the rays from various points of the larger radiant cross and confuse the image. But either of the above, which can be bought separately at a very moderate price, gives results I should once have thought impossible.

Lewis Wright.

THE SOARING BIRD.

[24856.]—I CANNOT do otherwise than think that Mr. Lancaster, in the pamphlet reviewed by you a short time ago, is supporting a most egregious paradox if he seriously maintains, as I understand, that a bird can be supported in either calm air or a horizontal current of air by the action of gravity alone. If in calm air, it is admitted that the supporting action of the air arises only by means of a motion of translation in the bird. How is this acquired? Either by muscular wing motion, which is postulated not to take place, or by the bird *falling* nearer to earth; that is, using some of its energy of position, which falling is *also* postulated not to take place. No amount of mathematics, or involving the question in queer terms, will alter that fact. There is no other possible or impossible force in the question. Mr. Lancaster, in fact, must resolve the vertical downward force of gravity into an equal and opposite force without the intervention of any assistant force before he can prove his point. A queer parallelogram of forces that would make! Again, suppose a regular (not intermittent) horizontal current of air. This, again, will not help us: for before this can be resolved into an *upward* force, we must have some force acting, if not directly, at least slightly, in a direction against it, so as to form a fulcrum of resistance by which the bird may, so to speak, stand up against the wind, and by offering a resistance resolve the horizontal into a vertical force by wing inclination. Gravity is no good for this purpose, for being absolutely at right angles to direction of wind (postulate 1), it is strictly neutral as a fulcrum of resistance. The bird has only its store of inertia with respect to the wind; and that is not only slight, but strictly terminable, and no good for prolonged use. In fact, the bird is a kite without a string, and would simply blow away with the wind, falling as well all the time. A bird in "calm" air is, in fact, in the midst of a current of several hundred miles an hour, due to the earth's rotation; but as it remains in it and goes with it, it feels and can feel no effect of it.

It is otherwise if we imagine the wind intermittent or constantly changing its direction. Suppose a bird sailing in calm air to be suddenly struck by a sharp gust of wind. It has, relatively to that gust, a store of inertia (the kite has now a string), and by a suitable disposition of its wings, it can resolve part of the wind force into a vertical pressure, and so get a rise out of it as long as its store of inertia lasts—that is, until it has acquired all the horizontal speed of that gust. Now, if the gust will obligingly cease suddenly, the bird will find itself restored to its calm air, but with an added horizontal speed due to the gust of air, and some added vertical height also. Both these factors are added force, for its additional speed can be turned into a vertical rise as long as it holds out, and the bird find itself, when reduced to its original speed, at a much greater height; or its additional height may be used to increase its speed, so that when reduced to its original height above earth, its speed of translation is much increased. Either result is a gain, and that without flapping of wings—only by wing inclination. Again, as all speeds, in an ocean of air, are *relative*, the short intermittent gusts we have supposed followed by dead calm, would be equally well, though less distinctly, represented by a wind of varying force (or speed)—the bird would take a rise out of each variation, plus or minus, on the *average* speed of the gale. But the paradise of a soaring bird must be an eddy or miniature cyclone, where it finds not only plus and minus currents, but actually reverse currents on the opposite sides, and by taking a direction across the eddy, can get a rise out of each of them. I have never been to sea myself, but have been told that birds do *not* soar continuously in calm weather, and that they do so most of all in gusty weather: and in such weather one may see even land birds doing a creditable performance—crows, &c., alternately turning and facing the gusts till carried along by it, and then sailing along for a long distance. Again, I have been told that birds will sail round and round the hull of a ship, rising on one side and falling on the other. Here they have a plus and minus change of current—that is to say, the full benefit of the wind on one side the ship and comparatively still air on the other; and assuming that they lose little by friction, continuous soaring becomes possible, the bird acquiring additional speed on the wind side, though falling a few feet vertically, and regaining the vertical fall on the lee side at the expense of the additional momentum. In fact, I believe that a bird can soar wherever it can obtain either currents of varying horizontal direction, or plus and minus currents (i.e., considerable variations of wind-speed), or a "lee" of comparatively still air; or, in fact, any plus and minus eddying, or confused condition of currents, but *not* in absolutely calm air, nor in an absolutely regular horizontal current. I took this view some years ago in our paper, under the name I then adopted of "Guido," so I am not stealing that gentleman's ideas!

Norman.

[24857.]—THE remarks of "B. B." in your issue of the 4th ult. on the subject of my statements in "Soaring Birds" seem to require correction. He implies that I traverse the law of the conservation of energy in my explanations, whereas I hold them to be throughout in harmony with that law, as interpreted by Helmholtz, Joule, and Count Rumford. He also objects to my assertion that a soaring bird is a body doing work on the air by "falling without losing its energy of position," without giving the sense in which those words are used, which has been fully done in the book in question. This is a good way to misrepresent a writer; but it hardly answers any other purpose. I hold to Newton's three laws of motion absolutely; and should my positions be in conflict with those laws, and with the law of the conservation of energy, I should anticipate nothing but inglorious defeat for them. What horrible, unnatural monsters they would be if they succeeded!

I. Lancaster.

MODERN MAN-FLIGHT AND AERIAL NAVIGATION.

[24858.]—PERMIT me, through the medium of your columns, to enlighten "Silex Seadrift" upon propelling balloons by compressed air. One, Russell Thayer, of Philadelphia, has constructed (or is about to construct) a cigar-shaped balloon, pointed at both ends, which is to have an ascending force of seven tons, and cost nearly 10,000 dollars. It will travel, independently of wind, at a speed of thirty miles an hour, the motive power being compressed air, which is accumulated by machinery, and discharged at the rear end. This air ship can be steered in any direction. As to its size, it will have a length of 66ft., and a diameter of 60ft., and will be known as the dirigible war balloon.

Monmouthshire. **A. Freyer Evans.**

[24859.]—IN giving description of machine for man-flight (No. 24747), I partly thought that, at least, it would open up new ideas for the achievement. I therefore hope that replies will be somewhat charitable.

Is "Crumby" prepared to prove that springs compressed horizontally exert all their force downwards? Is the resistance which the sides of the frame offer to those springs downwards? I hope he will pardon me, but I really fail to see that his machine is an exact parallel of mine. My springs move right and left, resisted by parallel upright sides. Have these upright sides no tendency whatever to go towards each other when the springs are compressed? Which way would the springs fly if, when compressed, both ends suddenly got free? In all these cases, if the answer is "downwards," nothing more need be said; but if otherwise, then I think the matter ought not to drop. If a well has a pulley over it, and a bucket is to be pulled up by a rope passing over that pulley, I am aware that all the pressure is on the top of the pulley if I pull the bucket up by pulling the rope down parallel to the rising side of rope; but if I pull the bucket up by running straight out at right-angles to the ascending part of the rope, then the weight of bucket is not on the top of the pulley. I am, therefore, still inclined to think that the springs would assist the man. The question may be, "What becomes of the downward force of gravity on the machine and man?" I am unable to reply, except by asking, "What becomes of the horizontal force against the uprights of the machine?"

"Seadrift" is probably aware that when the locomotive was proposed to run and draw a load after it, critics urged that it could not, because there was as much pressure of steam to drive it backwards as forwards. This was true: nevertheless, the locomotive went forwards, owing to internal motion. May I draw an inference?

Norfolk.

THE FERROUS OXALATE DEVELOPER.

[24860.]—ON p. 102, last number, Mr. Bottone objects to my "falling foul of the Ferrous Oxalate Developer," and proceeds to show that in his opinion this developer is the "sewing-machine" which turns out the work most neatly; at any rate, when he is the "sempstress."

Now, were I to be cast upon a desert island where developers were unknown, and had no wherewithal to develop my plates but a moderate-sized bottle of this developer, I doubt not that before it was gone I should have acquired so much dexterity in its use that I might prefer it to others when I returned to my native land. But as matters are, I must confess I prefer the sodic sulphite—which seems to me to give negatives of the most intense blackness (the fine lines are just as if drawn with a pen and ink)—to any developer I have tried, notwithstanding the fact that I have in the house a copious supply of certainly every chemical used in photography, and many others which have not yet been used in that art, and that I have spent much time in experimenting therewith.

My experience with the F.O.D. was highly unsatisfactory. The first time I mixed it up there must have been some impurity in the F.O., for the whole concoction turned perfectly thick—in fact, exactly resembling pea-soup: and, not being accustomed to develop my negatives in that culinary compound, I threw the whole away with what speed I might, and developed my negative with the S.S.D. as usual. Shortly after, I had another attack of F.O.D. fever, and tried some more negatives, using this time a perfectly pure F.O., which, I was informed, was made on purpose for the developer. This time, to my delight (for I had never been beaten before in chemical manipulation, and didn't want to begin with the F.O.D.), I actually got a picture! But what a picture! It was about as much like the brilliant negatives I had been getting with the S.S.D. as a washed-out tablecloth is like the same article when new; and for pretty much the same reason.

I am perfectly well aware that if you know how to work it, the F.O.D. is a very excellent developer, and, indeed, anyone who knows anything about photography knows that it is used on the Continent almost entirely; just as the pyro developer is used almost entirely amongst us Britishers. But it must be borne in mind that I was not answering a query by Mr. Bottone, who knows how to use the developer; but by "E. Y.," who evidently did not get satisfactory results when he tried it, any more than I did. The great objections seem to me to be that the iron solution is likely to get full of oxide, if not protected from the air, and if the oxalate is impure the whole "biling" gets thick; but with the S.S.D. you can make up a good big bottle beforehand (it will keep as long as you like), and use a few drops to each ounce of water each time you develop. I don't think Mr. Bottone can have given this a fair trial, being previously in favour of the F.O.D., any more than I gave the F.O.D., probably, being previously in favour of the S.S.D. With regard to lantern transparencies, I really can't agree with Mr. Bottone that no other developer answers but the F.O.D.; for the sodic sulphite gives most brilliant transparencies, as black as a coal (or any other degree of blackness), and the shadows perfectly clear glass. I should not think of using the ordinary pyro developer for this purpose, as it is certainly apt to behave as Mr. Bottone remarks; but the sodic sulphite never. I hope this epistle won't be considered too long. If it is the Editor must curtail it; but some kind of reply I felt bound to make.

R. A. R. Bennett.

Walton Manor Lodge, Oxford, Oct. 5.

[24861.]—ENGLISH photographers seem to have so strong a partiality for some form or other of pyro developer, that little information is given in handbooks of photography on the method of working with the ferrous oxalate developer. I have for some time past discarded pyro for ferrous oxalate, which, in my hands yields satisfactory results—partially owing, no doubt, to the fact that from long experience I seldom make any great error in exposure. Sometimes, however, I do, and the plate is then lost, whereas it might have been saved, so I am told, if I had developed with pyro. I am, therefore, exceedingly glad to hear that Mr. Bottone finds the ferrous oxalate development perfectly under control, as if this can be secured, then the one only defect of this method is removed. May I ask him to kindly describe his manner of working for the benefit of those readers of the ENGLISH MECHANIC who do not see the *Photographic News*?

Shaftesbury. **T. Perkins, M.A.**

ON HYDRAULIC RAMS.

[24862.]—IT has always appeared to me that stability, by which I mean non-liability to stop, is of more importance in a ram than even its efficiency, and that the vexatious stoppages to which so many rams are liable have done more to bring this admirable machine into discredit than failure to throw sufficient water. What I have to say, then, will chiefly concern stability; but, as the word "efficiency" must often occur, I may as well mention that it will be used in its scientific sense to denote the relation or ratio of the work done to the power employed. The work done will be so many gallons per minute raised so many feet, the power employed will be so many gallons per minute falling so many feet, or if

q = water discharged per minute from outlet of delivery pipe.
Q = waste water escaping per minute through outer valve.
h = height of outlet of delivery pipe above surface of water in supply tank.
H = height of surface of water in supply tank above orifice of outer valve.

Then the efficiency = $\frac{q\,h}{Q\,H}$, a fraction which in ordinary rams varies from ·50 to ·70; in other words, from 50 to 70 per cent. of the power employed in the ram is returned in work actually done.

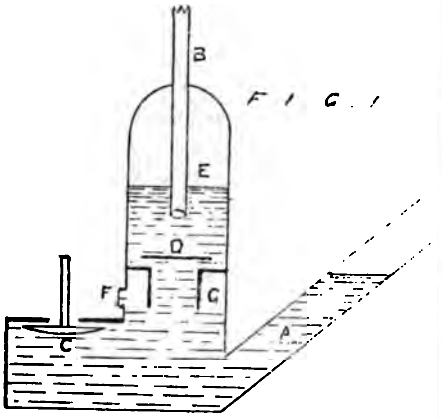


Fig. 1 shows the various parts of a ram: it by no means pretends to exhibit the best arrangement of them. We will call

A the motive column or drive pipe leading from a supply tank.
B the delivery pipe.
C the outer valve.
D the inner valve.
E the air-ball.
F the snift hole.
G the air-chamber, which, for the present, we will leave out of consideration, or suppose it to be filled with water.

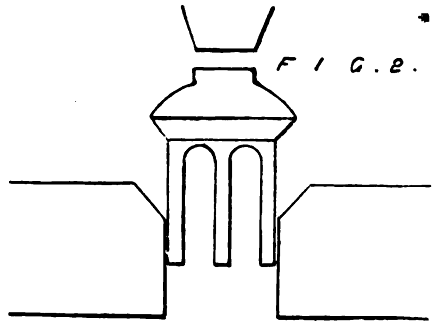
The experiments given below were made by me with a ram supplied by a maker of high repute. It has a vertical fall of 24·7ft.; horizontal length of drive-pipe, 32 yards; inside diameter of drive-pipe, 2·25in.; vertical height of delivery pipe, 87ft.; horizontal length of delivery pipe, 800 yards; inside diameter, 1·5in.; outside diameter of outer valve, 4·5in.; inside diameter of seat, 3·5in.; average weight of valve, 3¼lb.; diameter of snift-hole (in valve), ·025in.; area of opening of inner valve-grating, 2 sq. in.; capacity of air-ball, 2 gallons; capacity of air chamber about half an imperial pint.

It will be observed that the drive-pipe is both long and high, as compared with the delivery, which, we shall see, materially increases the difficulty of recoil and the chance of stoppages,

To estimate the time occupied by various portions of the stroke, an indicator was employed, like that mentioned by Morin as having been used on rams by Eytelwein so long ago as 1828. A horizontal pencil is fixed to the top of the spindle of the outer valve; a cylinder caused to revolve by clockwork, and having a ribbon of paper wrapped round it, is then brought up to the pencil point. As the valve makes its up and down stroke, the pencil traces a continuous line on the paper, horizontal during the open and close periods, sloping or curved during the rise and fall.

Now, to return to our figure. Suppose a stroke has just been made; C is closed, D is open, but only for an instant, for the force of impact on D is soon spent, and down it comes again under pressure of the column in B; in its descent it presses on the water in A and below C, and gives the former a backward motion which it retains, by virtue of its inertia, for an instant after D has closed. This leaves a more or less perfect vacuum below C, so that the atmospheric pressure above it, aided by its weight, can force it down in readiness for another stroke. The whole body of water in A has been pushed, or rather flung, back, so to speak, towards the supply tank, and this simply by the descent of the inner valve through a height of less than half an inch. There is thus a sort of see-saw or oscillatory movement kept up between the two columns; the motive column driving the delivery column back a comparatively long distance, and the delivery in turn driving the motive back a shorter distance. The recoil, though slight, is easily apparent to the senses. Now it is evident that stability of working depends on this recoil, also that the force of recoil will depend on (1) the pressure above D—i.e., the vertical height of B; (2) the prompt and sudden closing of D; (3) and, lastly, on the mass of water in A that has to be moved or flung back. By (1) we see why it is that until the delivery pipe is full up to a certain height the ram will not work at all, but has to be kept going by the foot, for there is not pressure above D to cause sufficient recoil. It explains, too, the great improvement often found in the working of a ram when it has been made to deliver to a higher level, as well as the mischief resulting from tapping the delivery pipe by a branch at a lower level; (1) and (3) show why it is that rams with low fall and high lift often work well in spite of ball-valves (see below) and other defects. It is better to sacrifice some available fall, than to have the power in excess, and this, for reasons to be given below, specially applies to rams with the ordinary sized air-chamber. Of no less importance than sufficient pressure above the inner valve is its prompt and sudden closing. Suppose at D we have, as is very common, a ball-valve; the ball, instead of falling promptly and vertically as it should do, is apt to fall obliquely, resting for an instant on one side of its seat, and so allowing the pressure of the delivery column to cease gradually; thus the motive column is pressed rather than flung back, and the removal of pressure from below C is imperfect. It cannot be too much insisted on that the action of both valves must be that of a guided piston incapable of any but an up and down motion, for everything depends on their closing suddenly.

Fig. 2 represents an excellent form of inner valve used by one of our best makers. The flange *a b* forms the face of the valve which, when worn, is easily ground on its seat; the legs serve as guides to prevent lateral motion. I use a spindle valve guided above and below, and having its face lined with indiarubber. Under a pressure, usually of 118ft. this lasts only five or six months; but is easily renewed at the cost of a few pence, and has the great advantage while it lasts of being perfectly watertight. It should be remembered that, with a leaky inner valve, the water is escaping from the delivery pipe during considerably more than half the time that the ram is in action; this is more likely to reduce efficiency than a leaky outer valve. I have known a ram work well, though the water spouted through the outer valve when closed.



And now to pass on to the air-chamber G. It appears that all the early rams were without it. Montgolfier does not mention it. General Morin, in his work on "Machines for Raising Water" (1868), alludes to it as being used by some makers, notably by Messrs. Easton and Amos in England. He had not had an opportunity of testing it thoroughly, but remarks that its principal effect must be to diminish the shock from the closing of the outer valve; that it affords also a convenient means of replenishing the air in the ball E. This at once proves that an air-chamber
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alone produce a recoil). "This causes a recoil of the water, which momentarily diminishes the pressure in the pipe below the pressure due to the statical head. This assists in opening the outer valve." Strangely enough, the writer just before has repeated that very common fallacy: "The outer valve is of greater weight than the statical pressure of the water on its under side," in which case any outer valve, instead of 3¼lb., should weigh 150!

A similar account is given by the accurate Todhunter ("Nat. Philosophy for Beginners," Part I.): "As soon as the water comes to rest, the outer valve sinks by its own weight, and the action is renewed. A small auxiliary chamber is sometimes added containing air; when for an instant the water comes to rest, the compressed air recoils, and occupies a larger space than it did originally. Thus, the pressure below the outer valve is lessened, so that it descends more readily. Rankine, in his "Prime Movers," says: "When the energy of the mass of water in the supply pipe is so far expended that its pressure can no longer keep the inner ball-clack open, nor the waste-clack shut, then the inner ball-clack shuts, the waste-clack opens, and the operation begins anew. Joseph Montgolfier, the inventor himself, seems to have supposed that the outer valve fell by its own weight, for in the account he gives of his invention in the *Journal des Mines* (1802) he says: "The inner valve shuts, and the motive and delivery columns return to their state of rest. Their previous velocity, by means of which they had shut the outer valve, no longer existing, it drops by its own weight, and by its fall prepares for a new round of operations."

There are but two explanations given of the drop of the outer valve in all the works in English that I have seen. One attributes it to the weight of the valve—an absurdity that we need not stop to notice; the other to the re-expansion of the air in the chamber, and I must confess that until two years ago, when I happened to come across Morin's book, I accepted the latter view, which seems to be supported by such high authority. Yet one need but watch the same ram, working with and without air in the chamber, to be convinced both by eye and ear that this view is altogether wrong. There can be no question with those who have seen it that the valve falls with more force and promptitude without the air. It is, indeed, almost difficult to stop such a ram, whereas many rams with ordinary air-chambers, are but too prone to stop of themselves. The air-chamber does not assist the recoil—it moderates it. Its first and obvious effect is, of course, to lessen the violence of impact. The water, instead of striking on rigid metal, strikes a yielding cushion of air. The hammer falls on a spring; velocity is checked gradually instead of instantaneously; the blow is therefore feebler. This, in itself, diminishes the recoil, which is always in proportion to the force of the impact. In fact, a part of the energy of the stroke is stored in the air, and the question arises when and how does it restore it? I believe it is restored in moderating the force of the recoil thus: At the moment when the inner valve closes and the motive column is continuing its retreat by inertia only, at that very instant there would be a removal of pressure below the valves, and the drop would take place if there were no air-chamber; but, when there is air, the expanding air follows up the retreating column, and prevents any vacuum or sufficient removal of pressure till it has expanded to or below atmospheric pressure. Thus, not only is the recoil itself feebler; but the removal of pressure in consequence of that recoil is more gradual and less complete. As the air moderated the positive pressure when the outer valve was on the point of closing, so it moderates the negative pressure when it is on the point of opening.

In the diagrams taken by the indicator described above, the most noticeable effect of the withdrawal of air from the chamber is the shortening of the close period of the outer valve. In my ram it is shortened by quite one-half as compared with the same stroke when the chamber is supplied with air. The open period is lengthened, but by not more than one-tenth, and less with a short stroke than with a long one. A consequence of this is an increase in the number of strokes per
minute, and they increase more rapidly as the
is shortened; thus a rate of 50 strokes per
with air was raised to 52 by the with-
of the air, 66 was raised to 76, 75 to 92, 90
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·52 to ·61: at 75 strokes, from ·53 to ·65; the delivery and waste being respectively with air, 1·64. 14—1·25. ·84—·099. 6·5 gallons per minute; without air, 1·77. 14—1·57. 93—1·5. 8·4. These figures would, of course, vary with the size of the chamber: they serve, however, to show a general principle. Of what use, then, it may be asked, is an air-chamber if it not only interferes with the recoil, but reduces both delivery and efficiency. In the first place it is, as Morin says, a most convenient means of supplying air to the air-ball. Air is absolutely necessary there, and being soon absorbed under the great pressure, needs constant renewal: but for this purpose a chamber so small as to be harmless would serve as well as a larger one. And next, there are cases where a very long stroke is permissible, the largest possible delivery being desired without regard to waste. With such a stroke, there is little fear of insufficient recoil. An air-chamber will then be useful in saving the machine from injurious shocks, nor will it materially affect the efficiency. In short, what I have desired to point out in this paper is, that the air-chamber, probably from mistaken views of its effect, is often made too large, and that in this, coupled with excess of fall in proportion to lift and the use of ball, or other unguided valves, lie all the cause of instability.

W. A. S.

PHOSPHORESCENCE OF THE SEA.

[24863.]—THE appearance of Noctiluca on this coast seems to be dependent on the temperature of the water. I have never observed any until warm weather has fairly set in, and a good spell of summer heat appears to be most favourable to their development. As winter approaches, they gradually disappear.

Several times lately I have captured but few when using a surface tow-net: but, walking on the beach at mid-day last Sunday, I caught sight of indications of their presence, and by just stooping down and filling a bottle that I happened to have in my pocket, I found that I had in this simple manner taken a large quantity. On getting home, I put them into a shallow dish, and watched them in the dark.

With them were several little jelly fishes (*Beroë, Cydippe*, &c.), and the movements of these were plainly discernible by vivid trails of light. Removing these restless creatures, in a few minutes the Noctiluca settled down in peace and darkness.

I have just now had another look at them. The darkness of the room was unbroken. Standing close, I shouted, whistled, sang, clapped my hands, and made other noises without eliciting a single spark.

Tapping the table close to them brought out flashes from two or three individuals; then tapping the dish smartly, a beautiful flash promptly appeared along the surface, and when I agitated the water with a syringe, the whole contents of the vessel became brightly opalescent.

I am writing this in great haste, and have only time to add that, if "Landbird" will communicate with me, I will, with much pleasure, send him some living specimens.

W. H. Shrubsole.

DOMESTIC HOT-AIR ENGINE.—A SUGGESTION.

[24864.]—A SHORT time ago I noticed an inquiry for a hot-air motor, suitable for driving a sewing machine, &c. The only reply was a reference to "Deschanel's Natural Philosophy," in which there is a diagram, &c., of Stirling's air-engine. Of course an engine could be made from this description: but it would be very expensive for every amateur who might wish to do so, to have to make all the different patterns and to procure the castings. Now, what I wish to suggest is, that some of those gentlemen who advertise in "Ours," and supply such useful castings for small work, should take up this subject, and supply a set of cheap castings (nearly all could be done in iron) for an engine of this description which would drive a sewing machine. This engine could be managed by any lady, and either gas or paraffin oil could be used as the source of heat.

Motor.

GRAMME ARMATURES.

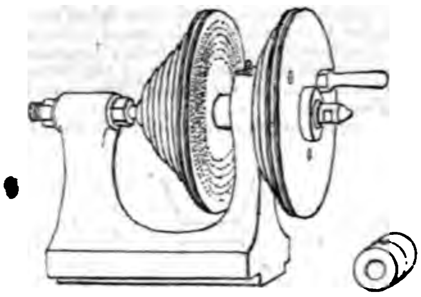
[24865.]—I THANK Mr. Eaves for replying to letter 24748, and entirely agree with him as to the high electrical efficiency of sheet-iron ring cores in comparison with those of wire. I think that where the rings can be easily obtained and used, they make the nearest approach to a perfect core that theory and practice can point out. It was, however, the object of my letter to describe a method of constructing armatures which should be electrically and mechanically good, as regards the mounting of the core, notwithstanding its being made of wire. Of course, a wire core, from its low density, must necessarily be made of an increased size relatively to a ring core, in order to carry the same number of lines of force, and, therefore, to give the same E.M.F., though, as Mr. Eaves points out, there is little difference as regards the price of the two methods in a dynamo of the size he mentions (10-lighter). I think it possible that in larger dynamos, or in slow-speed dynamos, with armatures of a large diameter, to which I think the constructions I described are more especially applicable, the price per weight of the rings, owing to greater waste in stamping, might be increased.

With reference to fastening the wire of the core, preparatory to winding, the end of the wire is forced into a small hole drilled in one of the end flanges: the wire is then bent over, and may be wound on the bobbin with any necessary degree of tension, till the bobbin is full and the wire level with the flanges. At intervals during winding two or three strands of the wire may be soldered together, and the wire may be fastened down at the finish in the same way. With due care the wire may be kept wound evenly during the whole process, and the bobbin having been turned perfectly true before starting, the wire should be perfectly true, and the armature perfectly balanced at the finish.

Stafford. **G. E. Dorman.**

GERMAN LATHE APPARATUS.

[24866.]—I HEREWITH inclose you photos. of lathe appliances which will, I think, be new to your readers: they are also by Mr. Walz, of Berlin, whose agent's advertisement appears in your issue of Sept. 18th.



The Fig. is a dead-centre chuck. Here the centre which usually revolves remains stationary, whilst the band is removed from the pulley on the mandrel to its duplicate on the nose of the mandrel. Thus the driving pin revolves round the stationary mandrel and centre.

Another is a frame with spindle to carry milling cutters for fluting or wheel cutting: the frame is mounted upon a slide which can be set to any angle as required in spiral fluting, bevel, or worm-wheel cutting: the whole apparatus is shown bolted into the tool-holder of a well-made slide-rest. The pulley is shaped so that the band may make a complete turn or a turn and a half round it, so as to give more power without gearing: the apparatus overhangs considerably, and would require the slide-rest to be capable of being withdrawn a long way from the centre line.

I am anxious to know whether Reichel's method of correcting screws is new to our practical men, and whether anything similar is used in England.

F. A. M.

VENTILATION AND LIGHTING OF COAL-MINES.

[24867.]—MR. WOOD, in letter (24810) contained in your issue of last week, appeals to your readers for an expression of opinion regarding the value of certain illuminating properties which he claims for a mining lamp he has invented or devised.

The "acquisitions" he credits his lamp with are certainly very valuable, though the illustrations he gives of its penetrative power are somewhat quaint, to say the least. If, however, as he states, his lamp gives a "brilliant white light" of 4-candle power (I assume the comparison to be made with the usual standard sperm candle), then I should say that the lamp is, in that respect, to be commended.

It is unfortunate that he sent a "rough specimen" to the Ellis Lever competition, for an imperfectly-made lamp would assuredly militate against any chance of achieving satisfactory results, even if the principle on which it was constructed was good. Probably, its roughness has contributed to, if it has not been the sole cause of, its rejection, as the trials to which the several lamps sent in for competition were subjected, were necessarily of a very severe kind.

Mr. Wood dilates at length on the light-giving properties of this lamp, which, of course, is a matter of great importance: but what is of still greater moment is its behaviour in a mixture of firedamp, and of this he makes no mention whatever, and in the absence of any details as to the principle of construction, it is of course impossible to form an opinion of its merits as a safety lamp, if it possesses any.

Mr. Wood's best course would be to get a perfect and complete lamp made, and have it thoroughly tested in a lamp-testing apparatus such as is kept at some collieries for that purpose; or he might bring the lamp before the notice of the Royal Commission on Accidents in Mines, if that learned body have not already finished their unconscionably protracted labours.

Sept. 29. **Lyons.**

COMPOUNDS: ARE THEY A SUCCESS?

[24868.]—THE following tables will show that they are a decided failure:—

Engines.	Miles.	Coal cwt.	lb. per mile.	Rape oil.	Non-corrosive oil.	Grease.	Cost per 100 miles.
							£ s. d.
503	4,610	1,284	32·4	132	59	52	1 4 7
504	4,919	1,540	36·2	123	63	66	1 5 7
Average			34·1				1 5 6

The above table shows the lowest and the highest and the average, for a whole link of compounds which use nothing but the best Welsh coal for the month of July last. I will now give the link of Jumbos which use Welsh and sharp coal mixed:—

Engines.	Miles.	Coal cwt.	lb. per mile.	Rape oil.	Non-corrosive oil.	Grease.	Cost per 100 miles.
							£ s. d.
759	4,241	1,149	31·7	78	35	33	1 3 4
470	4,890	1,514	35·8	83	33	38	1 4 5
			33·7				1 3 10

With inferior coal and other disadvantages, the Jumbos beat the compounds four-tenths of a pound per mile in coal and 1s. 2d. per 100 miles in expense.

Then, again, the compounds are very difficult to start, and at certain stations they have to set back several hundred yards before they *can* start. This is very dangerous. Another point is that they have all got hooks and links, or some other sort of jemmies, in their blast-pipes. They have a deal higher pressure than the Jumbos. Now if the Jumbos can beat them, which are the greatest wolves that ever ran on the L. & N.W., what would one of Ramsbottom's do, which are the best we have had so far? Why, they would beat them if they had the same pressure 10lb. per mile, and at least 3s. per 100 miles in cost.

Of late at least one a day has broken down, and at last an order has come out that they must not run to Carlisle.

There is just one more danger I, as an engine-driver, wish to point out—viz., that the compounds occupy so much time in repairs, that other engines cannot get that attention that they should have, and they have either to go out with their engines in a dangerous state, or face another danger, that is, take a strange engine out. From the above cause very often regular engines have to be sent out, and the men are several days before they get their own engines again.

Now engine-men have, besides their own defects, to rectify the defects of everybody on the line, and I contend that everything should be done to avoid irritating them and flinging them off their balance. This is a point I bring against the compounds: they must be favoured, and all the other engines must wait.

The above are facts, and opinions of an engine-driver who is

In Favour of an Old Racer.

CONTINUOUS BRAKE RETURNS.

[24869.]—I HAVE read with surprise the letter signed Henry Prince, p. 102, No. 24834, more especially because it contains such convincing proofs that this correspondent has undertaken to write upon this important question of continuous brake returns without being acquainted with even the preliminary requirements.

On the 22nd of April, 1880, the Board of Trade issued a circular in which the returns relating to failures were considered very unsatisfactory, and desiring that the information should be of a uniform character, and arranged so as to be easily compared, that it should be limited to, and include all instances in which the safety of the trains is concerned, and directed that the replies should, in future returns, be given under the three following heads:—

(1) "Failure or partial failure of the continuous brakes to act when required in case of an accident to a train, or a collision between trains being imminent.

(2) "Failure or partial failure of the continuous brakes to act under ordinary circumstances to stop a train when required.

(3) "Delay in the working of trains in consequence of defects in, or improper action of, the brakes, distinguishing whether they arose from neglect or inexperience of servants, or failure of machinery or material."

Mr. Prince evidently knows nothing either of the Board of Trade circular of April, 1880, nor of the three heads under which the failures are to be recorded, for he asks if Mr. Stretton is "perfectly unprejudiced in his views in bringing forward this second clause."

It is hardly necessary for me to say that my opinions on the brake question are "perfectly unprejudiced," and I certainly took no part in drawing up the Board of Trade circular of 1880.

Clement E. Stretton, C.E.,
Leicester. Vice-President A.S.R.S.

BRAKES.

[24870.]—Having read some remarks made by Mr. Henry Prince, M.S.A. (p. 102), I would like to point out to him that "failure under ordinary circumstances" means, for example, when an up express runs right through Kentish Town station, because the brakes, which were all right at the previous stopping station, had somehow gone wrong without apprising the driver of that fact. If a train had been standing in the station that would have been a "failure in a case of emergency," and a collision would have happened, as hundreds have, through the failure of the vacuum system. "Failure under ordinary circumstances" does not mean "burst hose," nor "extensive renewal of certain classes of brake"—matters which are connected purely with the manufacture of the brake appliances, with which the Board of Trade has nothing to do. As Mr. Prince is evidently an unprejudiced questioner, and, above all, quite honest in his questions, might I ask him whether "M. S. A." means anything more than the ability to pay two guineas a year? **Nun. Dor.**

THE ACCIDENT NEAR EDGE HILL.

[24871.]—Your correspondent, a "Railway Servant," page 101, will be glad to know that when the charge of manslaughter against the signalman was investigated at the Prescot Petty Sessions on Tuesday last, the medical evidence proved that the deceased died from consumption and pleurisy rather than from the effects of the railway collision which occurred last April. Why this fact was not discovered by the coroner's jury *before* the verdict of manslaughter was returned, is a question which should receive the attention of the proper authorities. **Clement E. Stretton, C.E.**

Leicester, Oct. 3rd.

RAINBOW.

[24872.]—On Sept. 29th I observed a very brilliant rainbow with a secondary bow above it. The colours of the primary bow were very vivid, and what rendered it remarkable was the presence of three violets and three greens. There was the primary bow containing the ordinary spectrum, but inside the violet there was a dirty green, inside of which was a bright violet, inside of that again, another dirty green, and inside that another violet slightly fainter. Altogether there were three violets and three greens. I have searched books treating of the subject for an explanation of the cause of the repetition of these colours in vain. Would "A Fellow of the Royal Astronomical Society" kindly help me?

Edward M. Nelson.

Shetland, Sept. 30th.

MUSICAL SCALE.

[24873.]—In No. 1049 Mr. Hardie closes letter 24195 about the difference between his "melodic" and the harmonic scale with the words "*proof experimental.*" Evidently this melodic scale, evolved from perfect fifths, finds favour in his hearing, and no theoretical objections will shake his allegiance to it. I therefore tried to hear it on a monochord, but in so disjointed a form, could not fairly judge of its effect. Colin Brown's voice harmonium at the Inventions, however, has enabled me to hear melody with these intervals, and the result is, as I expected, worse than with even temperament. It is easily managed, as you have simply to use all white keys in the scale. No one supports Mr. Hardie in upholding this scale; but it should not be a matter for surprise if we found some ears with a preference for it, after the conclusion Mr. Ellis arrives at—viz., that the musical scale is not one but diverse; not natural but artificial, and not necessarily founded on laws, but very capricious. This is difficult to believe: but Mr. Ellis bases it on facts. It would be interesting to know if any show this preference, and the voice harmonium will easily test the point, as this melodic scale is as easily played as the natural one. Unfortunately, the top E flat is cyphering, and cannot be silenced without opening the instrument.

This is my first look at the voice harmonium. The natural keyboard is a splendid arrangement, and I could soon learn to use it. Do voices and strings change to the grave form of the keynote when modulating from the major to the minor? You have to do this on the voice harmonium, as the just minor third of the major scales is not on the keyboard.

Anent musical notation, would it not be an advantage to make the treble and bass clefs read alike? This could best be accomplished by adding the "A" line above the treble clef, and the "E" line below the bass clef (dotted if preferred), when both staves would have six lines, E, G, B, D, F, A, and the middle C line would stand between as now, making a grand stave of 13 lines. This would not interfere with the middle of the stave at all, and all music would be the same as now written. Several aids to memory suggest themselves, and reading would be simplified, especially for beginners. The six-line stave might be used for teaching, and then abandoned, or existing music could have the extra lines ruled in.

Swindon. **S. E. Hunt.**

CLAMP v. CRAMP.

[24874.]—If the authority of lexicographers, catalogue makers, and writers on mechanical subjects is not worth the consideration of "J. K. P.," I cannot suppose that anything further which I might adduce from those sources would have weight with him. If I err, I err in very good company indeed, and am satisfied that though my authority is not worth considering, that of the writers quoted is of the nature of a final court of appeal. **J. H.**

PORTABLE EQUATORIALS.

[24875.]—There are many possessors of small telescopes who would derive much more benefit from their instruments if they had the advantage of a fixed equatorial; but this being inconvenient for many students of astronomy, I am induced to send my experience with a small portable equatorial.

I must admit having been somewhat sceptical as to their utility; but my late experience with such an instrument has completely removed my former prejudice.

I obtained one of the small portable equatorials by Wray, a notice of which appeared in the English Mechanic of last July 31.

The tripod is always placed in approximately the same position on three blocks of stone let into the ground for that purpose. The equatorial is carefully adjusted once for all, and the adjusting screws of the levels are then moved until the bubbles are central.

All that is required to set up the stand at any future time is to set the declination circle to the declination of a six-hour star, and revolve the base-plate till the object appears central in the field, using the right-ascension movement as required (the base-plate must, of course, be first levelled by its adjusting screws). On clamping the base-plate, the equatorial is to all intents and purposes a fixed one. As my experience may be of use to others, I have much pleasure in sending it.

Robert Bryant.

SPEED FOR TURNING METALS.

[24876.]—The speed at which any metal can be turned, is entirely governed by the means used for keeping the cutting-tool cool. As in the ordinary method of effecting this, the water, or soapsuds, drips upon the work, it is evident that its principal action takes place upon the shaving, before reaching the buried point of the tool, and to remedy this, an engineering gentleman in this city some years ago, caused the tools to be made with a hole drilled in them, so as to throw the lubricant more directly upon the point. If suitable steel tubing can be manufactured for these tools, I am satisfied that, by means of an indiarubber pipe, attached to the end of said tool, to convey the suds, that a much quicker rate of turning metals could be attained by this means. **A., Liverpool.**

HOW SUNDIALS CAN TELL SECONDS OF TIME.

[24877.]—The notion that a solar shadow received at any number of feet—or of miles—is less distinct than at as many inches, comes of totally mistaking the nature of *penumbra*, the space wherein a part only of the sun is visible. The width of that space must always (on earth) be a trifle over the movement made in two minutes, whether the shadow be cast on a scale one inch distant or on the moon. The degree of indistinctness, *as regards time-measure*, will be exactly the same at all distances; and you cannot descend much below a minute, unless able to mark where the penumbra merges into perfect shadow. This you can do thus. Suppose you observe, on a smooth pavement, the shadow of a corner of building 50ft. distant. The width of penumbra is about 6in.; lay across this a thin rod or bar, supported on two bricks. The shadow of this bar will be traceable right across the penumbra, up to the commencement of perfect shadow, but no further. You will see its junction with the building's shadow advance every *second*, and the application of this to sundials is obvious. Instead of the short graduation lines of the scale being crossed by a long line on the same surface, they should be crossed by the shadow of a wire or thin rail, supported like a hand-rail, *a little above* that surface. Its distance from the scale should not exceed a fiftieth or sixtieth of the gnomon's distance, or say three or four minutes of the time-scale itself.

Oct. 1. **E. L. G.**

SILVERING GLASS SPECULA.

[24878.]—Several inquiries on this subject having lately appeared in the "E.M.," it is possible that my experiences may be useful to those who are not adepts in depositing silver.

The subject of experiment was a $10\frac{1}{2}$in. mirror; weather cold and stormy, the outside temperature varying from 37° to 45°. In all the experiments, with the exception of the 4th, the washed mirror and the solutions were kept in the room where the silver was deposited for 24 hours. The mirror was carefully washed with nitric acid, followed by potash solution, plenty of spring and distilled water being employed at the various stages.

1. Experiment was made with Martins's process, as published by an optician in the Strand some years ago. 175 grains of silver nitrate were used, and ammonia nit.; potash and sugar-candy in proportion. The temperature of the room at the time of immersion was 52°. The result was a thorough failure; the film being thin, irregular, and spotty.

2. Experiment 1 was repeated, with fresh solutions of silver and ammonia. Temperature of room was rather above 50°. The result was almost as great a failure.

3. I had then recourse to the process recommended by Mr. Brashear—

Silver nit.	150gr.
Water	6oz.
Caustic potash	100gr.
Water	6oz.

Ammonia was added till ppt. formed just cleared up; then the potash was added, and the ppt. cleared up by more ammonia. An ounce of the silver solution, kept back for the purpose, was added until a decided ppt. was formed. The solution was then made up to 30oz., 6drm. of the reducing fluid made three years ago was stirred in, and the mirror placed in the solution. The result here again was a decided failure, the film was thin and irregular, and portions of it rubbed off on attempting to polish.

4. Everything was conducted as in Expt. 3; but the silver and potash were increased to 200 grains each, and the reducing fluid to 2oz. I also filtered, after clearing up by ammonia, the ppt. occasioned by the addition of the potash, distilled water again being added to produce 30oz. The result at last was the most perfect and most beautiful film I think I ever saw—not a flaw visible. As the day was cold and blustering, I was obliged to remove my mirror and solutions to a warmer room, where the temperature was 57°. I then cleaned and washed the mirror, and finished washing after depositing the silver within two and a half hours after removing from the cold room.

The four experiments were conducted on four successive days.

I may add that I use the clamp recommended by Mr. Brashear, and find it more handy and neat in every respect than the old pitch and suspension process.

I have just seen Mr. Woodside's letter in the "E. M." of last week. I quite agree with him as to filtering before the reserve silver be added. I think this is important. May I say that there is little difficulty in dropping from any ordinary-sized stoppered bottle—none at all from a 4oz. or 6oz. bottle. Withdraw the stopper, say, from a quarter to one-third of its length from the bottle, holding the bottle with the hand; place the forefinger on the stopper, thus keeping it securely in its place. The heat of the hand will expand the air in the bottle, and force the ammonia out in drops. If required to flow faster, press the stopper in gradually; but I have just seen a very neat stoppered dropping bottle, sold by Mr. Taylor, druggist, in this place; when the stopper is in a certain position, it permits air to enter through one groove, and the fluid to flow out in drops through another; turning the stopper quarter round, by altering the position of the grooves, prevents this. The marks on the side of the bottle are "Patent L. H.," and on the bottom "30." Probably it is well known, but I have only just seen it.

Robert Smith, M.D.

Saltburn-by-the-Sea.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[55634.]—**Engine Boiler.**—To "GLATTON."—Many thanks for your reply to my "Engine Boiler" query: but I am sorry you have taken it up wrong. I have the boiler 11ft. by 3ft. diam., ⅜in. plate, no internal flue. I want to know the best way to build it in brickwork, sizes of firegrate, flues, and iron chimney. Will boiler steam enough for two engines, as under?—4¼in. bore, 8in. stroke, about 150 revolutions per minute. I have one engine nearly made, and would like sketch of single governor (giving sizes) suitable to work at the above speed at 50lb. pressure per square inch. Fret Saw.—Could any brother reader give particulars of arrangement for power fret saw to give equal tension on saw all through the stroke. There is an American machine fitted with the arrangement, I am told.—QUEENSLANDER.

[56916.]—**Telescope Eye-Tube.**—Our former contributor, Mr. Lancaster, described the making of one in Vol. XXXIII. p. 585, and Vol. XXXIV. p. 29. The number of threads generally used for eyepiece fitting is 16 to the inch; but as the number of threads required is only 3 or 4 as a rule, a tap or chaser differing slightly from this may be used. If you cannot understand Mr. Lancaster's articles, I have a spare rack to focus and sliding tube I could lend you for three or four weeks but I could not make and send drawings. If you have no experience in brass turning and fitting, I doubt whether you could make one. In that case you might be able to make a sliding tube for coarse movement, and carrying a piece of screwed tube for fine adjustment.—J. C. L.

[57199.]—**Gas-Engine.**—I regret I cannot help your correspondent, as I hear of that make of engine for the first time. I should suppose the makers would be glad to answer his query. People should not buy gas-engines without a guarantee, as there are quite a host of quacks in the market attracted by the large profits which are said to be made; but all the reputable makers are well known, and do not object to give a guarantee or to contract to keep the engine in order by the month or year. Quite enough has been said in these columns to warn all who have eyes to read and brains to comprehend what is written.—A. SIEGER.

[57210.]—**Tar.**—In reply to "Dandie Dinmont," I would observe that I thought he knew that if Stockholm tar is subjected to distillation the residue is black. The tar also becomes black with age, probably through the action of light. Stockholm tar is a crude product of a sort of distillation of resiniferous pines, and contains resin, acetic acid, and turpentine. Coal-tar is obtained from vegetable matter, too: but the vegetable matter has been subjected to such treatment in Nature's alembic that it is called mineral, and before the tar reaches the shops it has undergone the ordeal of a roasting such as wood tar is never subjected to. As to what can be done in the way of varnish-making with Stockholm tar, I suspect your correspondent knows a great deal more than—NUN. DOR.

[57211.]—**Steam Launch.**—"Windermere," I am afraid, does not grasp the meaning of my reply. I know that it is quite "practicable" to build a launch to suit an engine: but I still think the idea is rich—something like building a skiff to suit a pair of sculls, with this difference, that while the dimensions and consequently the capacity of the launch are fixed, the engine can be made to do very different amounts of work by alteration of the steam pressure and adjustment of the valves. An engine should be adapted to the hull in which it is placed, not the launch to the engine.—ESSAR.

[57226.]—**5ft. Reflector.**—You must add from 2in. to 4in. to the half-diameter of tube, to find out how far from the large speculum the plane mirror must be placed. Theoretically, the book is right, but practically it is wrong, because it allows no room for eyepiece tubing or rack to focus motion. If your tube be 6in. diameter, the half is 3in.: add, say 3 to it, and deduct the 6in. from 60, leaving 54in. the distance between the centres of the two mirrors.—J. C. L.

[57271.]—**Flageolet Tuning.**—To "D. W."—I have had my flageolet about 12 months, and it cost 24s. I got it from Riviere and Hawkes, London. The instrument was in perfect tune when I got it, and it kept so for some time; but since then it has gone nearly half a tone too sharp, and I have tried several ways to alter it, which has always proved a failure. If you can give me any information how to put it right, I shall be very pleased.—R. E. H.

[57323.]—**Restoring Clock Case.**—It is not quite definite what this querist wants to do; if it is "regilding," I would advise him to look in back volumes; but preferably to give the work out, as a novice is almost sure to make a mess of such a job.—NUN. DOR.

[57324.]—**Wire on F.M.'s.**—Our "Electrical Engineer" is slightly astray in saying that in a series-wound machine the resistance of the F.M. should be only ¼ that of the armature. A series-wound machine always works better when the resistance of the field magnets exceeds that of the armature. After 16 years experience (my first dynamo I made in Italy in 1868), I find that series-wound machines give the best results when the resistance of the field magnets is from 1·25 to 1·50 that of the armatures, and that from 1·50 to four times that of the armature the results remain nearly stationary, especially in small machines, as the loss of current entailed by extra resistance is compensated by the increased magnetism of the field. As to shunt-wound machines, the best resistance of the coils on the F.M.'s depends entirely on the resistance of the outer circuit: unless a compromise be made to meet varying resistances (and then a compound shunt is best). The rule is $R\,M = \frac{R\,X^2}{R\,A}$, in which R M = resistance of fields, R X = resistance of external circuit, R A = resistance of armature.—S. BOTTONE.

[57326.]—**Pattern-Making.**—No doubt this query has been answered in the excellent series of papers on the subject which has recently appeared; but I have not time to wade through them and find out. Perhaps the hint will do for the querist.—NUN. DOR.

[57327.]—**Fireproof Composition.**—Will not the ordinary fireproof lining of blast furnaces do for this querist?—S. R.

[57337.]—**Carbolineum.**—Probably what is known as tar oil, coal oil, &c.—E. J. T.

[57338.]—**Canadian Mounted Police.**—This question can be answered by applying to the High Commissioner for Canada, 9, Victoria Chambers, S.W.—S. R.

[57342.]—**Carbon Moulds.**—These are made of ground coke-dust or retort scurf, cemented with treacle or sugar, and baked at a high temperature.—E. T. M.

[57344.]—**Punching Round Washers.**—If "Scotch Mechanic" means round washers with a central hole, I would ask him if he has ever seen a machine to punch them from the sheet, or whether he is fishing for hints to enable him to make something he could patent?—OLD SOLDIER.

[57354.]—**Surveying.**—A "good textbook on surveying"—what? Queries like these do not deserve an answer; but the querist can be recommended to look at the list issued by Lockwood and Co.; and then, as he presumably knows what he wants, he may possibly find it.—E. G.

[57357.]—**Tinfoil.**—Not the mercury or the tinfoil, but the inexperienced worker. The mercury should be placed on the tinfoil in superabundance: the edge of the glass, which has been rendered chemically clean, is then pushed against the edge of the mercury and driven slowly but steadily along the whole surface in such a manner as to prevent air getting in. Suppose the film of mercury is ⅛in. deep; by causing the glass to enter half way a film of perfectly clean mercury will be brought to the clean face of the glass, and the latter being weighted down, the amalgam will adhere.—S. R.

[57359.]—**Cotton in Lubricators.**—Much depends on the arrangement of the lubricator; but generally, it may be said the more cotton the greater will be the quantity of oil delivered.—T. M.

[57361.]—**Laying out Sheet Iron and Boiler-Work.**—I should think it would pay this querist to procure Mr. Nicholls's book on boiler-making, which is, I think, published by the author at Blackpool.—S. R.

[57367.]—**Deflector.**—The answer to this query is that a water-containing deflector is used in some locomotives.—S. R.

[57368.]—**Organic Chemistry.**—No doubt it is acetic acid.—M. O. C.

[57369.]—**Locksprings.**—Heat to a cherry red, and drop into oil. Put them on a red-hot plate, and when they turn blue (to se[illegible] which, polish a portion) drop into oil again.—E[illegible]R.

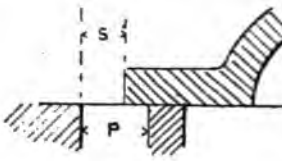
[57372.]—**Organ Pipes.**—If [illegible]s" continues his rank with a stopped octa[illegible] [illegible]will get the pitch, but cannot expect to get [illegible] v of tone of the open pipes. If he canr[illegible] [illegible] height, cannot he mitre his pipes, s[illegible] the full length of 8ft. open flue?—FL[illegible]

[57375.]—**Heating Gree**[illegible] is no use beating about the bush in [illegible] What is the area of exposed glass? J[illegible] [illegible]e measure of the amount of heat that [illegible] [illegible]aired. Oil stoves are of little or no us[illegible] [illegible] due cannot be introduced, better have [illegible] piping and a proper boiler, for it is a [illegible] supplying so many units of heat which must be given off in the house.—HORTUS.

[57453.]—**Lathe Overhead.**—Could T. Hughes kindly give particulars and sizes suitable for 5¼in. centre lathe; also sizes of pulleys, wheels to change for setting out pitches of screws—standard sizes that an amateur may be able to understand to work at? Or would "R.W.F." kindly give his experience to the above, as I have not the No. of the "E.M." he refers to?—SOMERSET LAD.

[57477.]—**Reflecting Telescopes.**—A square wooden tube would certainly be easy for you to make: but a round one is not so difficult as it might appear at first sight. For a tube nearly 10½in. inside diameter, you could take 16 pieces of pine the length you want, and plane the two long edges of each piece to an angle that would admit of the pieces closing round into a circle. When all are ready, paint the edges; when dry, paint again, and put them together, and put on at each end and in the middle a brass or iron band. I have forgotten to say that each long piece should be 2in. broad on the bevelled side, and will, of course, be a little wider on the outside. You can plane the outside of the tube round or not. You would find, I think, in Vol. XXIX., a very good plan for mounting the speculum, and the flat mirror also. Also in later Vols., and in Vols. X. and XIII., there are three or four different methods explained of mounting the flat. I could lend you, if you like, a spare flat cell and mount as a pattern to work to, a set of tracings for another plan (but they are rather elaborate), and a model mounting for the large speculum with adjusting screws, if you do not wish to go to the expense of an iron cell for it. You would have to pay postage.—J. C. L.

[57511.]—**Slide-Valves.**—This sketch represents part of a slide-valve with "steam full open"—i.e., S is the maximum width of port which is uncovered to admit steam. Fix the length of S,



which may be taken at about ⅞ to ¾ of P, and then if there is no lead, lap = S × y, where y is taken from the table below. If there is lead, the lap so found is to be diminished by an amount equal to half the lead. The travel of the valve will be—

2 × (+ lap).

The throw of eccentric is usually half the travel of valve—

If steam is cut off at………	¼	⅓	⅜	½	⅝	⅔	¾	[illegible]	[illegible]
y =	6·47	4·44	3·76	2·41	1·58	1·37	1·69	·54	

This will give you an approximate dimension which will generally need modifying when tried on the engine. To get it exactly right on paper, you must use some such diagram as I have published in the last few volumes.—GLATTON.

[57513.]—**Adjusting Mirrors of Newtonian Reflector.**—This has been repeatedly explained in back Nos. of the "E.M.," more especially in Vol. XXXIV. Mr. Calver and Messrs. Horne and Thornthwaite both explain in their pamphlets how to adjust. In the *Observatory* for January and February there are elaborate and simple directions by Mr. Grubb for the same purpose.—J. C. L.

[57520.]—**Rusting Cast-iron Borings.**—Mix one ounce of powdered sal-ammoniac with one pound of cast-iron borings, and add sufficient water to wet the mixture thoroughly. This should be done some hours before it is required to be used. The cement is caulked into the joints with a caulking iron. The skin of the iron must be broken where the joint is to be made, and if greasy must be rubbed with nitric acid and washed with water till no grease or oil remains.—J. W. DEAR.

[57520.]—**Rust Joints.**—A plumber who was erecting a few hundred feet of hot-water pipes asked me for some information. I gave him the following instructions, which worked satisfactorily:—Put c.i. borings through fine riddle, crush sal. am. fine, and mix dry in following proportions: 1lb. sal. am. to 1cwt. borings. Damp well with water and use at once, putting into pipe a turn of rope yarn, and then caulking in the borings well. If the borings are damp enough, the caulking will force out a little water. Mix sufficient for a day's work. The pipes may safely be used in two or three days.—C.E., M.E.

[57522.]—**Bell Ringing with Leclanche Battery.**—I should say that the cause of "Amateur's" bell not ringing is that the hammer sticks to the electro-magnets. To prevent this, solder a disc of stencil copper to the pole end of each core; also see that the contact screw breaks the circuit the moment before the hammer touches the cores. By allowing the circuit to be broken early in the stroke, the disc of copper may be dispensed with, as the cores have time to demagnetise themselves before the hammer touches them; but if the cores are not properly annealed, the hammer is sure to stick without the copper.—A. Beckett.

[57531.]—**Pulleys.**—If belts are 1/16in. thick, effective dia. of pulleys will be 9 3/16in., 36 3/16in., and 54 3/16in., respectively. The new pulley to effective diameter will be—

$$\frac{140 \times 54{\cdot}19 \times 36{\cdot}19}{1000 \times 9{\cdot}19} = 29{\cdot}84;$$

and the actual dia. $(29{\cdot}84 - \frac{3}{16}) = 29\frac{5}{8}$in.—Glatton.

[57533.]—**Setting Small Coleoptera.**—I am afraid that the experience of "J. E. C." among the coleoptera has not been very extensive. There are many species of that order ranging in size from a pin's-head to that of a full stop. I should be very pleased to hear of a successful attempt to pin one of these latter, even with a number 20. The practice of pinning beetles at all is to be condemned. Forcing a pin through the hard elytra has generally the effect of distorting the shape, even if the lop-sided effect produced by pinning through one side is not taken into account. I should like to know how "J. E. C." would set insects by means of cement which dries directly it is applied? The idea is preposterous; and the cement he names is used for fastening broken antennæ and legs. What is wanted is a solution which will dry hard, but permit of the legs, &c., being put in position. A mixture of gum arabic and tragacanth in about equal proportions answers this purpose perfectly.—Nester Letthew.

[57553.]—**Cement for Glass.**—Let "Jimbo" try the following recipe:—Boil three parts of rosin, one of caustic soda, and five of water, mixed with half its weight of plaster of Paris.—J. W. Dear.

[57569.]—**Electric Light.**—Thanks for replies to my query; but I am not wanting a constant good light so much as an occasional novelty. Would four or five Léclanché cells and a fairy lamp do for this purpose? My window is small, and it would be noticed more perhaps if on for half an hour and then off for a time. I cannot go to the expense of 15s.—getting a good light from petroleum lamp for much less. My object is to show a novelty in this country place.—J. I. S.

[57570.]—**Defective Flue.**—The fire has caused draught holes through the crevices of the stonework, thus setting your improved brick-stack at defiance. You, no doubt, open doors and windows to let out the smell. This makes matters worse, as it tends to invite a draught down the chimney. Have it cemented inside all the way up.—Jacob Magloskie.

[57572.]—**Lightning Protection.**—It would appear that the well described would make a very satisfactory "earth" for the system of conductors. If the water pipes which draw the water are a complete metallic circuit, they would make an excellent conductor also; but that depends entirely on the mode of jointing the pipes, and also upon the condition of the surface which is in the water: the proper mode of settling this would be by an electrical test of the resistance. Take a copper wire terminated with a plate long enough to go into the water, solder a copper wire terminated with an iron plate to the piping at any convenient spot: now measure the resistances of two circuits: (1) the two wires with their plates inserted in a tub of water; (2) the wire and piping through the water of the well. If the latter is much the greater, the pipe should not be trusted to; but a proper conductor carried down the well. The pillar of the telescope is a very dangerous point, and should most certainly be protected by a conductor. The small gas-pipe is by no means sufficient, though it might advantageously be connected to the pillar by a copper strap. As a rule, metal, where distributed over a house, should be connected to earth; but this is not important as to gas and water pipes, which have, of necessity, a moderately good connection of their own sufficient for their own protection, though not to be trusted to protect the buildings, but rather likely to bring lightning into the place by some forcible entry. Water-heating pipes may, or may not, have a similar connection of their own. If not, they should be connected at their lowest point to the conductor. The benzoline tank may be safe, or not, according to whether it is in moist or dry ground. It is probably protected by the gas-pipes; but I should solder a wire to the tank and test its earth connection. The danger to it is the possible firing of the vapour by a discharge either from or to earth, against which it would be safe if the cover is metallic so as to afford a free electric path to the surrounding space, and if this is also safely connected to earth; but, if wholly buried well under ground, I should think it is pretty safe. Of course, the salient points of the building should be protected, as usual, by conductors led to earth.—Sigma.

[57577.]—**Compound Launch Engine.**—In answer to "H. G.," I have made bold to add certain data to his question, in order to arrive at the indicated horse-power. I have supposed the piston to travel at the very moderate speed of 150ft. per minute, and the boiler pressure at 90lb. above the atmosphere, and steam to be cut off at ⅓ of the stroke. Now, putting all these data through their proper course, I find that the engine will give off about 4 horse-power, indicated. Now, according to an eminent authority on the matter, I give the rule to find the respective sizes of the two cylinders. Thus, $\frac{33,000 \times 4}{150} = 800$. The maximum pressure of steam above the atmosphere = 90; add pressure of atmosphere = 15, total, 105. The average pressure in this case = 54·8; deduct for back pressure 2 = 52·8. Then, $\frac{880}{52{\cdot}8} = 16{\cdot}66$, area of low pressure cylinder. Then, $\frac{16{\cdot}66}{\sqrt[2]{5}} = 7{\cdot}47$ area of high-pressure cylinder. The dia. of the two cylinders will be, for condensing cylinder 4·6in., for non-condensing cylinder 2·74in. Use the surface condenser.—F. Richardson.

[57580.]—**Dentistry.**—As "Dental Reform" seems never tired of harping on the terribly hard "exam." which must be passed to obtain the L.D.S. degree, will he kindly explain whether there is any difference between "dentist" and "surgeon dentist," and will he also state how many or what percentage of existing practitioners have taken up the degree of L.D.S.? If it should turn out that only about 10 per cent. of those who practise dentistry, and not more than one per cent. of those who do the actual work, have obtained the degree, a statement to that effect from "Dental Reform" or "998" would be a refreshing comment on sundry remarks recently made in these columns.—A. Mallard.

[57585.—**Casting Zinc.**—The reason for your castings falling to pieces as if rotten, I put down to your not skimming the metal after it is melted. You perhaps know that when zinc is melted it takes fire and combines with the oxygen of the air forming zinc oxide (a white powder), which contaminates your castings.—A. Freyer Evans, Monmouthshire.

[57587.]—**Glycerine Barometer.**—Instead of using a cork, get a piece of indiarubber and cut it by means of cork borer to the size of the neck of the bottle, then with a smaller borer pierce a hole through the centre, which is to hold the tube, or you can saturate an ordinary cork in melted paraffin wax. I have made one of these so-called barometers, but think they are of little use, being so sensitive to the temperature of the weather, and more fit for a thermometer than a barometer.—A. Freyer Evans, Monmouthshire.

[57587.]—**Glycerine Barometer.**—If "Leakage" will try the following method, I think he will succeed in making his barometer air-tight:—Make from a sound cork a tube that will fit nicely into the bottle neck and allow the glass-tube to pass tightly through it. When placed in the bottle, do not let the cork appear above the top of the neck. Cover the joint up with sealing-wax. If he finds any difficulty in making the cork fit, substitute tape wrapped round the glass tube. This will answer equally well.—C. B.

[57590.]—**Piano.**—A little rust on the strings will do no harm; but if they are rusted through, it will be necessary to replace them with new ones. You can obtain very good steel wire from Mr. Thos. R. Willis, who advertises in the English Mechanic on the front page. What are called "covered strings" should be used for the lower bass notes. The quantity of wire required depends on the length of the strings. From 10s. to 15s. will be about the cost of new strings for your piano. Buy the steel wire of exactly the same gauges as the old strings. If the querist has had little or no experience in restringing pianofortes, he will probably find the following suggestions of some practical assistance to him:—1st. If the wrest pins are rather loose or turn very easy, replace with a set of new wrest pins a trifle (not much) larger than the old ones. Don't try to force too large a pin into the wrest plank, however sound it may be. 2nd. To get a similar number of coils on each wrest pin (without which the job will not appear neat), turn the pin round by aid of the tuning hammer until the hole is in a perpendicular position, or thereabouts. Now secure lower end of string, pass the other end through hole in wrest pin, draw the string as tight as possible with the left hand, then cut the wire off 4in. above the wrest pin. Then carefully draw the wire down through hole in wrest pin until the end of the wire is almost flush with wrest pin. Afterwards carefully wind the wire round the wrest pin, holding the wire firmly with the left hand, and taking care that the coils of wire come as close as possible to each other without overlapping. This operation requires practice in order to make a neat job of it. If you can obtain the assistance of a friend, there may be some advantage in doing so. New strings require to be drawn up a few times before they will stand in tune.—G. Fryer.

[57596.]—**Orguinette.**—I should have been much obliged to Mr. G. Fryer if he had confined his answer to my query. To relieve him I beg to say I do not mean to spoil a good American 3½ cavity-board. I have separate reeds. All I want to know is the most suitable size and form of bellows to obtain the most power in the given space.—A. B. C.

[57597.]—**Photographic Camera.**—To A. Freyer Evans or others.—I would advise you to buy the dark slide and bellows from a photographic dealer, and make the rest of the camera yourself,—the dark slide being a very nice job, and if you are not an expert at cabinetmaking, you had better buy one ready made. The bellows can be made to order, which when made of American cloth will answer very well. They must be square, and the inside measurement being about ½in. longer than the greatest length of the plate. As to the lens for ordinary work, a single landscape lens will do, but if you want to succeed obtain a doublet lens. It will cost much more, but is indispensable for good work.—A. Freyer Evans, Monmouthshire.

[57599.]—**Gauge of Railway.**—In answer to "Liqtar," the standard gauge of English lines was fixed by Parliament in 1846 as 4ft. 8½in. for narrow-gauge lines, and 7ft. for broad-gauge. The following are instances of European lines, which deviate from the British standard gauge:—Ireland, 5ft. 3in.; Russia, 5ft.; Norway, 3ft. 6in. and 4ft. 8½in.; in Spain and Portugal, 5ft. 6in.—J. W. Dear.

[57599.]—**Gauge of Railway.**—Smiles, in his "Lives of Engineers," Vol. III., gives a very interesting account of the birth of the railway gauge, but it is too long for quotation. Briefly, it seems to have been a series of transitions; first from waggons running on flagstones, then longitudinal timbers instead of stones; next cast-iron plates to save wear and tear (plates having a flange); and finally, the waggon wheels were flanged instead of the rail. Thus, it was existing circumstances and previous conditions that determined the gauge. The principal growth of the railway seems to have been in connection with the coal trade near Newcastle.—Girder.

[57599.]—**Gauge of Railway.**—To "Liqtar."—There can be no doubt that the width of the old wooden and cast-iron tramroads practically determined the gauge of our present railways. The usual width or gauge of these old tramroads was 5ft. over all, that is including the width of the two rails, and as Jessop's edge rails and the Killingworth tramroads had rails 1¾in. wide, it is easy to see that the width of two such rails deducted from 5ft. leaves 4ft. 8½in. between the rails, or what we now consider the national gauge. George Stephenson saw no reason to alter the gauge, therefore he adopted 4ft. 8½in. for the Stockton and Darlington, and the Liverpool and Manchester railways, and when consulted as to the gauge for the Canterbury and Whitstable, and Leicester and Swannington Railways, he replied, "Make them of the same width. Though they may be a long way apart now, depend upon it they will be joined together some day." "Liqtar" will find some further details of ancient tramrails in my letter Vol. XL., p. 218.—Clement E. Stretton, Leicester.

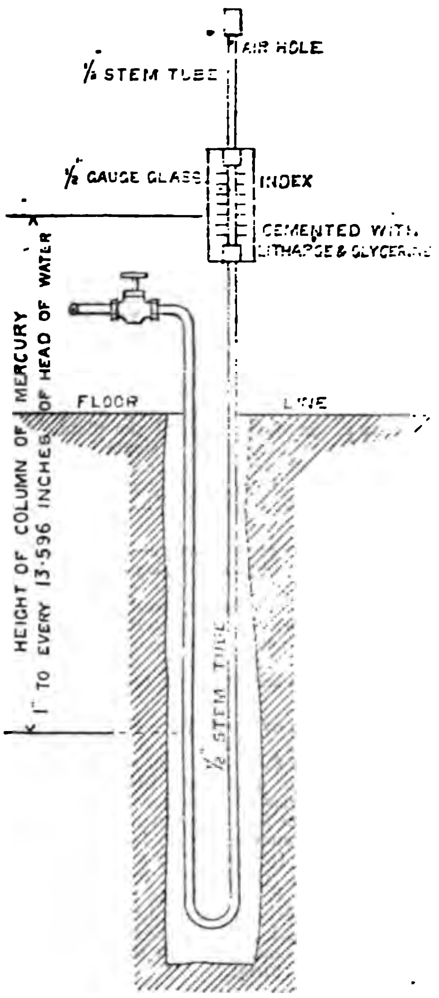
[57609.] — **Construction of Formula.** — Errata. — In the last two formulas of the answer to this question, given in the last number of the "E. M.," "log. *f*" has been put accidentally for *f*; in place, therefore, of 3·34101, put its number 2193.—Milverton.

[57615.]—**Coals and Fraud.**—The money value of the fraud will be exactly £23 8s. 9d., and the increase per cent. on the tonnage 2¼ per cent.—T. Richardson, Lower Ince, Lancashire.

[57625.]—**Medical.**—"Nervous" is suffering from writer's cramp—a most troublesome complaint. If he is an old person, there is no hope of recovery; and if he is young, the only prospect of recovery is entire and protracted rest. All the medical advice in the kingdom can do no more for him. Should he be anxious to know more of this disease, I shall be glad to communicate with him on getting his address in English Mechanic.—Scribbler.

[57626.]— **Calculation.** — The conversion of kilogrammes per square millimètres into tons per square inch is effected by simply multiplying the number of kilogrammes by the constant ·63494. Thus, in 32 kilogrammes per square millimètre there are 32 × ·63494 = 20·318 tons per square inch. I know of no quicker or simpler method.—Lyons.

[57630.]—**Water Gauge.**—The desired end can be attained by the use of a mercurial gauge, as sketch, the tap being opened. The exact length of the water can be read with the pump standing. The tap may be very slightly opened when the pump is working. Unless the rising main is too much, the attendant will very soon have to allow for friction, and thus to ascertain the length in the height of the water in the tank, whether the pump is rising or standing.—Chas. Lewis Hett, Ancholme Foundry, Brigg.


AIR HOLE
½ STEM TUBE
½ GAUGE GLASS
INDEX
CEMENTED WITH LITHARGE & GLYCERINE
HEIGHT OF COLUMN OF MERCURY
1" TO EVERY 13·596 INCHES OF HEAD OF WATER
FLOOR
LINE
½ STEM TUBE

[57631.]—**Electro-Plating.**—To S. Bottone.—Many causes seem to be at work here. The battery power seems to be too low; the deposit is pulverulent. Do you immerse the object to be coated before coupling up to the battery? That would account for some of the mischief. Is your bath free from other metals beside silver? I should strongly advise you to read our friend Mr. Sprague's book on "Electricity: its Theory, Sources, and Applications," beginning at Section 355, "Silver Depositing."—S. Bottone.

[57631.]—**Electro-Plating.**—In the first place, it seems probable that you do not use pure silver for the anode. Absolutely pure silver should be procured from the refiner for this purpose. The best way to make a solution is to make first a solution of cyanide, about two ounces to the gallon. In this, place the anode, connected with the copper of the battery. On the other wire place a small, clean piece of brass, and as soon as the brass commences to whiten your solution is ready for use. There is no really efficient substitute for cyanide of potassium.—Os.

[57631.] — **Electro - Plating.** — "Denmark Hill's" failure in electro-plating may have arisen from such causes as (1) excessive battery power, (2) lack of cyanide in the solution, (3) the employment of an impure anode, (4) the employment of lime water to form the precipitate in nitrate of silver solution. From the drift of the query the two last seem to be the most probable causes of failure. One Daniell cell will be found sufficient, if it is in good working order and the articles not too large. When the anode turns grey, more cyanide is required; when it turns red or purple, cyanide of copper is being formed, which shows that the silver is not pure. Pure silver should therefore be used. When the objects only are dark and dirty in appearance the current is too strong, and to remedy this the anode should be reduced in size, or placed further from the article in the bath, or the battery power lessened. Instead of precipitating the nitrate of silver with lime water, the usual way is to precipitate with a solution of cyanide of potassium, in the proportion of 3¼ parts of cyanide to 30 or 40 parts of water, which is to be added to the nitrate of silver solution as long as a precipitate is formed. Be careful to add the cyanide gradually, or the nitrate will be partly wasted. The precipitate is next to be thoroughly washed, then dissolved by adding, in portions at a time, a solution of cyanide of potassium 3¼ parts, water 20 parts, and well stirred till the whole is dissolved; add 3 parts more cyanide to form free cyanide, and sufficient distilled water to have about 1oz. of silver to the gallon, and filter. This is the usual mode of preparing the silvering solution, and if "Denmark Hill" tries it, I think he will succeed.—Bobadil.

[57636.]—**Electro-Motor.**—To Mr. Bottone.—The length of the armature should be the same as the length of the tunnel in which it has to turn. I should make it a laminated Siemens H armature, and should have punchings of sheet iron about ⅛in. thick for the laminations. The best quantity of wire for dynamo is not that which is the best for motor; but you will not be far out if you carefully measure the resistance of the wire you have on the fields, and balance it with the same resistance of No. 16 c.c. copper wire. By the bye, what an odd shape you have given the F.M.'s. Do I understand you aright when you say that their height is only 8in., while their length is 26in.? To work such a machine to the full 60 cells of the bichromate, each holding a gallon, would be none too much.—S. Bottone.

[57638.]—**Limelight with Ether or the Ethoxo Limelight.**—It is most undesirable to have the ether near the jet: it is best to have the vapourer to charge the oxygen with ether vapour on the floor. I shall be glad to send "Portable" full particulars of the arrangements requisite to make this, the most convenient form of limelight, safe and simple. The requisite, are to fully saturate one part of the oxygen and keep another part quite free from any contamination from the ether. Indiarubber tubing is soon spoiled if used constantly for carrying oxygen and ether vapour; but, if only used now and then, it will soon lose the ether it has taken up. The tube which has been used for the ether vapour must on no account be used for carrying the pure oxygen, or it will supply sufficient ether to make oxygen explosive and unmanageable.—A. Pumphrey.

[57640.]—**Carbonic Acid Gas.**—On the continent CO_2 is mostly made from limestone or dolomite, and is purified by causing it to pass through olive oil, or through tubes filled with lumps of pumice stone impregnated with the oil. A mere passage of water is, as you say, of no effect.—Percy W. Stanley, 119, Manchester-road, Poplar, E.

[57640.]—**Carbonic Acid Gas.**—The best way to get the contents of your generator away is this: When it is quite worn out, so that you cannot get any more gas, take the cap off, and fill your generator nearly full with water: give it a good mixing, then you will find it quite thin; then empty, same time put the hose-pipe down the drain and turn the water on; if not a hose, throw a pail or two of water after it. I do not think you will have any more trouble. I have never had a drain stop up through that for 12 years. I do not think you can better what you are using for the manufacture of carbonic acid gas, providing you get good whiting, free from sand, and keep your generator and gas-tub as clean as possible. The latter ought to be emptied and cleaned every week. Any more information I shall be pleased to answer. Can you, or any other kind reader, furnish me with a good recipe for brewed ginger beer, and if lemons are better than essence? I shall be greatly obliged.—A. H. A.

[57640.]—**Carbonic Acid Gas.**—Hydrochloric acid is much more volatile than sulphuric acid—in fact, it is hydrochloric acid gas dissolved in water, and if it is poured into the generator at its usual strength, some of it will escape with the carbonic acid. It should be mixed with an equal volume of water, and in this state of dilution it does not fume; but there is no necessity to use limestone, as the same whiting or chalk which you use with the other acid will do. Limestone is very hard, and it would take a much longer time for the acid to act upon it than whiting—too long, I should say, for practical purposes. You will find the hydrochloric acid much more expensive, as though it may cost about the same, weight for weight, there is much more real acid in a pound of vitriol than in a pound of hydrochloric acid; but if you feel inclined to use it, the taste and odour of which you speak will probably be removed by mixing a little whiting with the wash water, and by diluting the acid with its volume of water before pouring it into the generator, as some of the hydrochloric gas will escape with the carbonic before the former has time to mix with the water, &c., in the generator; but it is my opinion that it will cost less to have the refuse removed by cart or otherwise, than to use the hydrochloric acid. The liquid part can be run in the drain, and the other can be taken away as refuse.—Os.

[57641.]—**Dynamo Making.**—To Mr. Bottone.—Both dynamos work well; but they are wound for different purposes. The one at No. 1,067 is wound for rather high tension; the one at p. 66 of the present Vol. is of lower tension, and would work for a longer time without heating. If you will give me full details of the shape of your castings, and what you want to do, I will advise more fully.—S. Bottone.

[57642.]—**Electro-motor for Model Boat.**—Was described and figured by me at p. 570, Vol. XLI., of the English Mechanic. Will give further details if that is not clear enough.—S. Bottone.

[57644.]—**Pottery Glazes.**—For glazing common red ware with a transparent glaze, mix together finely-ground lead ore with clay slip, the dry weights of these constituents being in the proportion of about 3 of galena to 1 of clay; pass through a fine sieve, and dip the clay ware in it, or if only inside is to be glazed, then simply rinse the articles. Other mixtures for the glaze are red lead and silica sand, and, I believe, white lead and ground flint. Do not understand what you mean by the "arch kiln." All goods that are glazed by dipping must be fired in saggars; rinsed goods may be fired either in open kiln, if they are inverted on each other, or in "boxes" in the kiln.—Pottery Tech.

[57646.]—**Steam-Engine Formula.**—The formula for which explanation is required—namely,

$$L = p\left(\frac{B}{T} + \frac{2\,C}{T^2}\right) \times 2{\cdot}3026,$$

is derived by differentiation from the formula,

$$\text{Log.}\,p = A - \frac{B}{T} - \frac{C}{T^2},$$

in which A, B, C are abbreviations for the numbers 8·2591, 2,731·5, and 396,944·5. Rankine warns his readers that the complexity of these formulæ renders their use inconvenient, except with the aid of tables of the quantities p, L, and D for different boiling-points. Nevertheless, to show how they may be used for computing the value of L when the pressure is 33·7lb. per sq. in., it will be necessary, as a first step, to compute the temperature T of the boiling-point for this pressure. This is found from the second equation, which is a quadratic for $\frac{1}{T}$. Now, 33·7lb. per sq. in. gives $p = 4{,}852{\cdot}8$lb. per sq. ft., and log. $p = 3{\cdot}685992$; therefore A – log. $p = 4{\cdot}57311$, and the quadratic reduces to

$$\frac{1}{T^2} + \frac{\cdot 006882}{T} = \cdot 0001152,$$

from which we obtain

$$\frac{1}{T} = \cdot 001392 = \frac{1}{718{\cdot}4}.$$

Hence the temperature of the boiling-point of water, under a pressure of 33·7lb. per sq. in., is T = 718·4° Fahr., reckoned from the absolute zero, which is 461·2° below the zero of the ordinary scale. We are now in a position to compute L from the first formula, which may be put in the form—

$$L = \frac{p}{T} \times 2{\cdot}3026\left(B + \frac{2\,C}{T}\right).$$

To compute $\frac{2\,C}{T}$, we have—

$$\begin{aligned}
\text{Log.}\,2 &= \cdot 301030\\
\text{Log.}\,C &= 5{\cdot}598730\\
&\overline{5{\cdot}899760}\\
\text{Log.}\,T &= 2{\cdot}856366\\
\text{Log.}\,1{,}105 &= 3{\cdot}043394 = L\,\frac{2\,C}{T}.
\end{aligned}$$

$$\therefore\ B + \frac{2\,C}{T} = 2{,}731{\cdot}5 + 1{,}105 = 3{,}836{\cdot}5.$$

Hence, for L we have—

$$\begin{aligned}
\text{Log.}\,2{\cdot}3026 &= \cdot 362294\\
\text{Log.}\,p &= 3{\cdot}685992\\
\text{Log.}\left(B + \frac{2\,C}{T}\right) &= 3{\cdot}583879\\
&\overline{7{\cdot}632165}\\
\text{Log.}\,T &= 2{\cdot}856366\\
\text{Log.}\,59{,}675{\cdot}8 &= 4{\cdot}775799\\
\therefore L &= 59{,}675{\cdot}8\ \text{ft.-lb.}
\end{aligned}$$

—Milverton.

[57648.]—**Star Photographs.**—In the articles referred to in reply No. 57659, Mr. A. Brothers, F.R.A.S., remarks: "When we consider that this [the Common] negative required an exposure of thirty-seven minutes to the light concentrated by a

8ft. mirror, it must necessarily happen that the stars shown have discs, owing to the driving power [of the telescope] not being absolutely perfect, and partly to atmospheric disturbances; but this scarcely mars the beauty of the result, as they are all in proportion and are all irregular in shape in one direction, thus serving to distinguish stars from defects on the plate."—ARTHUR MEE.

[57651.] — **Defective Electric Pen.**—The porous cell bichromate battery can only be depended upon to work for a few weeks, and it would have been most remarkable if yours had worked after lying useless for "several years." Recharge with fresh solution, using the porous cells with water only, and 2oz. of mercury in them to assist in keeping the zinc amalgamated; in the outer cell a solution of bichromate, 6oz. to 2 pints water, and 6oz. sulphuric acid. Carefully clean the clamps that hold the carbons.—BOBADIL.

[57653.]—**Scales in Boilers of Portable Engines.**—I can commend to "A New Subscriber" what is known as "Algin Boiler Fluid" as an excellent scale-preventing compound. The least trace of lime, iron, or alumina, it precipitates and falls to the bottom of the boiler in a fine mud, which comes out when the boiler is run off. It is being made from seaweed. The patentee and maker is E. C. C. Stanford, F.C.S., North British Chemical Works, Clydebank, Glasgow.—SOUTAR.

[57654.]—**Electric Light.**—If you had a rather large flywheel attached to your dynamo, so as to equalise as far as possible the irregular driving of your engine, you could do what you require. Of course there will be some irregularity and some waving in the light; that cannot be obviated unless you get the engine to work quite steadily. Gutta-percha-covered leads would do very well; and the dynamo should be inclosed. The cost of the whole might be from £9 to £12.—S. BOTTONE.

[57655.]—**Plating Dynamo.**—TO MR. BOTTONE.—In plating hollows, it is usual to employ guiding wires to start the deposit. As to your dynamo, there is evidently no lack of volts—rather otherwise. Try to couple it as a shunt machine, inserting a short length of platinum wire as a shunt. If you could give me a description of the machine, as to its build, dimensions, &c., I might be able to assist. You should see what E.M.F. and what current your battery gives that does the work so well.—S. BOTTONE.

[57659.]—**Celestial Photography.**—To obtain on a screen a 4in. image of the moon requires an object-glass some 30ft. in focus, whilst one of 6ft. focal length will give an image ¾in. in diameter or thereabouts. The querist should read up the subject standing at the head of his inquiry, and can do so cheaply by obtaining the full, interesting, and practical articles in the *British Journal of Photography* for May, 1883.—ARTHUR MEE.

[57659.]—**Celestial Photography.**—The Nos. 934, 935, and 924 ENGLISH MECHANIC would teach you that an o.g. or reflector of 6ft. focus would give an image of the sun or moon of about 65-100ths of an inch. You would require a focal length of 36ft. to give you approximately an image of the moon 4in. in diameter. The focal lengths of o.g. for astro. purposes are usually 14 or 15 times the diameter of the o.g.; one of 3in. would be about 42in. to 45in. focus. The size of the image depends entirely upon the focal length, and increases with it. The brightness of the image increases with larger aperture, and the clearness of definition depends upon the excellence of the o.g. or mirror. For these purposes a Gregorian or Cassegrain reflector answers best, as you can get great power in a smaller compass.—J. C. L.

[57660.]—**Seaweed Paper.**—I can say nothing of the Japanese patent; but such a paper is made from seaweed by E. C. C. Stanford, F.C.S. For address see No. 57653. As to details of manufacture, it is a patent right, which I think cannot be entered into.—SOUTAR.

[57663.]—**Test for Silver in Lead.**—Dissolve the lead in nitric acid; add hydrochloric acid, when you will obtain a white precipitate; shake this up with ammonia, and filter. To the solution add nitric acid in excess. Should silver have been present, you will obtain a white precipitate of silver chloride. If a fair quantity is supposed to be present, the lead may be subjected to cupellation. It is heated in a bone ash crucible in the oxidising flame of the blowpipe, when the lead will be converted to litharge, which is absorbed by the crucible, and the silver will remain in the form of a bright metallic bead.—C. F. P.

[57663.]—**Test for Silver in Lead.**—Dissolve a portion of the old lead in dilute nitric acid. To the clear solution add dilute hydrochloric acid, which precipitates the lead and any silver that may be present, as (white) chlorides. To separate, throw the mixed precipitates on a filter and wash repeatedly with boiling water. The lead chloride is dissolved, leaving the insoluble chloride of silver on the filter; consequently, the presence of such a residue is a proof of the presence of silver. Confirm by dissolving the residue in a small quantity of ammonia, and re-precipitating with nitric acid. There are other tests; but this is perhaps the simplest.—LITHOS.

[57666.]—**Cheap Way to Charge Storage Battery.**—Very cheap, truly. Unfortunately, the water main would soon be corroded through. The current also, owing to the low E.M.F. and high resistance, would be extremely small. You might possibly charge an accumulator in one year sufficiently to light a 10-candle lamp for half an hour. —S. BOTTONE.

[57666.]—**Cheap Way to Charge Storage Battery.**—Cheapness is a relative term, and all the data should be taken into account. "H. B." should estimate the chances of being found out; the probable cost of replacing the "cast-iron main" (belonging, of course, to someone else), which he proposes to destroy, and also the question whether he might not find himself in prison, either for stealing iron, which he would certainly be doing, or for doing wanton damage to property. Another consideration is that, as the suggested earth battery would only give about half a volt E.M.F., it would be utterly ineffective.—SIGMA.

[57666.]—**A Cheap Way to Charge Storage Battery.**—I imagine "H. B." must have strangely overlooked one circumstance, or his query had never been written. Would not the whole effect produced by such a battery as he describes arise from the destruction of the water main, the property of a third party?—PERCY W. STANLEY, 119, Manchester-road, Poplar, E.

[57666.] — **A Cheap Way to Charge Storage Battery.** — I should not advise the querist to attempt to charge his storage batteries with an earth battery, as it will not give him sufficient E.M.F. To charge an accumulator, 2·25 volts is necessary, and as you cannot connect two or more earth batteries in series, it is impossible to get as much E.M.F. as this from this kind of cell. Besides this, Mr. Sprague tells us, in his "Electricity," that using the gas-pipe for an electrode of an earth battery is very deleterious to it, and that the damage is most likely to take place in the place nearest to the consumer. Better by far burn the ton of coke to drive a steam-engine and charge from a dynamo.—BUNSEN.

[57667.] — **Russian Names.** — The names of Russian places and persons are pronounced as they are written. Termination "off" is pronounced like the English "off," as in "I am off"; "ov" is like the English "ov" or "of": there is no sound in the Russian language like that of English "ow." There may be a termination in the Russian names of "ow," but it is a Polish termination, and is pronounced as ov or of.—W. H. GROSSE.

[57674.]—**Watchmaking and Jewellery.**—The best book is "Britten's Watch and Clockmakers' Handbook, Dictionary, and Guide," published 1884, price 5s. D. Glasgow's "Watch and Clockmaking," and Saunier's "Treatise on Modern Horology," are also first-class works.—W. WATSON.

[57676.]—**German Import Duty.**—According to the German Import Tariff, machines and machine parts, lathes included, pay an import tax, according to the material or materials of which they are made, as follows:—(*a*) Of wood, 1s. 6d. per cwt.; (*b*) of cast-iron, 1s. 6d. per cwt.; (*c*) of wrought-iron, 2s. 6d. per cwt.; (*d*) of other base metals, 4s. per cwt. These prices are practically correct, the Tariff prices being in marks per 100 kilos. Tools pay duties of 3s. to 7s. 6d. per cwt., according to quality. Carriage and agents' charges are about the same as in this country.—JUAN XPTOBAL.

[57681.]—**Acetous Fermentation.**—The addition of foreign acetic acid—id est, other than that produced by the actual fermentation—tends to retard it.—S. BOTTONE.

[57684.]—**Roman Arithmetic.**—The Romans seem to have used, for arithmetical purposes, a counting table and stones, *abacus*, and *calculi*. On this table perpendicular lines were drawn, and the value of the stone was according to the division in which it was placed. I believe a good account of arithmetic in all countries will be found in an article by Peacock, in the "Encyclopædia Metropolitana."—G. J. W.

[57684.]—**Roman Arithmetic.**—It was never used (but only the Greek) for reckonings involving more than addition; and only the most advanced cities, or till modern times only those of the Mediterranean, had use for such ciphering. None was needed in England till printing and banking times, when the Greek, that had served all European commerce and science for 20 centuries, had quite given place to the present Hindoo system. As this was, throughout the Middle Ages, in the hands of Moors and other infidels, any Christian learning "Algorithm" (as our figures were called) ran some risk of suffering for black art. Using them was one of the enormities for which Pope Sylvester II. got buried in unholy ground. "XCIV." and "XLI." were found enough of "the three R.'s" for those who planned, built, and carved Westminster Abbey.—E. L. G.

[57686.]—**Glucose.**—Pure glucose crystallises without much difficulty into the form of very hard square tables or cubes. When impure, or after partial caramelisation, it becomes uncrystallisable. Can you give some details as to the source of your glucose? I should be better able to assist.—S. BOTTONE.

USEFUL AND SCIENTIFIC NOTES.

When to Plant Trees and Shrubs.—So partial are owners of small gardens to planting trees and shrubs in the spring, that it appears desirable to remind them now that the best time in the whole year for making alterations in plantation and shrubbery is the autumn. Evergreens of all descriptions may be most successfully planted in September and October, and deciduous trees and shrubs from early in the month last mentioned. Generally speaking, planting operations can be carried on with greater advantage in the autumn than in the spring. There is usually more time for the work, the ground is invariably in better condition, and the trees make new roots before the winter is far advanced, and are able therefore to make good progress from the moment of their starting into new growth in the spring. The fact should also be borne in mind that when the work is not commenced until after the end of the year, there is a considerable risk of its being delayed by an unfavourable condition of the soil till late in the spring, with the result that the trees or shrubs suffer severely when the weather is either hot or dry during April or May. It will perhaps be useful to mention that all soils are much colder in the spring than in the autumn, and therefore much less favourable to the production of new roots by trees that have been transplanted. It is also worthy of note that at the nurseries purchasers in the autumn have a much greater choice than those who defer buying until the spring, for the quarters are then much thinned. Especially is it necessary in the case of fruit trees to buy in the autumn, for it is no unusual occurrence for the greater proportion of the more popular kinds to be sold out before the winter is far advanced.—*Amateur Gardening.*

Oil of Wine-lees—Oil of Cognac.—Under the heading "A German Poison," the *République Française* of a recent date says: "There is an article on the markets of this city (Paris) and throughout France, to which we desire in the most earnest manner to call the attention of the sanitary authorities of the Republic. It is a liquid preparation for the express purpose of the falsification of genuine and the manufacture of spurious brandies. Its name as expressed on the labels of the blue flasks in which it comes into trade is *huille essentielle de lie de vin* (essential oil of the lees of wine). A sample of it seized by the sanitary police, and analysed at the municipal laboratory, shows that its basis is castor oil which has been subjected to the action of nitric acid, and afterwards etherified with a mixture of ethylic, amylic, methylic alcohols. The label states that 125 grams (4oz.) of the oil mixed with the proper quantity of beetroot spirits (alcohol from the beetroot) will make a barrel of fine Cognac brandy.

IN continuation of previous experiments on the effect of high pressures on low organisms, MM. Cretes and D. Cochin state that the vitality of *torula* is not destroyed by a pressure of 300 to 400 atmospheres continued for several days. Examination under the microscope shows no perceptible change in the form or appearance of the cells, and when afterwards brought into contact with saccharine solutions they multiply, and otherwise behave in a normal way. Under the same pressure alcoholic fermentation always takes place after some time. When fermentation occurs under high pressures, the development of carbonic acid appears to ensue under special conditions of molecular equilibrium.

ACCORDING to Professor Tyndall, who has studied the absorptive power of gases for low temperature heat, the following are the comparative absorption powers of various gases, each of the pressure of 1in.:—Air, 1; oxygen, 1; nitrogen, 1; hydrogen, 1; chlorine, 60; bromine, 160; hydrobromic acid, 1,005; carbonic oxide, 750; nitric oxide, 1,590; nitrous oxide, 1,860; sulphide of hydrogen, 2,100; ammonia, 7,260; olefiant gas, 7,950; sulphurous acid, 8,800. The absorptive power of the three permanent simple gases for dark heat is thus very small, while that of compound gases is very considerable.

THE new steel works on the basic system erected by the Glasgow Iron Company are just about finished, and it is expected that they will begin operations without delay.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

57123.	Hand Fire Extinguishers, p. 485.
57131.	Bidwell System, 486.
57146.	Instantaneous Shutter, 486.
57152.	Incandescent Lighting, 486.
57155.	Microscopic, 486.
57161.	Wooden House, 486.

57320.	Model Dynamo, p. 573.
57321.	Webster Condenser, 573.
57334.	Heinrich Dynamo, 573.
57336.	Eccentric for Loco. Engine, 573.
57345.	Electrical Weather-Vane, 573.
57346.	Jewellery, 573.
57350.	Butter Fat in Cream, 573.
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57358.	Putting Bars in Lancashire Boiler, 573.
57360.	Chronometer Balance, 573.
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57364.	Electrical Veterinary Oil, 573.
57365,	Phosphor Tin, 573.
57366.	Chewalla, 573.
57370.	To "Sigma," 574.
57371.	Extra Currents, 574.
57374.	Portland Cement, 574.

QUERIES.

[57687.]—**Village Car.**—Could some of our readers give me a sketch and dimensions of village or governess car, suitable for a donkey? Have no doubt others, besides myself, would like to make one during the winter evenings.—LLOYD.

[57688.]—**Loss of Taste.**—Some years ago, on recovery from severe sore throat, my sense of taste was almost gone, and has never been quite recovered, although I have been under the best medical advice. Can any reader state what would be the best treatment to pursue in the matter? and would galvanism be likely to have any effect?—J. A. P.

[57689.]—**Dynamo.**—Would Mr. S. Bottone, or any other subscriber, be kind enough to give me some hints on the following? I have a dynamo with Pacinotti ring armature. The weight of F.M.'s, 21lb. The F.M.'s are the type of Jones', and are wound with about 14lb. of No. 16 wire; and the armature has eight spaces for wiring, with about 1lb. of No. 20 wire. On running the machine, I can barely obtain a 5 candle-power lamp. I have tried shunts of various resistances, but with no great improvement. The mechanical part of the fitting is fairly well done, and the insulation good. The ring is annealed cast-iron. Would a laminated one improve the working of it, and how many lamps may I expect from it?—ONE IN A FOG.

[57690.]—**Bichromate Battery for Lamp.**—I have a 10-cell Daniell's battery, telegraph form; each cell is divided into two parts by a porous plate, ½in. thick, making altogether 20 compartments. I propose to substitute carbon plates in place of the copper now in it, and new zincs. Each plate is to be 3½in. long by 1½in., both compartments to contain a bichromate solution and sulphuric acid; how many 5 c.-p. lamps will it light, and for how long at one charging? How long could I light a 2½ c.-p. lamp by using a solution of common salt, or chloride of ammonium? I should like to use a solution in the battery strong enough to light a 3 c.-p. lamp for about three hours for three days, removing the zincs after use and amalgamating them before, as this seems to play the most important part in lengthening the lasting power of the solution. What is the simplest way of connecting zinc and carbon plates together of different cells?—TELEGRAPHIST.

[57691.] — **Developing and Retouching.** — In developing a dry plate I used too little developer, and it did not go all over the plate in one wave at first, but left several spots untouched, which have come out lighter in the negative, and consequently darker in the print. Could any of your readers let me know through your paper if there is any means of making it right? I use the soda developer.—H. S. PHOTO.

[57692.]—**Storage Battery.**—Wanted to know how to make a set of storage cells for supplying, during sixteen consecutive hours, fifty 20 c.-p. incandescence lamps, each requiring about 1·2 amp., with E.M.F. of 60 volts? Also which are best and latest works on electric accumulators? Any information will much oblige—SERRA.

[57693.]—**Photographic.**—Can any of your readers tell me of any large towns where there is a large number of amateur and professional photographers, but in which there is no good shop for the supply of apparatus chemicals and other requisites? I am an amateur photographer, and am thinking of opening a depot for the supply of photographic materials and apparatus. I do not wish to enter into competition with any business already established, and as the town where I reside is already well served, I shall be glad of any information as to any other places, not already supplied, where such an establishment would be likely to be well supported. Owing to the late rapid increase in the number of amateurs, there will, doubtless, be many places not yet occupied, and I know of no better medium to elicit the information than "Ours."—J. X. C.

[57694.]—**Granule Carbon Battery.** — Will any correspondent acquainted with these say why 12 quart cells will not make a 2½ c.-p. lamp incandescent? Have used Leclanché zinc rods. Will an additional number do it? I wish to use such a battery as this if practicable, as the Bunsens are so much trouble to use for about three hours every night.—J. B.

[57695.]—**Electric Lighting.**—Will someone acquainted with the subject tell me the best method of lighting a shop in the most economical way; what power dynamo and gas-engine; whether to use accumulators, and how to make them? Could an accumulator be charged by a small hand dynamo to light a 2½ or 5 c.-p, for about three hours, or is this impracticable?—J. B.

[57696.]—**Gas Stove.**—Can any of "Ours" state cause of gas igniting at end of ring tube after being in use a short time? Can it be that the iron becomes heated, or the brass nipple does not enter the ring tube sufficiently? It is an atmospheric burner: one side of burner for boiling, and reverse is for grilling, and oven for baking underneath with a separate supply.—RESROC.

[57697.]—**Forcing Pump.**—Can any reader tell me what size pump I should require to force a column of water, 1in. dia., to a height of 100ft., and would a 1-man gas-engine be powerful enough?—H. M.

[57698.]—**Deposit in Boilers.**—I have three Lancashire boilers to look after, and this last two months I find in different parts of each the scurf about 1in. thick, and some of the rivet heads appear rusty to the eye. By cleaning the scurf off, a soft thin scale of iron comes off, showing where the iron is eaten in. We use common soda in them, about 30lb. every two weeks in each. Each boiler is washed every fortnight, and all loose scurf cleaned off. They work at 55lb. pressure, and have been in use about eight years. Could any of your practical readers please tell me the cause and prevention of this, as I am afraid, if not stopped, it may end badly?—T. E. F.

[57699.]—**Kiln.**—TO "POTTERY TECH" AND OTHERS.—Please to say if a small kiln, 18in. square inside, 8ft. from top of fire hole to top of kiln, open top, would do for an experimental kiln for glazed and unglazed ware, bricks, tiles, and garden pots?—M. W. S.

[57700.]—**Astronomical.**—Would any of our better informed astronomical friends kindly say what are the qualifications required for assistant observers, or observatory assistants generally? and are such appointments easily obtainable, either in the public service or privately? What course should one take in order to succeed in obtaining such an appointment?—A CONSTANT READER.

[57701.]—**Cometary Orbits.**—Will any of our astronomical contributors briefly describe how cometary orbits are depicted so as to give correct ideas as to their inclinations to the Ecliptic, their perihelion passages, and their directions in space? How are these particulars obtainable from observation? which would be a good treatise to read on the subject? Would Mr. Hind's work meet my requirements? Any information on the subject will oblige—AN AMATEUR.

[57702.]—**Coil.**—Can any of "Ours" tell me where the defect is in a small intensity coil? When I attach a condenser to it it stops the contact-breaker, which works well without condenser.—COUSIN BENEDICT.

[57703.]—**Electric Lighting.**—I have ½ H.P. Otto, which, I understand, would work 6in. dynamo for 10 to 30 lamps. As I only want about six lamps, would the extra power be wasted? What would be probable cost? Would the lighting cost 15 per cent. more than gas, leaving out wear and tear of engine, as that I have? Do dynamos and lamps last for some years? Could inexperienced person manage same after once fixed? Do not want to go to expense if same is very much more than gas.—YOUNG JEWELLER.

[57704.]—**Scratch-Brushing.**—Will any of "Ours" tell which is best to use for scratch-brushing—stale beer or soda and water? Ought articles to be rinsed in clean water before drying in sawdust? Would not sawdust do if kept hot in tin over gas-burner all day instead of heating by hot water, as when only one article in a day may want brushing, it is lot of trouble to get water hot and sawdust just for one job? Information would be esteemed.—YOUNG JEWELLER.

[57705.]—**Maiche Battery.**—I have a battery called the Maiché. The composition is gas-coke and manganese at the top, in a porous pot; the bottom has a tray containing zinc and mercury. What solution must I use to get a good electro-motive force to ring a 4in. bell 30 yards off?—IGNORAMUS.

[57706.]—**Faulty Dynamo.**—I have lately got a dynamo. When run at about 700 revolutions there is a good spark between the binding screws, when a wire is inserted; when run at 1,000 or upwards there is none. It fails to light even a 5 c.-p., although reputed to light five 20 c.-p. lamps. Would someone of experience tell me what is wrong, and how to make it right?—BRIAN BOROO.

[57707.]—**Creosote from Coal Tar.**—I wish to get a solution of creosote in warm or cold water. Can any of "Ours" tell me how I must treat it in order to obtain the desired result?—K. N. S.

[57708.]—**Hot-air Engine.**—TO MR. SUTCLIFFE.—Would you kindly give me some more information of your hot-air engine, the size of working cylinder, length of stroke, dia. of displacing cylinder, length of stroke, and, if possible, sketch of the engine in general, or any other information concerning it?—FRED. ALLEN.

[57709.]—**Repousse Work.**—I have been looking at some very fine repoussé work in brass, and have taken quite a fancy to learn how it is done and what tools are required. I have never seen this subject treated in our columns, but have no doubt we have among us some who are masters of this fascinating art. Now that the long, dark nights are in again, I am sure many readers of our paper would like to try their hands at this art, and I am sure the attention of our readers has only to be called to it and we shall have something forthcoming much more interesting to the great majority of our readers than the dry discussions on creation and such-like subjects we have had of late.—DICK.

[57710.]—**7in. Breech-loading 82cwt. Gun.**—Will anyone give sketch of vent piece, showing how it is fitted into gun?—C. E.

[57711.] — **Engineer's Taper and Parallel Rimers.**—Will anyone give directions for making; say how many flutes and what radius of flute should be to that of rimer? Should they be made from square or round steel?—C. E.

[57712.]—**Vacuum Brake.**—TO MR. STRETTON. AND OTHERS.—Can an engine and twelve coaches travelling at 50 miles an hour on level road and ordinary circumstances be stopped in 50 yards with vacuum brake?—[illegible] NOSAM.

[57713.]—**Strong Paste.**—Can anyone kindly recommend the best thing to use for putting cards or pictures upon American cloth? Ordinary paste is of no use.—DAFFORNE.

[57714.]—**Blueing Steel.**—I want to blue the [illegible] strips of steel by means of the melted-lead process. Will someone please say what I must mix with the lead to keep it from adhering to the steel in small globules?—T.

[77715.]—**Lathe Bed.**—How can I prove a lathe bed (V and flat gap) to be true when it comes from the people who plane it?—A. F. SHAKESPEAR, Dresden.

[57716.]—**Prepared Emulsion.**—I have read somewhere of an emulsion which only requires to be poured on the plate and dried, and it is then ready to take a photograph with? Could some reader of "Ours" inform me where I could procure such an emulsion, and let me know the probable cost per pint, and if the plates made [illegible] as rapid as the ordinary gelatine bromide dry plates?—AMATEUR PHOTOGRAPHER.

[57717.]—**Blotches on Face.**—I am troubled with blotches on my face at different times, which come to [illegible] or no head, and give great pain to discharge them, and [illegible] painful before discharged. Also after shaving I am troubled with small risings on the face, even though I use powder. I shall be glad of any hint to prevent them. I ought to say, perhaps, that I am by no means a [illegible] drinker.—FACIES.

[57718.] — **Annuities.** — Will "Milverton," or some other mathematician, be so good as to state on what principle the following equation is arrived at:—

$$P = n A - \tfrac{1}{2} (n + 1) P r,$$

and also refer me to the best current book authority on the subject?—W. C.

[57719.]—**L. and Y. Express Engines.**—Can any of our readers give the details of the new L. and Y. express engines, 870 pattern, by Kitson and Co., 1885? How [illegible] the Joy motion?—PASSENGER.

[57720.]—**New Brake.**—I see by the papers that [illegible] yet another new railway brake coming to the front. [illegible] an Edinburgh invention.—LOCO.

[57721.]—**Brakes.**—The brake return seems so [illegible] wrong, so many brakes under wrong heads, &c., that [illegible] a big job for one to know what brakes are good and which bad. If the returns don't give us the truth, we are [illegible] defeated in our knowledge. The Westinghouse is a [illegible] brake and fulfils conditions—there is no fear about that. I pass on to ask, How about the others? The chain [illegible] is out of the question, the leak-off Clayton is ditto. [illegible] Steel brake—well, there are only a few coaches, that is [illegible] any day. Heberlein also out of the question, and all the non-automatic brakes, of course are, as they say, not in [illegible]. Well, there is only one left worth looking at, that is the newest kind of Smith's Automatic Vacuum; it looks [illegible] well at the Exhibition, but is it any good on rails?—that [illegible] the question for me. Correspondence on it has been [illegible] various. Some say it is good, others that it is not. [illegible] there no plan of getting to know the truth? Does [illegible] thing fulfil what the Board of Trade call for?—BRAKE [illegible]

[57722.]—**New M.R. Engines.**—What class are the new Midland 1730 class just ready to come out?—EX[illegible] ENGINE.

[57723.]—**Grinding Flints.**—What kind of machinery is used for grinding flint in the potteries?—A. J. S.

[57724.]—**Soapstone.**—What is the chemical composition of soapstone? Also the value per ton in England?—A. J. S.

[57725.]—**Ball Room Floor.**—Will any reader kindly inform me the best method to get a floor in good condition for dancing? I believe there is something used consisting of spermaceti, &c.—DANCER.

[57726.]—**Book on Astronomy.**—A correspondent in a contemporary says: "Lockyer's works are not at all badly written, barring a few errors in the lessons"; another well-known writer says: "The author of this little work would have done well to have obtained the excellent American edition of Lockyer's Elementary Lessons on Astronomy, instead of trusting to the original edition." I want a good, yet simple, textbook for my boy, and have hitherto considered Lockyer's lessons very good. Would "F.R.A.S.," Mr. Sadler, or some other astronomical correspondent of "Ours" say if the English edition is glaringly faulty, and if the American edition is a trustworthy manual?—H. A.

[57727.]—**Magneto-Electric Machine.**—I am about to construct an electric machine as described in "E. M.," Nov. 7, 1879. I intend using it for shocks and sparks, not as a motor. Should I make two armatures, and wind one for quantity and sparks with No. 18 [illegible] covered wire, and another for intensity and shocks [illegible] No. 30 silk-covered wire, and will annealed cast-iron [illegible] armatures? How should the magnets be [illegible] either before or after magnetising, and what will five minutes' connection with six Daniell [illegible] sort, be effectual in magnetising the magnets [illegible] the currents several times? Should I wind w[illegible] paraffined paper tubes fitted to legs of magnets [illegible] netise them one by one?—G. McG.

[57728.]—**Printer's Ink.**—Will any corr[illegible] oblige by giving a description and sketch, if p[illegible] the latest improvements in mills for grinding pr[illegible] and tube colours for decorators?—W. H. T.

[57729.]—**Sanitary.**—Will someone inform m[illegible] calculate the dimensions of an outfall sewer for [illegible] tion of 15,000 people, the ground having a gradient [illegible] 600?—Y. N.

[57730.]—**Micro.-Lantern.**—I am desirous [illegible] up a micro.-lantern, and shall be greatly obliged [illegible] your readers can assist me in the matter. What [illegible] a full description of the instrument, together [illegible] account of the modus operandi of working and il[illegible] ing it.—G. C. R.

[57731.]—**Planing Tool.**—What shaped too[illegible] for planing into >-shaped corners, the saddles [illegible] rests for example? Please to give sketch, as I d[illegible] any of the tools by name.—A. F. SHAKESPEAR.

r Wheels.—Can skew gears be cast? pattern made?—A. F. SHAKESPEAR.

ıe Flywheels.—Is there any rule for weight of above; also the diameter? It few makers are aware that it is possible ght.—A. F. SHAKESPEAR.

lysis of Phosphorus in Steel.—has been filtered off in analysing steel for neutralise with ammonia. Is it necesng ammonia till all the iron is thrown e solution after the addition of HNO_3 is ıere not a definite quantity of ammonia ısed, say, to 5 grammes of steel?—T.

monia Molybdate Solution.—f our chemical friends kindly inform me preparing the molybdate solution for the hosphorus in steel? and what quantity for 5 grammes of steel?—T. BARRON.

ksilver in Loaf of Bread.—It is ity of the body of a person drowned may ing quicksilver in a loaf of bread and he loaf stopping immediately over the t, and, if so, what is the cause of it?—T.

hopp Gas Engine.—Thanks to lodon," and "One that has had Same Com- information respecting my engine. I struction books, which I have gone by, e the engine go, until last week, when I lap-valve behind that takes the gas in for pped half the supply of gas. Now she better. I think of having a cold-water ıer to keep her cool, as she gets so hot; will go all right. Will you, or any r, advise me the sort of coil that would t be quite up close to the cylinder, or if it? Does it matter?—BISSCHOP GAS

ng and Shafting.—I should feel ny correspondent skilled in such matters information on the following matters: anical contrivance by which the speed en with a belt from a shaft can be regun be altered as required while working lutions per minute to 100, or 50? I had at by mounting the machine, so as to m, the to-and-fro movement being crew, so that it could be advanced or the driving shaft, the belt would be made different speeds attainable at pleasure; experience in such matters, cannot say k. Is there any book published from abular information as to the diameters of r giving certain speeds, the speed of the vn, or must each be calculated, and, if rules for doing so? Would ordinary pipe be suitable for conveying steam for To convey power from one shaft to ft. distant, is a belt or a wire rope the ATEUR ENGINE FITTER.

d of Drills.—Could any of your corre- a list of speeds of various-sized drills, ıt and cast-iron and steel? Also rate of V. W.

Reeds.—In query No. 57252, Mr. G. he would explain some of the principal ying in the tuning if requested to do so. ıat gentleman to explain them, as it " does not mean to reply. Will Mr. F. ctions how to make a tuning apparatus, ctories?—AMATEUR TUNER.

anometer.—To MR. BOTTONE.—I galvanometer, of 6,000 ohms resistance. ells (small size) ought I to use with it for or if Fullers are unsuitable, how many ICO.

ring Solutions.—Will any reader give the proper ingredients? One re- nitrate of silver, ¼lb. of cream of tartar, Another says: silver, 1; salt, 1¼; soda, uch a vast difference.—JACOB MAGLOS-

oscopical.—Will "Procella" (p. 100, his default, will "Rob. Crus." kindly give king a B and C Dallmeyer orthoscopic ain the difference between a Ramsden this way: Take plano-convex of — glass diameter, and put it —in. from a lens description; not as the value of *p* is to *u* t sort of thing, which nine-tenths of understand? Also a rough and ready y mechanic to tell a flint from a crown IAN.

ımo.—To "W. H. E."—I have now ture, to your advice, with No, 16 d.s.- have put on about 3¾lb. Will 58lb. No. r F.M.? This gives a ratio of about nature and F.M.—RES.

p-holders.—Will Mr. Bottone kindly ment is used in fixing the caps on in- intended to be used with sockets? I rtain above with regard to the vitrite ıore especially.—ELECTRA.

nutator.—To "W. H. E."—Kindly w to make above for 30-lighter, how e fixed, and how insulated? Give sizes

r Required.—Suppose an inclosed by 3ft. in dia. inside, with discharge n. dia. and 6ft. long, with sluice valve pressed with water by hand-pump to what power will be required to pump rough a pipe 6ft. long by 4in. dia., and pipe is used instead?) to keep a con- 0lb. per sq. in. in tank when sluice is scharge given? If "Glatton," Grey, will kindly answer this plainly, it would oint.—CONSTANT READER.

[57748.]—**Boring.**—I want to bore to the depth of from 50ft. to 150ft. The ground is partly sandstone, and partly, almost, or quite as hard as granite. I have about a dozen holes to put down. The diameter of the hole should be about 2in. It is essential that the tool should be very simple and easy of repair, and capable of being worked by manual or horse-power. Can any of our readers kindly suggest a suitable tool?—A BORING NOVICE.

[57749.]—**Small Boiler.**—I have a small vertical boiler, 11in. high by 5½in. dia. made of brass, the outer shell of which is 5-64in. thick, brazed and riveted. Assuming that all other parts are equal in strength, what is the greatest pressure it would bear, and what weight will be required on end of safety-valve lever to blow off at half that pressure, the size of valve being: aperture, ¼in.; fulcrum to valve, ½in.; valve to weight, 3in.; weight of valve and lever, 1oz.? Also, would a cylinder, 1½in. by 2in. stroke, be too large for it?—G. R.

[57750.]—**Tramway Points.**—I shall feel obliged to anyone who can send a sketch, with dimensions, of the points used on steam tramways in England. Also those in America; also how they are actuated?—J. W. DEAR.

[57751.]—**Rain Gauge.**—Can any reader tell me how to calculate the area of a funnel, and also the amount of rain fallen through different areas in fluid ounces? Also, what would 6oz. of rain be equivalent to in cubic inches which had fallen through a funnel having a diameter of 4·697in.? What is meant by saying an inch of rain has fallen? Does it mean an inch has fallen on every square foot of ground? Please explain by decimal system.—CAERLEON.

[57752.]—**Tinning Wire.**—I have a coil of bright iron wire, which I wish to cover with tin. Is there not some way of doing so by boiling with a solution of tin? Can any of "Ours" assist me with this or any other method?—EOS THE SECOND.

[57753.]—**Photos. of Diagrams, &c.**—I want to take some negatives, 3¼in. square, for the purpose of afterwards making transparencies for the lantern, the matter to be copied being portions of printed maps, astronomical diagrams, &c.; but when I fix up the diagram and focus in camera, what should, for my purpose, be 3in. square, appears on ground glass as, say, only ½in. or ¾in. square, and too small. I can't put camera any closer, as, if I do, I cannot get print in focus at all. How can it be accomplished?—R. M. P.

[57754.]—**Gas Supplies.**—Wanted, title of treatise giving information to consumers on the reading and management of their meters, and hints as to how to detect waste, and to know when they are getting full value for gas consumed in proportion to the amount of light, &c.—R. M. P.

Meteorology.—At the third meeting of the International Meteorological Committee held in Paris, at the Ministry of Public Instruction, a valuable report on Cirrus-cloud Observations by the Committee appointed at Copenhagen, 1882 (MM. Capello, Hildebrandsson, and Ley), was submitted, and will be printed. It recommends that the observations of these "Mare's-tail" clouds should be added to the daily meteorological telegrams in each country. The subject of Atlantic Weather Telegrams was discussed with General Hazen (Chief Signal Officer, U.S.A.), and it was decided to maintain the present system of reports of weather, ice, and derelict ships which are extracted from ships' logs, telegraphed to Europe, and forwarded to the public press, and which has been carried on since Christmas last by the Meteorological Offices of France and this country, and to endeavour to improve the system as at present organised. A proposal, made by M. Léon Teisserenc de Bort, for the daily transmission by cable of a *résumé* of the weather prevailing in the United States, especially in the New England States, was considered. General Hazen expressed his readiness to furnish such reports, and it was resolved to endeavour to organise the service, provided the cost of telegraphic transmission of the reports could be guaranteed by the European Meteorological Offices proposing to participate in it. It was decided to recommend that barometrical observations should have an additional correction introduced into the method of their reduction, viz., the correction of the force of gravity at the parallel of 45°. The force of gravity varies with the latitudes, and, accordingly, the middle latitude 45° is selected. It was considered desirable, as absolute synchronism in weather observations appears to be unattainable in Europe, that the same hours of local time should be adopted in each country. This would involve in the United Kingdom a change from 8 a.m. to 7 a.m. Greenwich. At present the hour varies from 7 a.m. local in the East of Russia (corresponding approximately to 6 a.m. Greenwich) to 8 a.m. Greenwich at Valencia, 8 a.m. (local) at Lisbon, and 9 a.m. (Lisbon) at Oporto, the last hour being approximately 10 a.m. (Greenwich). It was decided to recommend that the next International Congress should not take place before 1889 and Prof. Mascart stated that probably the French Government would be disposed to invite the Congress to assemble in Paris in that year.

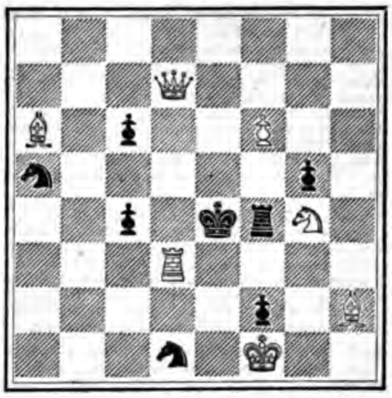
Green Transparent Varnish for Metals.—Grind a small quantity of Chinese blue with double the quantity of finely-powdered chromate of potash (it requires the most elaborate grinding): add a sufficient quantity of copal varnish thinned with turpentine. The tone may be altered by adding more or less of one or the other ingredients.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLX.—RESPICE FINEM.

Black.



White. [7 + 8

White to play and mate in two moves.

This is the last problem in the Tourney.

THE Judge's Report of the three-move Problems in the ENGLISH MECHANIC Tourney.

OF the 13 competing three-movers, only two must be dismissed as faulty, 956 and 958; that the first should be impossible, owing to a slight omission in the construction, is much to be regretted, as it would certainly have taken a very high place. Of the rest, we may pass over Nos. 934, 936, 938, 944, 950, and 954, not as being without merit, but as greatly inferior to the remainder. The other five are all most excellent, and abound in interest and ingenious strategy; they would deserve to rank high in any Tourney. No. 940 has a difficult first move, but when this is found the rest is plain sailing, and there is over-much checking. No. 942 is remarkably pretty, but is hardly deep enough to score very high. No. 946 is a beautiful and difficult problem. The various moves of the Black Knight produce some charming variations. There are also some very near and deceptive tries; the duals seem unavoidable, and can hardly be said to mar the problem to any appreciable extent. No. 948 is also extremely fine, and I have found it very difficult to say whether this or the preceding is the better problem. If I were allowed I should prefer to bracket them as equal, but as I must pronounce in favour of one of them, I will give the preference to 946, as it possesses, perhaps, a rather finer first move. No. 952 is very ingenious, but after the first move is pretty easy.

AFTER careful consideration, I place the problems in the following order of merit:—First prize, No. 946, "Ideen"; second prize, No. 948, "Tessie"; third prize, No. 940, "Double Pawns"; fourth, No. 942, "An easy shave"; fifth, No. 952, "Patience." It is, perhaps, unnecessary to place the rest. It will be advisable to allow this judgment to remain open for a month, in case any faint flaw should be discovered in any of the prize problems.

W. TIMBRELL PIERCE.

Brighton, Sept. 29, 1885.

SOLUTION TO 958.

White.	*Black.*
1. Kt-K 5	1. B-Q Kt 5 5 (*a*)
2. Q-Q B 4 (ch)	2. K takes Q
3. Mates	
2. Kt-Q Kt 6 (ch), &c.	(*a*) 1. P-K B 4 (*b*)
2. Kt-K B 8, &c.	(*b*) 1. P-K B 3 (*c*)
2. Q-K 8 (ch), &c.	(*c*) 1. K-K 3 (*d*)
2. Q-Q B 5 (ch), &c.	(*d*) 1. Anything else

THIS problem can also be done by 1. K-Kt 5, 1. Kt-Kt 6 (ch), and 1. Kt-Q Kt 7.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 957, by E. Stanley Follwell, A. S. Olver, and F. O'N. H.

To 958, by F. O'N. H., A. S. Olver (four solutions) R. A. Bennett, Streetgate, E. S., H. S. T. Glover, Rev. W. Anderson (Old Romney), A. A. E. Lecluse (two solutions), A. Bolus, J. A. Mills (three solutions), and H. Culmer.

To 959, by E. S., R. A. Bennett, A. S. Olver, Streetgate, H. Culmer, and J. A. Mills (weak), H. E. T. Glover.

E. S.—We admit the hardship, but any other course seems to us unfair, as some solvers—we know, at least, one—might have refrained from sending any solution on account of the defence which the author overlooked.

R. A. BENNETT.—The receipt was not acknowledged last week because we should have been obliged to point out that it was not the Author's Solution, and this would have been a clue to others.

V. S. POCHIN.—We fail to see the mate if $1.\frac{\quad}{\text{Q takes Kt,}}$ $2.\frac{\text{Q takes Q}}{\text{K-B 6}}$. You have not given the play if $1.\frac{\quad}{\text{R takes R.}}$ We are certain it cannot be done in the way you propose.

WE notice that the *Weekly Times and Echo*, which appeared in an enlarged and improved form last week, has added to its many attractive features a Chess Column, which is under the able editorship of Dr. Gunsberg.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 7, and unacknowledged elsewhere :—

MRS. OAKES.—H. P. Hitchcock.—Whittam and Co.—Long Boat.—J. Browning.—Amateur Jack.—Would-be Electro Plate.—E. H.—G. B. P., Southsea.—J. W.—Negative.—Enquirer.—S. B. R. M.—J. E. Gore.—H. H.—One in a Fog.—John Ballot.—Fugo.—Amateur Musician.—A., Liverpool.—Eos the Second.—Glatton,—S. R. Bottone.—Sand Rat.—Jas. Wimshurst.

W. HONEY. (The only process of cold soldering that is worth anything is that described on p. 81, No. 888.)—MAGNET. (You will find recipes for a large number of cements in back volumes, and it remains to try which gives best results. Boil an ounce of isinglass in 6oz. of water until it is reduced by a half; add 1¼oz. of rectified spirit; boil a minute or two, strain, and add whilst hot a milky emulsion of gum ammoniac (½oz.), and then 5 drachms of tincture of mastic. Proportion may be varied. The principle is an alcoholic solution of gelatine mixed with an alcoholic solution of gum mastic. Perhaps the latter alone would answer your purpose.)—SCHOOL BOY. (For methods of painting blackboards, see No. 1,002, p. 311. A simple process is to paint with two coats of good black paint in turps, and then two mixed with varnish. Rub down with pumice dust on a felt. Some put with the finishing coats a small quantity of very fine coke-dust or emery.)—T. C. (An etching ink for glass was given in Vol. XXXIX., p. 162. There are also many other recipes in back volumes.)—P. I. K. (See p. 326, No. 1,029, and many other places in back numbers. All high-pressure work should be left to those who have had experience.)—F. M. B. (See Hints No. 5. Apply to Messrs. Piper and Carter, Castle-street, E.C., for a list of books published by them, and to Messrs. Marion, Soho-square, W., for materials.)—J. O. X. (Incubators, p. 471, Vol. XXXIX.; p. 562, Vol. XXXVI.; p. 553, Vol. XXXV.; and many other places in back volumes.)—F. P. (See innumerable replies on such questions in recent numbers. It would not be cheaper than gas at 3s. per 1,000 c. ft.)—QUERIST. (No practical book, in the sense we understand you; but Dempsey and Clark's "Locomotive Engines" will be useful, and Goodeve's "Steam Engine" is just what you want. Both are published by Crosby Lockwood and Co., Stationers' Hall-court, E.C.)—A. M. (We presume you mean those in Vol. XXXVII., pp. 130, 244, 272; but there are many papers on the Indicator in back volumes.)—Z. (See previous answer or any textbook of the steam-engine.)—T. SMITH. (We understand that an application of strong acetic acid is very useful in cases of ringworm.)—S. ELLIS. (Ointment of galls is frequently recommended; but it is better to consult a medical man, than to apply any remedy that may be recommended by mere experience.)—N. E. TOKE. (We should imagine so; but you can obtain an authoritative answer by addressing the question to the Civil Service Commissioners, Cannon-row, S.W.)—L. C. S. (They are examination questions—the first of no particular interest; the second answered in any textbook of mensuration.)—B. H. (Is it a fact? If so, it can only be through the resistance offered by the air to the motion of the exposed portion, and that, we think must be infinitesimal.)—R. S. MELLOR. (Quite possible; but the only way is to apply to owners or the chief engineer on board.) J. E. TAYLOR. (Some little bend can be put into it by warming very gently and applying pressure; but as a rule the bent pieces are cut to shape with a fret or bow saw and tripoli powder, water being applied freely, as amber is liable to fly to pieces when subjected to much friction.)—BYSICLIST. (Get some solution of rubber from the leather-sellers. Anoint the parts with that, and bind a piece of linen similarly covered over the junction. It is a "botch" at best, and risky.)—ZERO. (Isinglass dissolved in acetic acid. It becomes liquid when the bottle containing it is placed in a basin of warm water. Or use the ordinary shellac cement. See indices.)—SMANGLE. (Write for particulars to those who advertise gas-engines in our columns, and read up back volumes.)—J. BRISTA. (We are not aware that it has any corrosive power; but consult the textbooks, or better, try a few experiments, when you will find that it is insoluble in water.) A CONSTANT READER, Altrincham. (If you refer to your Vol. XXXIX., you will find on pp. 96, 117, 139, a tolerably full description of the whole art of nickel-plating.)—R. M. P. (We do not see how any useful article can be written on such a subject, for much depends on the wants and the resources of the individual.)—KNARF. (Ask the collector of Inland Revenue. 2. It could be patented; but we are afraid it would be void, as outsiders might be able to prove that they had seen it used.) MATCHLESS. (See the indices, and a letter on p. 456, No. 1,061.)—POOR INVENTOR. (Procure a copy of the rules (post free 7d.) from Mr. H. Reader Lack, Patent Office, Southampton-buildings, London, E.C. Other information will be found in back volumes.)—E. F. N. (You were answered as soon as possible after receipt of your letter, and referred to p. 226, No. 1,024, for all the description necessary of Thauma.)—A WILLING ONE. (We can do no more than refer you to the advertisements, and advise you to use a little common sense. Nobody gives something for nothing—especially if he advertises to do so. 2. The best way is to photograph it, and transfer that. 3. Procure the rules from the Patent Office. The cost is £1 for the application stamp (including forms and declaration stamp, about £1 2s.), which protects for ten months, when a complete specification must be filed with a stamp of £3.)—JOHN CHARD. (It will be inserted if deemed suitable; for the rest, we can only say that we make a selection from what is sent us. Have you, for instance, done anything to help in spreading information?)—EXCELSIOR. (The tube-well would be cheaper, of course; but as to cost, you must apply to those who do such work. There is much information on the subject in back volumes.)—SWEET MUSIC. (Procure a set of proper glasses from dealers in musical instruments. Alum and water is the best solution.)—BRUNO. (Any suitable wood—that is, no one would use pine; but they might ash or lance, oak or mahogany, &c. Cut out or steam bent, which you like. 2. Whichever you like. We should use neither; but Prof. Guthrie's "Penny Water Cleaner," described in No. 965.)—SHOWCARD. (Any good coloured ink mixed with gum tragacanth and a little sugar candy.)—OATMEAL. (Recipes for making oatcakes have been given many times. Perhaps the following is as good as any:—2lb. oatmeal, a slice of butter, salt to taste; rub the butter into the oatmeal, mix with hot water to a stiff consistency, roll and cut into squares or any other shape as quickly as possible, and bake. The "griddle," an iron plate put over a clear fire, is the best arrangement.)—WALTER J. MAY. (The "Rules," which can be obtained at the Sale Office, Cursitor-street, E.C., price sixpence, give all necessary particulars for taking out a patent. If the intending patentee is sure that his invention is so novel that he runs no risk of rendering the patent void by claiming too much, there is no reason why he should not fill up the forms (sold at most law stationers), and dispense with the services of an agent; but an "intelligent mechanic" is not necessarily skilled in the technicalities of the law, and we strongly advise all intending patentees who believe they have a "good thing" to secure the services of a respectable patent agent. The money is well laid out.)—FIAT LUX. (If you had not put in "diffraction grating plates," we might have guessed that you meant speculum metal; but now we are all at sea. Still, we have no doubt you will find what you want by looking up back volumes.)—C. DAUBENY. (Answered to "Inquirer" on p. 90. We never heard that it did, and, personally, we are convinced that it does not.)—D. BOOTH. (You will have seen what has been said in our columns. It will be time enough to argue about the theory when more definite information has been received from observers in other parts of the the earth.)—LITHOS. (Mr. Sprague's "Electricity" is published by E. and F. N. Spon, Charing-cross, S.W.)—G. (See answer to Walter J. May. 2. Only when the combination makes an entirely different machine or effects a different purpose, new in itself.)—JACOB MAGLOSKIE. (Benzene is prepared from coal-tar oil. Benzine and benzoline are chiefly mixtures of paraffins, and do not contain benzene, or benzol.)—LEITHER. (Dilute sulphuric acid, say, 1 in 12 or 20 of water. Some use equal parts sulphuric and hydrochloric acid, diluted with water. The object is to remove the oxide and scale, and the time depends on that. The iron is then scoured with sand, used generally with a coker-nut husk as a rubber. The metal must be perfectly clean, and any process that will effect that will do.)—JACK SAW. (A hydro-incubator was illustrated in No. 773. Messrs. T. Christy and Co., of Fenchurch-street, E.C., publish a book on the hydro-incubator.)—F. W. JACKSON. (Under the circumstances, we think the master is liable.)—A. BEDFORD. (Nos. 200, 238, 240, and Index for Vol. V. are out of print. Price of the other numbers post free will be 2s. 3½d.)—SAND RAT. (Please send address, that we may return your paper on "Moulding" for revision. The illustrations seem hopelessly mixed up with the numbers.)—MECHANIC. (See a reply on p. 108. 2. No such paper, or anything. Knowing what is wanted is half the difficulty in invention.)

A Hint for Pianists.—For the benefit of pianists a Continental surgeon has recently advised division of the connecting bands which join the extensor tendon of the ring finger with those of the middle and little fingers respectively. It is a fact well known to anatomists, and even to the laity, that in most people the fourth finger cannot as a rule be fully extended whilst the others are kept in the flexed position, and that consequently a certain amount of restraint is placed upon the movements of the digit when acting alone. The difficulty, however, can by practice be sufficiently overcome to enable a player on a keyed instrument to dispense with the operation in question, slight though it be. We doubt if the "execution" of our most renowned pianists would be materially improved by the proposed plan of treatment, for what would be gained in range of action would be lost in power. Moreover, it is by no means certain that division of the lateral bands would not be followed by cicatricial union of their severed ends, and thus a distinct crippling of the finger result. And, again, the records of surgery abundantly prove that no wound can be inflicted with absolute certainty of freedom from mishap in the shape of suppuration, or, it may be, graver evil; and certainly tendons are not the structures least liable to resent operative interference. Theoretically, the proposal is ingenious; practically, it is dangerous.—*Lancet.*

USEFUL AND SCIENTIFIC NOT

Opionin.—This is a body obtained by O. from Smyrna opium, by treating it at ord temperature with an excess of milk of lime, saturating the solution with excess of aceti and concentrating to a weight equal to that opium. The brown flocculent mass which sep contains gypsum, and yields to ammoni opionin, which is precipitated from the filtra hydrochloric or acetic acid. It forms conc groups of small needles, melts and turns bro 227° C., is easily soluble in alcohol and sparingly soluble in boiling water, is neutral paper and seems to be free from nitrogen solutions in alkalies are yellow, but acids se it as a nearly colourless crystalline precipitat warming, its alcoholic solution yields with chloride a flocculent brown-red precipitate boiling its solution with lime, a crystallin soluble in water and ether is formed. On m opionin with potassa, *opionylic acid* is fo which is likewise freely soluble in water and and crystallises in dense colourless prisms.—*L Annalen.*

Enamel for Iron.—A good enamel coati cast iron, wrought iron, or steel, one that wi crack on being subjected to moderate chan temperature, has long been a desideratum, an says this is now claimed to have been disco In the case of an opaque enamel being requir for instance, a basis for vitrified photographs, eight parts of oxide of tin are to be added. A 125 parts, by weight, of ordinary flint-glass ments, 20 parts of carbonate of soda, and 12 of boracic acid are melted together, and the mass poured out on some cold surface, as of sto metal. When this has sufficiently cooled off, pulverised, and a mixture made of the po together with silicate of soda of 50° R. With substance the metal is glazed and heated in a m or other furnace until it is fused. This is sai prove an effective application for the purpo compared with other methods, and, at l possesses the advantage of simplicity.

THE German organ for railroad progress gi the following method of checking milemen practised on the Russian road from Charkov Nikolajev. The track is patrolled before ea train by a watchman on each section, who carri forward a number found by him at the beginni of his section, and left on a hook provided for at the end, even numbers being carried in a direction and odd ones in the other. The numbers which are painted on metal plates, are hung in view of the trains, so that officials passing can readily see them, and by means of a small table of the positions of the numbers on any day or hour can see whether the watchmen are doing their work. A hook without a number indicates the negligence of a watchman, who can be readily identified, since every watchman is required to give notice when he does not find a number at the beginning of his section, and must do so to avoid having the carelessness ascribed to him.

THE *Chicago Railway Age* states that over 1,4 trains pass over the junction of the New York Elevated Railroads at Chatham-square every twenty-four hours. No railroad in the world does an equal train business on two tracks. There is a junction in London where 2,400 trains pass daily, but four tracks are provided for their accommodation. The only railroads in operation that compare with the New York Elevated Railroad system for crowded business are the London Underground Railways. The Underground Railways carry an enormous number of passengers, and the traffic has developed very rapidly. In 1879 a total of 91,420,178 persons were carried by the London Underground Railways, while in 1884 the number had increased to 114,447,514. During the corresponding five years the New York Elevated Railroads showed an increase from 46,045,181 to 96,702,620; in other words, while the Underground showed an increase of 23,027,336 in five years, the Elevated had expanded its figures by 50,657,4

THE traffic on the St. Gothard Railway continues to show a steady, if not very rapid, increase. In 1876 it was estimated that the goods traffic between Germany, Belgium, and Italy would reach an annual total of 150,000 tons. In 1883, the first complete working year, the weight of merchandise sent from the two first-named countries amounted to 204,000 tons, while there were consigned thither from Italy 37 tons. In 1884, the traffic both ways made an aggregate of 249,000 tons. The list of articles transported from the two northern countries to the Peninsula is headed, in 1884, with hardware, 89,958 tons; next come coals, exclusive of fuel for the service of the line, 64,835 tons; while glass and earthenware figure for 6,000 tons, textile fabrics for 3,412, and paper for 1,610. For these things Italy gave in exchange, wholly or in part, 13,13 tons of eggs, 4,476 tons of flax, 1,361 tons of marble, 3,558 tons of fruit, 1,637 tons of wine, and 316 tons of corn, and several other commodities.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, OCTOBER 16, 1885.

THE STORY OF THE HEAVENS.*

THERE is, perhaps, no one amongst the present generation of distinguished astronomers better qualified to write "the story of the heavens" than Dr. Ball, the Professor of Astronomy in the University of Dublin, and the controlling spirit at Dunsink Observatory. Nowadays, the man who wishes to keep abreast with the advancing knowledge of the time cannot afford the leisure to appreciate the beauties of what is called "fine-writing"—at all events, in connection with scientific facts, and the works he prefers in his library are those which will give him a plain answer to his question without the labour of wading through pages of words — mere words. Several writers of scientific works are beginning to appreciate the fact that there is now so much for a man to learn who would desire to be ranked amongst the "educated," that little more than a plain unvarnished tale is all he cares about studying: he requires the facts, with so much of explanatory matter as may be requisite to render them comprehensible, but without any useless verbiage. Dr. Ball occupies about 540 pages in telling the "story of the heavens," but there is not a line one would wish omitted, and not a paragraph that could be spared; and yet his pages do not read like a dry statement of facts: on the contrary, what he has written interests the reader and leads him on from page to page, and when the book is finished there is a copious index, by the aid of which any point can be easily looked up in the future. In this introductory chapter Dr. Ball enlarges on the wondrous nature of the story he is about to tell, and in a few pages places before his readers the magnitude of the subject they are invited to study. Thus, in a few paragraphs, he gives an outline of the history of astronomy, and brings out the salient points in such relief that they make an almost imperishable impress on the memory. Although, he says, the Ptolemaic doctrine is now known to be framed on an utterly extravagant estimate of the true place of the earth in the scheme of the heavens, yet the apparent movements of the celestial bodies are accounted for by the theory with considerable accuracy. Ptolemy's theory was described in his "Almagest," written in the second century, and for fourteen hundred years it was regarded as the true story of the heavens; but, as Dr. Ball points out, the discovery of the true system of the universe was nearly simultaneous with the discovery of the new world by Columbus. Copernicus showed the difference between real and apparent motions, proved that all the phenomena could be as easily accounted for by the assumption of the rotation of the earth, as by the cumbrous supposition of Ptolemy—really a preposterous one when it is calculated what an almost infinite velocity the stars would have if the whole universe revolved around the earth. Copernicus, in fact, not only demolished the hypothesis of Ptolemy, but assigned to the earth its true position—one of a system of planets revolving around the sun; and when that "space-penetrating instrument," the telescope, was invented, all who approached the discussion of the subject in the proper spirit—the search after truth—were convinced that Copernicus was right, and Ptolemy wrong. The telescope having played so important a part in the history of astronomy, Dr. Ball devotes his first chapter to the Astronomical Observatory, and having briefly referred to the establishment of Tycho Brahe, on the island of Huen, with the rude instruments then available, proceeds to explain the structure of the eye (from the optical point of view) and the refracting telescope. Engravings of Dunsink serve to illustrate what an observatory is like, and a full-page plate of the great Vienna telescope as erected in Mr. Grubb's factory gives an idea of the appearance of one of the modern instruments used by astronomers for penetrating space. A diagram of the principle of the Herschelian reflector is followed by a page plate of Lord Rosse's telescope; but the reader having been made acquainted with the modern wonders in the shape of instruments, and having realised how far they are above his reach, is comforted by the intimation that a binocular, such as a captain uses on board ship, is the most suitable instrument for commencing astronomical observations, as though not nearly so powerful as a large telescope, it has some compensating advantages not possessed by the latter. Failing a binocular, a good opera-glass will suffice, as it covers a large region of the sky, while the telescope would show only a part. The tyro having become possessed of an opera-glass is invited to study the "renowned group of seven stars," known as the Plough, the Dipper, or Charles's Wain, which astronomers prefer to regard as a portion of the constellation of the Great Bear, Ursa Major. We need scarcely say that for many reasons the Plough is the most important group of stars visible to the naked eye; but to mention one, it contains the "Pointers," Alpha and Beta, a line drawn through which "points" directly to the Pole star, the chief star in the firmament so far as the student of astronomy is concerned. When the opera-glass is directed to the Plough on a clear moonless evening, our young observer finds that the portion of the sky included within its limits, though not exceptionally rich in stars, contains at least ten times as many as could be seen with the unaided vision, and his view of the universe is at once broadened, especially when he finds that, turn his glass almost where he may, the heavens appear to be teeming with those bright dots of light which he knows as stars. The student soon becomes dissatisfied with his opera-glass: he wishes to see more and more of the wonders of the heavens, and by implication Dr. Ball advises him to procure a telescope with an object-glass of 3in. aperture—an instrument which will provide "ample and delightful occupation for many a fine evening." An atlas of the stars, a copy of the *Nautical Almanac*, and that indispensable book "Celestial Objects," by the late venerated Prebendary Webb, will form a sufficiently complete astronomical equipment for "much interesting occupation." Dr. Ball having aroused the interest of his reader by initiating him into the wonders of the starlit heavens, proceeds in his second chapter to describe the sun, whose dimensions are "so great as to tax our imagination to realise them." If the sun's globe were cut up into a million parts, each would appreciably exceed the bulk of our earth, while the temperature of our great luminary is higher than any we can produce artificially. We are about 92,700,000 miles from the sun—an enormous distance, which is, however, as nothing compared to the vast interval which separates us from the farthest of the fixed stars—suns themselves, it may be more majestic in their magnitude and power than the great orb which is the centre of our universe. With such questions as the cause of snow on the tops of high mountains, Dr. Ball deals in a brief and felicitous manner, while he treats at greater length on sunspots, the corona, prominences, and the phenomena of eclipses—this portion of the work being illustrated with some beautiful plates and engravings, the sources of which are duly acknowledged in the preface. Not a few readers, diving for the first time into the sea of wonders presented to us by the heavens, will be startled to read in Chapter III. that the most important work which the moon has to do is to cause the daily ebb and flow of the tide, and it is rather unfair perhaps that Dr. Ball should postpone to another chapter a sketch of the "marvellous part which the tides seem to have played in the past history of our earth." However, as he enters fully into the subject in the last chapter (XXVII.), the reader, whose curiosity has been aroused, can quickly satisfy it, while the student can follow the author through his description of the moon itself, a description which loses nothing because the story has been so often told. This portion of the book, too, is illustrated with fine plates and explanatory engravings. The physical features and phenomena of the moon are dealt with in a manner which is calculated to impress the facts upon the memory, while the attention of the reader is secured by references to the important part played by the moon in the practical work of navigation, for she acts as the hand on the great clock-dial of the heavens. "We owe much to the moon," says Dr. Ball; and he spares a few lines to say "the idea that the moon and the weather are connected has, no doubt, been entertained by high authority, but comparison has shown that there is no definite connection between the two." Chapter IV. deals with the Solar System as a whole, and diagrams are used to give an idea of the comparative sizes of the planets, and the apparent size of the sun as seen from the different planets. In the succeeding chapter Dr. Ball deals at some length with the theory and the law of gravitation: and then the planets themselves are taken in the order of their position from the sun as centre, the first being the "planet of romance"—Vulcan. Concerning the question of an intra-Mercurial planet, Dr. Ball is inclined to believe that there is no reliable telescopic evidence of its transit over the face of the sun; but he thinks it not improbable that when the intra-Mercurial planet or planets become better known posterity will have to admit that the first trustworthy observation was made by Prof. Watson. A chapter is devoted to each of the planets, and one to the minor planets: but as to the existence of a trans-Neptunian body, Dr. Ball says there is not at present any ground for believing in the existence of a planet beyond Neptune; but as the latter has since its discovery travelled through only about a quarter of its path, it has been impossible to construct from any observed perturbations the orbit of an unknown and still more remote planet. One of the most interesting chapters in the volume is that dealing with comets, although Dr. Ball says "we must be content with the mere recital of what we know, rather than with attempting guesses about matters beyond our reach." He shows that comets are obedient to the laws of gravitation, and afford the most striking illustration of their truth, and he points out how modern science has dissipated the fear and the superstition with which in earlier ages the advent of a comet was regarded. In the chapter on Shooting Stars the author says "there can be no doubt that the débris of the ordinary shooting stars must rain down upon the earth in gentle showers of celestial dust." Some of the motes in the sunbeam are particles of cosmical dust, which the earth is continuously drawing in, never to part with again until the final catastrophe. The chapter on the starry heavens is embellished with small maps, which will enable the student to readily find the best-known objects in the "glittering canopy of night:" while the succeeding chapters on "distant suns," "double stars," "distances of

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* The Story of the Heavens. By R. S. BALL, LL.D., F.R.S., Royal Astronomer of Ireland. London: Cassell and Co., Limited.

VOL. XLII.—NO. 1,073.

the stars, deal with all the interesting questions evoked by the observations of the telescope. Before dealing with the star clusters and nebulæ, Dr Ball interpolates a chapter on the spectroscope, an instrument by the aid of which a "mighty stride has been taken in our attempt to comprehend that elaborate system of suns and other bodies which adorn the skies," accompanying which is a coloured plate of the spectra of the Sun, Sirius, Aldebaran, and Betelgeuse. Besides the chapter on the Telescope already mentioned, there are others on the Aberration of Light, and on the Astronomical Significance of Heat the latter perhaps an unusual heading in astronomical textbooks. Dr. Ball's work, however, is something more than an astronomical text book: it tells the "story of the heavens," and we know now that heat has really been one of the chief agents by which the universe has been moulded into its actual form. This subject, too, leads to a résumé of the nebular hypothesis, and the theory of sidereal aggregation put forward by Herschel, which for all that can be proved to the contrary, may be as brilliant an inspiration of genius as his announcement that the sun and the planets and the countless host of stars were bound, as Dr. Ball puts it, "on a stupendous voyage through the realms of space."

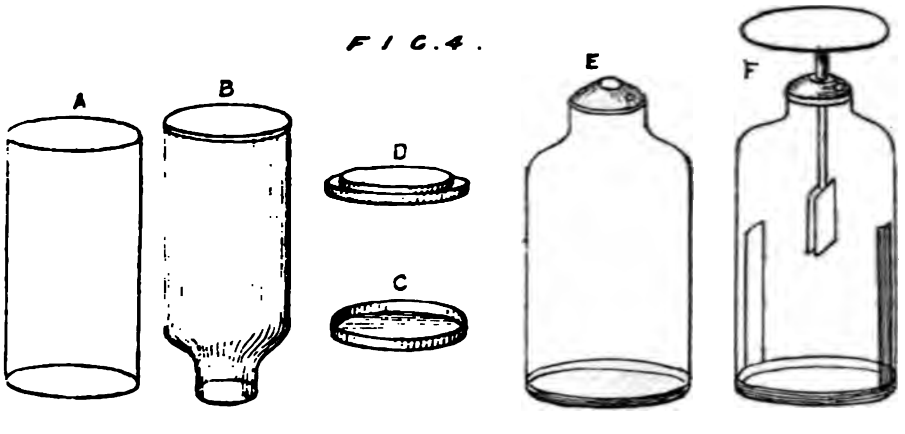
ELECTRICAL INSTRUMENT-MAKING FOR AMATEURS. IV.*

By S. R. Bottone.

§ 11. **GOLD LEAF ELECTROSCOPE.** This is a most useful instrument for the detection of minute charges of electricity. If well made, it also serves admirably to show the phenomena of induction. The requisites are a tall wide glass jar, a sheet of gold leaf, a couple of strips of tinfoil, a short piece of brass rod, about ¼in. in diameter, a couple of beef-tin bottoms or similar pieces of tinned iron, and an empty cigar box.

For the glass jar, we may either use the straight glass chimneys (about 3in. in diameter by 7in. in height) that are used for large gas or paraffin burners, and which may be obtained at any respectable ironmongers for a few pence (see Fig. 4, A), or the bell-shaped chimneys (see Fig. 4, B). Whichever shape be selected, the diameter should not be less than 3in., nor more than 4in. Preference should be given to the bell form, when procurable, as the "cap" is more easily fitted to the narrow neck. Having procured the glass jar, the next step is to fit a cover to both extremities. If Fig. B be chosen, the wider extremity, which is destined to form the bottom, should be fitted with a tinned-iron cover. If the bottom of the glass be 3in. diameter, it will be fitted exactly by the bottom of a Swiss milk tin. The bottom must not fit too tightly, if fitted in winter, or else the slightest increase in temperature will expand the glass and cause it to crack. If a tin "bottom" is not at hand to fit, it may be readily made, by striking out on a piece of thin tinned iron, a circle of the same size as the outside of the glass jar. Keeping about ⅛in. outside this line, the circle is cut out, and then the edge turned up square by hammering lightly on the edge of an ordinary iron. The tin disc should now show the appearance sketched at Fig. C. This bottom must not be fastened in until after the gold leaves have been adjusted. The next operation consists in making the cover to fit the other end of the jar or cylinder. If A has been chosen, two circular discs must be cut out of the cigar-box wood; one that will just drop into the jar, the other precisely the diameter of the outside of the jar. The two circles had better be measured, struck out with the compasses, and sawn with a fret or hand-saw. The two discs, after being well smoothed, should be glued together, as shown in Fig. D. If B is cut close, half a reel of sewing-machine cotton will be found to fit with a trifling adjustment. All that will be necessary in this case will be to cut off the narrow portion, leaving one of the small heads, the rim of which can be trimmed with a rasp, until it just fits the small mouth of the chimney. Whichever form be adopted, this wooden cover must have in it two perforations, one central, about ¼in. in diameter, wherein will pass the brass rod from which depend the gold leaves; the other near the circumference, which will serve as an exit for moist air. Fig. E shows the glass chimney fitted with its lower "tray" and upper "cap."

FIG. 4.



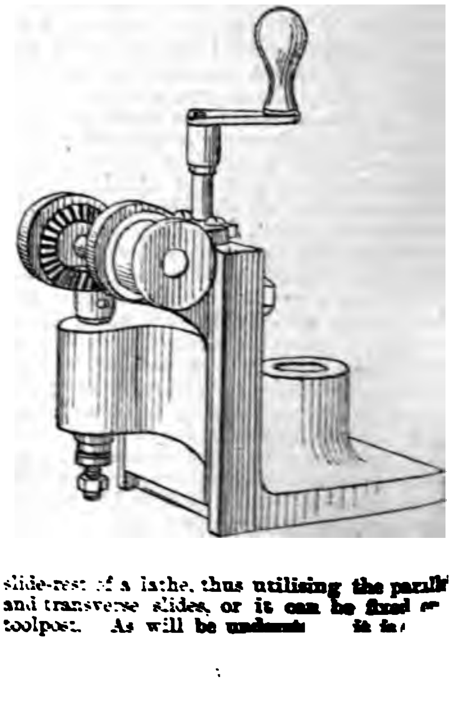
At exactly opposite diameters of the glass jar, two strips of tinfoil, about ½in. wide by 4in. long, are to be pasted *inside* the jar, reaching from a little above the middle downwards to the metal tray. The object of these is twofold: they increase the sensibility of the instrument by heightening the *apparent* repulsive effect of a charge; and they serve to discharge the gold leaves without tearing, if by inadvertence an overcharge be given. This being done, the brass rod may be fitted to its *table*. Many operators use a brass ball at the top of the gold leaf electroscope; for general purposes, a metallic table will be found more sensitive and more convenient. Having cut a tinned iron or thin brass disc 3¼in. in diameter, let the edges be turned in by hammering. To the centre of this metal disc, and perpendicular to it, should be soldered about 6in. of brass rod, having a small hole drilled in it at half its length—say, ⅛in. in diameter. Care must be taken that this rod is quite straight and smooth. The under portion of the disc, as well as the rod to within ½in. of its free extremity, should now be varnished with red varnish (see § 10) and set aside to dry. While this is drying, the upper wooden cap of the cylinder may be immersed in melted paraffin wax, and allowed to remain therein until thoroughly permeated with paraffin. The brass rod may now be passed into the central orifice in the "cap," and tightly fitted thereto by means of a roll or two of paraffined brown paper. (N.B.—When paraffin is mentioned in these articles, paraffin *wax* is understood, not paraffin *oil*). The rod must be pushed down into the orifice until the ⅛in. hole is just level with the top of the cap. A short brad, or similar piece of wire, pushed forcibly into this hole, will effectually prevent the rod sinking through, if any weight be afterwards placed upon the table above. A small, flat piece of brass, about ½in. long by ⅛in. square section, must now be soldered to the lower end of the rod, transversely to it, so as to form a letter ⊥. It is to this transverse piece that the gold leaves are to be attached. The gold leaves should be about ¼in. wide by about 2in. long. To cut them neatly is not an easy job for the tyro; still, it may be managed in the following mode:—

Having procured a clean half-sheet of note-paper, let it be folded down the middle. This is to be placed *open* close by the side of the book containing the gold leaf. Holding his breath for a few seconds, so as not to blow away the leaf, the operator slides the edge of the note-paper under the edge of one of the leaves of gold, and assisting operations with a pin point, or perfectly clean camel-hair pencil, coaxes the gold leaf so that it lies flat and square in the centre of the note-paper. He then covers it over with the bent half of the note-paper, so that the gold leaf lies between the two leaves of paper forming the half-sheet of note. Then, with a pair of perfectly clean scissors, he cuts the paper into strips, about ¼in. wide by 2in. long. In so doing, he must take care not to let the papers separate, otherwise his gold leaves will get crumpled or blow about. Of course, in cutting the paper, he cuts the gold leaf into the desired size. He then touches the two sides of the transverse piece of brass (attached to the rod passing through the cap of the electroscope) with the merest trace of gum, then carefully lifting the upper pieces of paper off the strips of gold leaf, takes up, first on one side, and then on the other (of the transverse piece), a strip of gold leaf, being careful that they hang straight down and parallel. Having succeeded in getting the two strips to hang squarely and free from one another, the operator next inserts them very cautiously into the chimney. The cap may now be cemented down on to the neck of the chimney by means of a piece of silk ribbon moistened with thin glue. When this is quite dry, and after the bottom has been likewise cemented to the lower end of the chimney or cylinder, a coating of red varnish is applied, care being taken not to stop up the side air-hole. This air-hole should be fitted with a small wooden plug, furnished with a rounded knob, likewise varnished.

A small quantity of Prout's elastic glue, run round the edge of the warmed tin will be found the most effectual way of fastening the bottom to the lower portion of the glass chimney or cylinder. Care must be taken that the two tinfoil strips are *opposite the width* of the gold leaves, and that the said strips make metallic contact with the tin bottom. If all has been carefully executed, the electroscope will present the appearance shown at Fig. F, and will be so delicate as to give a large divergence of its leaves, if a rubbed rod of sealing-wax is held at a distance of one foot from the "table," or upper plate

GEAR CUTTER FOR LATHE.

THE annexed engraving illustrates a gear cutter for lathe, which is being introduced by the Britannia Co., Colchester. As will be seen, the appliance is made to fix upon the slide-rest of a lathe, thus utilising the parallel and transverse slides, or it can be fixed on toolpost. As will be understood [illegible] its fa



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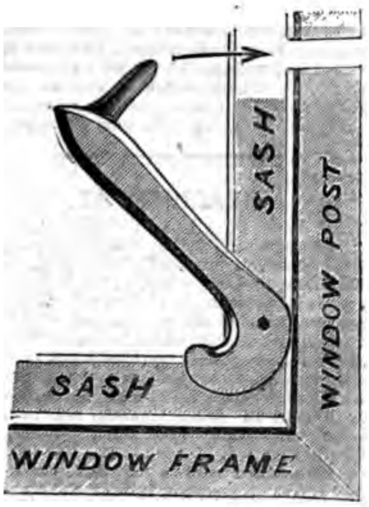
* [illegible]

from the overhead motion, and the milling tools and cutters of circular form are attached to the spindle and held firmly by the washer and nut. The vertical movement is obtained by means of the slide shown. The appliance is used for cutting the teeth of wheels on a lathe with a division plate; but it will be obvious that it can be utilised for various purposes—*e.g.*, for fluting taps, for cutting bevel and worm wheels, and it may also be made to do spiral fluting. This lathe accessory has been introduced at a moderate price, to meet the requirements of those who want to cut gear wheels with any desired number of teeth, and as will be readily understood, should be found a very useful appliance.

FELLOWS'S PATENT WINDOW GRIP.

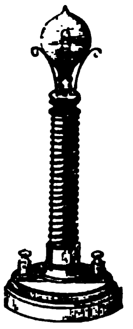
THIS simple appliance for sustaining window sashes without the aid of sash weights, patented by Mr. Charles Fellows, of Merridale-street, Wolverhampton, consists of an eccentric about 1in. diameter and ⅜in. thick, weighted with a lever. The grip is attached to the window sash by a common wood screw, on which it works freely, so as to fall by its own weight, and as close as possible to the window post in the position shown above. It offers no resistance to the window being raised, and to fix the sash at any desired height it is only necessary to press the lever slightly to the left, which drives the eccentric against the window post, jams the sash, and so prevents it descending. When it is desired to lower the window, the sash is held with the left-hand whilst the right hand lifts up the lever. This removes the pressure, and the sash can then be lowered, care being used not to let it fall suddenly. To fasten the lower sash when closed, the handle is simply moved to the right in the direction of the arrow, which shoots the arm or bolt into a socket cut for it in the window post. For the upper sash no fastening is required. As the eccentric prevents its *descent*, it of course prevents it being opened from the outside. The bolt, however, can be used, if preferred. The "grip" may be fastened to any part of the lower sash, but on the upper sash should be placed as high as possible. The price is nominal, and the whole cost of sash weights, cords, &c., is saved.



VARIABLE RESISTANCE INCANDESCENT LAMP-STAND.

TO the science teacher and experimenter this little stand, just brought out by Messrs. King, Mendham, and Co., of Bristol, is one of the most useful appliances ever introduced. It is designed specially for those who use battery power, no matter to what little extent, as a means for illuminating incandescent lamps. It very frequently happens that amateurs are not aware at the moment of the quantity of current that their batteries are giving, and [illegible] at hand for testing. The [illegible] [illegible] switching on the [illegible] to their lamp, they find to their dismay that, after lighting up most brilliantly for a few seconds, it suddenly collapses into total darkness—in fact, fused by the too liberal supply of current.

The stand is so arranged that a small collar, sliding up and down the stem, causes more or less of a quantity of German-silver wire, coiled round, to come into the circuit, thus introducing a *variable resistance* between the battery and the lamp. The collar, when at the bottom switches off the current. The advantages of a stand such as this cannot be over-estimated. By its means the life of many a lamp may be usefully prolonged which in very many instances, is prematurely cut short by inexperienced treatment.

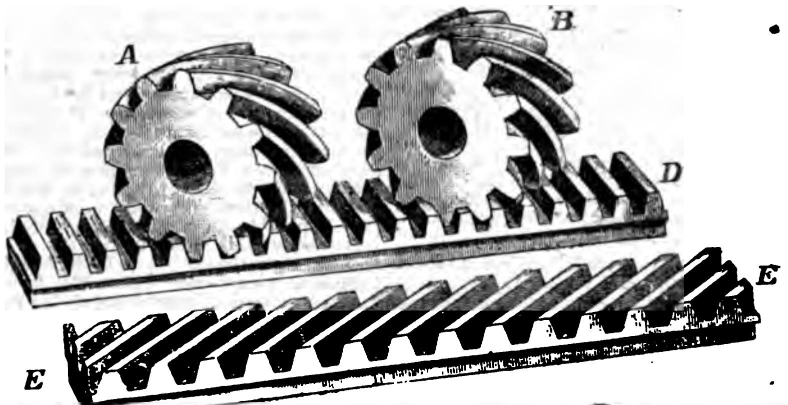


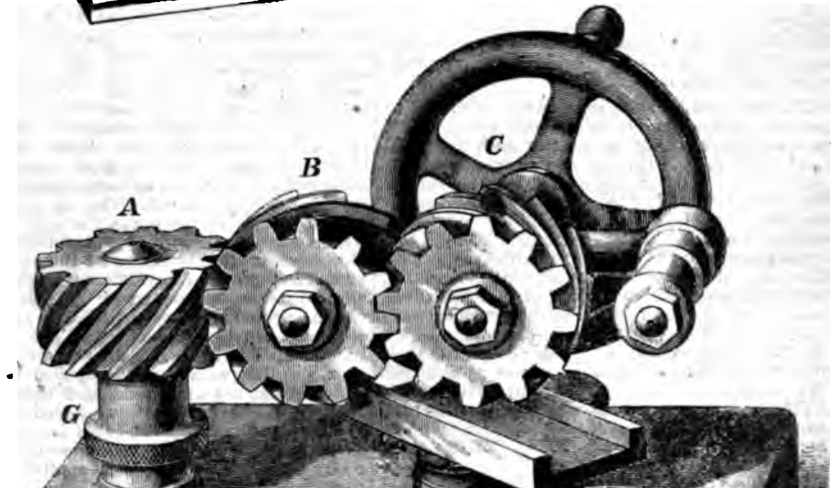
SPIRAL GEARING.*

WHILE making some experiments with spiral gears, and constructing a model for the Brown and Sharpe Manufacturing Co., I have noted down a few points that may be of general interest. When the teeth of a gear are cut, not in a straight path, like a spur gear, but in a helical or screw-like path, the gear is called, technically, a twisted or screw gear, but more generally, among mechanics, a spiral gear. A distinction is made between a screw gear and a twisted gear. In twisted gears the pitch surfaces roll upon each other exactly like spur gears, the axes being parallel. In screw gears there is an end movement, or slipping of the pitch surfaces upon each other, the axes not being parallel. In screw gearing the action is analogous to a screw and nut, one gear driving another by the end movement of its tooth path. This is readily seen in the case of a worm and worm-wheel, when the axes are at right angles, as the movement of wheel may then be said to be wholly due to the end movement of worm-thread. But, as we make the axes of gears more nearly parallel, they may still be screw gears, but the distinction is not so readily seen. We can have two gears, that are alike, run together, with their axes at right angles, as at A, B, Fig. 2. The same gear may be used in a train of screw gears, or in a train of twisted gears. Thus, B, as it relates to A, may be called a screw gear, but in connection with C, the same gear B, may be called a twisted gear. These distinctions are not usually made, and we call all helical or screw-like gears made on the Universal Milling Machine, *spiral gears.*

In making these gears, we devised a method that we think is new. The teeth of these gears are of the involute form, commonly called single curve. Theoretically, a rack to run with involute gears should have teeth with straight sides, as in the two racks, Fig. 1. For our system of involute gears, the sides of rack teeth incline to each other at an angle of 29°, or what is the same thing, the teeth sides are at an angle of 75½° with the pitch line of rack. Acting upon this principle, we arranged to plane the teeth of the three spiral gears, Fig. 2, on spiral mechanism of one of our Universal milling machines. Instead of using a rotary cutter we took a planing tool that accurately fitted the space between teeth of rack, as seen in D D, Fig. 1. The tool moved diagonally across the face of gear in a straight path tangent to spiral at the pitch surface, the spiral mechanism being set to the proper angle, which, in this case, was 45°. The tool was set to the full depth to be cut at one operation, and the gear cut all round without changing tool. The gear was fed up to the tool by the spiral mechanism, the same as is done when using a rotary cutter. By this method each gear was an *original* one, and all sizes of spiral gears having the same pitch, can be cut with a tool of the same shape.

The rack D D, Fig. 1, is of regular form, the depth of teeth being $\frac{11}{16}$ of the circular pitch, nearly (P′.6866 accurately); or, what is the same thing, two diameter pitches plus $\frac{1}{10}$ of the thickness of tooth at pitch line. If a section of a tooth in either of the gears be made square across the tooth, that is





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* By O. J. Beale, in the *American Machinist*.

a normal section, the depth of the tooth will have the same relation to the thickness of the tooth, as in the rack just named. But the teeth of the spiral gears, looking at them upon the side of the gears, are considerably thicker in proportion to their depth, see Fig. 2. The same difference is seen between the teeth of the two racks D D and E E, Fig. 1. In the rack D D we have 20 teeth, while in the rack E E, which is the same length as D D, we have but 14 teeth. Yet each rack will run with each of the spiral gears, but at different angles. The teeth of one rack will accurately fit the spaces of the other rack face to face, but the sides of the two racks will then be at an angle of 45° with each other. The shortest distance between the centres of two contiguous teeth, or the normal distance, is called the *normal pitch*. In the gears, this distance is measured upon another spiral, perpendicular to the spiral path of the teeth. Now, in the rack D D the circular pitch and the normal pitch are the same, but in the rack E E the normal pitch line is at an angle of 45° with the side of the rack.

When the normal pitch does not coincide with the circular pitch, it is less than the circular pitch. This means that a gear, say 4in. pitch diameter, 12 teeth, 3in. diametral pitch, would not be cut with a 3in. pitch cutter. In the gears shown, the circular pitch is 1in., while the normal pitch is but ·707in., or less than ¾in.

A guide for holding racks is seen at F. This guide can be moved to any angle with shaft C, up to 45°. The gear A, Fig. 2, rests on the sleeve G, which is threaded so that A can be raised or lowered.

We have examined the two gears, A and B, to determine whether they run with equal angular velocity at all places. The gears were graduated into 216 parts, which gave, as there are 12 teeth in each gear, 18 points of observation as a gear turned through its pitch arc. By raising the threaded sleeve G we have another set of points for observation, because, when B is held stationary, and A is raised or lowered, A will turn on its axis in proportion as it is raised or lowered, thus changing the relative position of the gears A and B. Two microscopes of pretty high power were used, but no variation in the relative angular velocity of the two gears A and B was found. This proof is experimental, and not mathematical, but for practical purposes, we would accept it. It rests upon the same kind of evidence that we would have in saying that two pieces were the same size, after having found them so by measurement. Having tried a sufficient number of cases we might, by induction, establish the law that all spiral gears made upon the system described would work together with a constant velocity ratio. We would expect that any two gears that worked correctly with a rack, made upon the system shown, would work correctly with each other. Then, if the gears ran together without backlash, we would accept them without further trial.

Gears arranged like A and B, Fig. 2, have contact in points only, and for heavy work might wear somewhat rapidly. Spiral gears also have end thrust, but, of course, no more than a worm and worm wheel of same tooth angle. Generally they have considerably less tooth angle than a worm, and hence less end thrust.

The action of spiral gears is generally very smooth and noiseless. This makes them somewhat desirable for quick-running machinery. As already implied, they can also be used for driving shafts at an angle with each other.

The angle which tooth sides makes with axis of gear is called *angle of spiral*. When two gears are both of right-hand spiral teeth or both have left-hand spiral teeth, the angle of their shafts will be equal to the sum of the angles of their spirals. But when two gears have different hand spirals, the angle of their shafts will be equal to the difference of their angles of spirals. Thus, in Fig. 2, the gears A and B both have right-hand spirals. The angle of both spirals is 45°, their sum is 90°, or their axes are at right angles. But C has a left-hand spiral of 45°. Hence the difference between angle of spiral B and C is 0, or their axes are parallel. Had A and B left-hand spirals, their relative direction of rotation would be reversed. When the centre distance of two shafts is variable, a greater range can be had with spiral than with spur gears. This sometimes makes them desirable for driving rolls when the widest possible range is wanted.

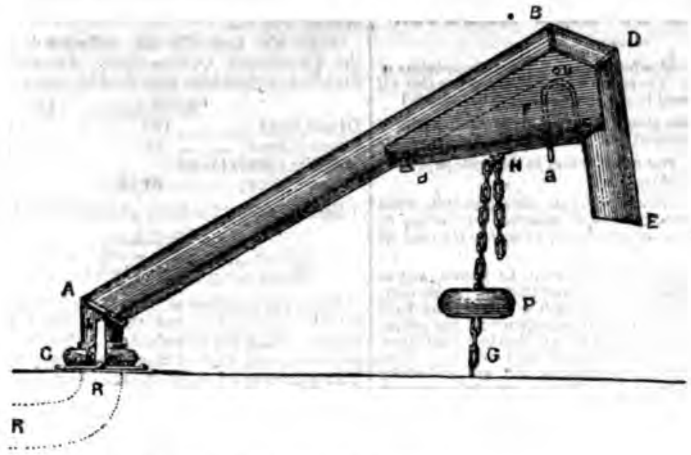
The end thrust on parallel shafts is sometimes avoided by combining a right and a left-hand gear on the same shaft. When the gears are cast, the two parts can be made solid. Such a combination is called "Herring-bone" gearing. In these gears the end adjustment must be accurate, so as to have both parts of the gears in action at the same time, or one shaft only need have shoulders or collars to prevent end motion. The herring-bone gears would prevent end movement of the other shaft. This kind of gear has sometimes been preferred for flour-grinding machinery.

MODERN EDUCATION.

In an introductory lecture in connection with the Medical department of the Yorkshire College, Mr. Jonathan Hutchinson, F.R.C.S., made some remarks on education which deserve careful consideration. Speaking of the uses of knowledge, he compared life to an evergreen, and said that we live in the most liberal manner upon the past, and are what we are in virtue of its former life, just as each successive generation of the leaves of the mighty pine has taken up the work of its forerunners, and, eager to do and die, has in turn submitted to the same fate. The result has been increasing growth and perpetual youth. There has been a permanence of life amidst unceasing change. The life that seems to be lost is simply transferred to others. The human tree, however, differs from the pine in this respect, that not only do generations of men inherit from the parent stock their life-vigour and its tendencies, but they are capable of receiving by direct communication with their predecessors a vast wealth of impulse and power which has not yet assumed a form in which its acquisition by inheritance is possible. The communication must be voluntary, and to it has been given the name of education. In Mr. Hutchinson's opinion, the law of limitation, in reference to memory, is not sufficiently taken into account in dealing with education. We cannot, he says, put in more than a certain quantity. Do what we will to improve our faculties, sooner or later a limit is reached, and we are then compelled, however reluctantly, to choose what we will keep and what we must surrender to oblivion. He would let those who had leisure, or industry, or special aptitude, cultivate to the utmost special sciences; but whether it is better to aim at a superficial acquaintance with many subjects, or a detailed familiarity with one or two, he unhesitatingly recorded his vote in favour of an acquaintance with things in general. Having exalted knowledge, and claimed for it that it is the seed of that plant of which wisdom and love are the flower and the fruit, and described the teacher, whether working alone in a parish school, or as part of a great collegiate organisation, as engaged in the noblest vocation of man, the lecturer reminded his hearers that he had been speaking not of the kinds of knowledge which are obviously useful in the affairs of daily life, but of those which men and women may get or not as they like, and which are usually considered matters of personal pleasure and social adornment. Surely we ought to rank some knowledge of astronomy, geology, botany, natural philosophy, human history, and the like as essential to the formation of character. If the truths that they teach are once ingrained in the mind, so as to become the bases of all its processes, the person concerned has become capable of meeting the changes of life with patience; he has learnt the best of all lessons—the doctrine of continuity. It was impossible for him to despair of the world's progress, or think lightly of the value of individual work. Upon the subject of Latin and Greek, Mr. Hutchinson expressed emphatically his conviction that as a matter of general knowledge it is a great waste of time and memory to teach them. He considered that the study of a language was for the most part a mere matter of rote memory, and that it encumbered rather than strengthened the mind. When Homer, Virgil, Tacitus, and Cæsar should cease to be school books, and when it should be held not discreditable to be acquainted with them in translation only, a sound knowledge of them would probably become a far more general possession than at present. The student unacquainted with Greek and Latin was at an immense disadvantage in reading in the sciences, as the textbooks teem with words derived from those languages. Still, a good vocabulary was sufficient, and there was no need to study grammatical construction in detail. The use of terms taken from the dead languages was the mere survival of a bad custom, from which we should free ourselves. Never would the knowledge of the sublime facts of science become as wide as it ought until we effected reform in this matter. The terms in many instances could be expressed as easily and far more elegantly in English, and the gain would be immense. The mind unconsciously associated its own meaning with words compelled to be used which it did not understand, and thus often was not only left ignorant, but was actually led astray. A high-sounding name also often led us to believe that our knowledge was far more definite than it really was. The objection applied chiefly to descriptive names, and especially to appended adjectives At the present stage of the world's progress the dead languages were far from being our most important acquisition; and the custom of exacting it was a great bar to real mental development. In connection with this subject, he noted with pleasure that some of the leaders of the medical profession in Leeds had recently had the courage and common sense to break through the mediæval practice of writing presciptions in so-called Latin. The learning of modern languages also was far too much insisted on. Time and labour consumed upon them would be better bestowed on other subjects. He did not believe the acquisition of a new language to be easier in youth than in adult age; and respecting modern languages, he suggested delay in learning them until a definite need for them had been realised. He did not decry any branch of learning, applauding at a distance the declaration of Bacon, "I take all knowledge to be my portion." But we should put a right relative value on things, and not waste time and labour in planting laurel bushes in mistake for apples; we must distinguish between knowledge which is fruit-bearing, and that likely to prove barren, however ornamental and fashionable it might be. In the development of objective teaching the formation of educational museums and the improvement of educational examinations were essential. The medical profession had always taken a large share in the formation of museums. Hitherto, though, they had been mainly collections of elements of proof too unwieldy in extent and too miscellaneous in character to be within the grasp of the general student. We wanted them specially arranged for the students, the specimens few in number, and by the aid of label and catalogue telling their own tale. It was to be hoped the time would soon come when every town, however small, and every school would have its collection of objects illustrating the history of man and the natural sciences. These should be places where teachers would take their pupils, not once a year as a holiday outing, but frequently, and as the best method of serious study. What, indeed, hindered that every enclosed city square should be open to all, and that it should contain a ministure collection of suitable zoological and botanical objects, a conservatory, and a museum? As to the methods of examination, they should be employed to encourage industry and the acquirement of retainable knowledge; and they should much less than at present offer incentives to mere cramming. They should be more certain in their results, take a more accurate measure of those submitted to them, and their verdicts should be less liable to question and criticism on the part of teachers and lookers-on. These desirable objects would be attained only by making examinations more objective, and by taking more time for them.

SEALING WAX.

The basis of all the different varieties of sealing wax is shellac and Venice turpentine, and the different qualities of the product—called in the trade, fine, superfine, extra superfine, &c.—are made by selecting in the manufacture the different qualities of the several ingredients. Fine red sealing wax—that which is commonly used—is made as follows: Melt cautiously 4oz. of very pale shellac in a bright copper pan over a clean charcoal fire at the lowest degree of heat that will be necessary to melt it. When melted, stir in 1¼oz. of Venice turpentine (previously warmed), and follow it with 3oz. of vermilion. The heat should be so maintained as to be just sufficient to permit of the thorough incorporation of the constituents. When this has been done, the fluid mass is discharged into metallic moulds and allowed to cool. To facilitate the melting of the shellac some makers prefer the addition of a little alcohol. Another recipe is: 3lb. of shellac, 1¼lb. of Venice turpentine, and 2lb. of finest cinnabar, mixed and manipulated as above. To produce the beautiful polished surface characteristic of sealing wax of commerce, the sticks are removed from the moulds in which they are cast as above, and placed in other moulds of polished steel, which may be engraved with the name or brand of the maker, and with any desired ornamentation. These moulds are heated just enough to melt the surface of the sealing wax, and the sticks thus acquire, when cooled, a beautiful glossy surface. This operation can be readily accomplished with a spirit lamp. A common, cheap sealing wax is made by using 4lb. of resin, 2lb. of shellac, to which are added, when melted, 1½lb. each of Venice turpentine and red lead. The different colours are obtained by the incorporation of different pigments, thus, fine black, by adding a sufficient quantity of ivory black to the first recipe; common black, by adding sufficient lamp black to the second recipe; gold coloured, by incorporating bronze powders of suitable shade; yellow, by colouring with orpiment; light brown, by incorporating a mixture of two parts of brown ochre and one part of vermilion; blue, by incorporating mineral blue, indigo, or Prussian blue in sufficient quantity; green, by using a soluble mixture of orpiment and mineral blue. To perfume sealing wax, add to the ingredients, when somewhat soft, and incorpo thoroughly, one per cent. liquid storax or bals Peru; a little musk essence or ambergri answer the same purpose. The latest [illegible] the sealing wax craze is a cabinet conta tapers, a miniature metal ladle [illegible] and a small wax balls, looking [illegible] the various coloured pills. T [illegible] e is



pills is put in the ladle, which is held per, and when the wax is hot it is poured of the envelope.—*Manufacturer.*

L'S AUTOMATIC SIPHON.

N, at an elevated point in a meadow, ere exists a spring or vein of water that itilised at a distance, either because the ot sufficient, or because of the perme- he soil, it becomes very advantageous to the water in a reservoir, which may be om time to time through an aperture gh to allow the water to flow in abund- ll parts of the field. The storing up of permits of irrigating a much greater d, and has the advantage of allowing the o be effected intermittingly, this being n if it were done continuously. But of irrigating requires assiduous atten- necessary, in fact, when the reservoir is and raise the plug, wait till the water has and then put in the plug again as accu- ossible—a thing that it is not always . The work is a continuous piece of and takes just as much the longer to do ion as the reservoir is more distant from ling. In order to do away with this in- ce, Mr. Giral, of Langogne (Lozère), *nie Civil*, has invented a sort of movable at primes itself automatically, however the spring that feeds the reservoir in is placed. The apparatus (see figure) f an elbowed pipe, C A B D E, of gal- on, whose extremity, C, communicates utlet, R, where it is fixed by means of a rubber of peculiar form that allows extremity, B D E, to revolve around K, while at the same time keep- outlet pipe hermetically closed. ber, whose lower extremity is bent the bell of a trumpet, forms a washer ich there is applied a galvanised iron s fixed to the mouth of the outlet pipe by six small screws. This ring is provided studs, which engage with two flexible K and L, that are affixed to the siphon vets. These studs and thimbles, as well ews, are likewise galvanised. Between es, A B D E, of the pipe there is soldered galvanised iron, which forms isolatedly a or air-chamber, F, that contains at its t a small aperture, *b*, that remains always at its lower part, a copper screw-plug, *d*, anised hook, H. In the interior of this here is arranged a small leaden siphon, ose longer leg, *a*, passes through the here it is soldered, and whose shorter one, close proximity to the bottom. Finally, sed iron chain, G H, fixed at G to the the reservoir, and provided with a weight, anised iron, is hooked at H to the siphon s it to rise more or less, according as it is eater or less length. From what precedes, seen that the outlet is entirely closed, so der that the water may escape, it must the pipe in the direction, E D B A C. ted, let us see how the apparatus works: e as the water rises in the reservoir, the dually loses weight, and its extremity, B D ly lifted by the thrust, so that the entire lves upon the studs, K, until the chain nt. The apparatus then ceases to rise; but ever continuing to rise, finally reaches b, of the smaller siphon, and through it air-cham[illegible] and fills it. The equili- ng thus [illegible] on descends to n, bec[illegible] ies the reser- n the [illegible] descending [illegible] this [illegible] aber F in turn, so that, at the moment the large siphon loses its priming, the entire apparatus is in the same state that it was at first. In short, when the water enters the reservoir, the siphon, movable upon its base, rises to the height at which it is desired that the flow shall take place. Being arrested at this point by the chain, it becomes primed, and sinks, and the water escapes. When the water is exhausted, the siphon rises anew in order to again sink; and this goes on as long as the period of irrigation lasts. This apparatus, which is simple in its operation, and not very costly, is being employed with success for irrigating several meadows in the upper basin of the Allier.

MAGNETISM IN WATCHES.

SOME very pretty experiments, showing the effects of magnetism on the steel parts of a watch, can be very easily made, as follows:—Take a glass of water, a balance-wheel, and an ordinary magnet, say 12in. horse-shoe. The balance-wheel will float if carefully laid on the surface of the water. Bring the magnet near it, and it will be attracted, repelled, or revolved, as the different poles are brought to bear, and when the magnet is removed to a distance, the balance will arrange itself in the north and south polarity the same as a compass needle. A hair spring will float in the same way, and is much more sensitive to the magnetic influence—the delicate lines of steel are alive to the slightest change of polarity, as exhibited by the magnet, and if left free it will immediately arrange itself in the north and south line. Also the fork, the regulator, or any of the flat pieces of steel can be made to float (care being taken that they are dry and carefully laid upon the water) and their antics under the magnetic influence are very amusing, appearing "like things of life" as they "'bout face," turn sharp corners, or "scoot" across the surface of the water in obedience to the attracting force. It will be noticed that the finer finished pieces of steel, and those with the finest points, are much the more sensitive, thus demonstrating the assertion that the finer the watch the more susceptible it is to magnetism. These simple experiments, which any watchmaker can readily try, show why and how a watch, when once magnetised, is affected by varying influences of magnetic or electric conditions. The parts are each attracting the other; but with a varying force as the position of the watch is changed, or brought into an atmosphere more or less charged with magnetic or electric forces. Some such simple investigations as these may furnish a key to mysteries which have long puzzled many skilful watchmakers, and will account for the unsatisfactory performance of watches, otherwise perfect.—*Watchmaker and Metal-worker.*

Preserving Dahlias.—If you have not a cellar or a frost-proof shed, in which to keep your dahlia roots through the winter, you may store them in a clamp in the same way as potatoes are kept. Select a position for the clamp in the full sun, make the surface firm and level, then pack the roots close together, and cover them with plenty of dry straw; and then the whole must be covered with earth 8in. or 10in. thick. The roots will come out much drier in the spring if the clamp is thatched all over with straight straw to keep off the rain.—***Amateur Gardening.***

MESSRS. BOLCKOW, VAUGHAN, AND CO. have come upon a thick bed of salt at their bore-hole near F[illegible] Jetty, to the east of Middlesbrough. The[illegible] ched at a depth of 1,550ft., and al[illegible] been pierced through without re[illegible] of the bed.

SCIENTIFIC NEWS.

THE death of M. Charles Robin, the eminent histologist, is announced from Paris. He had been Professor of Histology at the Faculty of Medicine since 1832, and was in his 65th year. In 1871, he worked with Littré in founding the Society of Sociology, and by his death the Senate loses all but the last of its scientific men.

A small planet, No. 251, was discovered by Dr. J. Palisa at Vienna on the 4th inst., raising the number of those found by him to forty-nine.

The observations of Prof. Asaph Hall of the two outer Satellites of Uranus, to which we referred last week, were commenced in 1881 and continued to May, 1884, through the four oppositions of the planet. The inner satellites are very faint objects, and can be observed well only on good nights, which do not occur often at the time of the year Uranus now comes into opposition. Prof. Hall, however, says that it is doubtful whether observations of the inner satellites can add much to our knowledge of the mass of the planet, or to the accuracy of the position of the orbit-plane of the satellites. Oberon and Titania are easily seen in fair conditions of the atmosphere with the Washington 26in. refractor, and Prof. Hall for his observations used achromatic eyepieces magnifying 606 and 888 times. The mean result of the observations in 1875 and 1876, and 1881-1884, give the mass of the planet as $\frac{1}{22603}$ (from Oberon data) and $\frac{1}{22813}$ (from Titania data); or, combining these results by "weights," the final result is mass of Uranus = $\frac{1}{22682}$, which is smaller than any found before, but is a true deduction from the measurements. No new satellites were found, although special searches were made on several fine nights.

Prof. Hall, in the appendix referring to the Satellite of Neptune, says that on favourable nights during 1881-1884 he made several examinations of the region, but found nothing. In an average condition of the atmosphere the satellite is an easy object to measure in the 26in. whenever its distance is greater than 10″. The apparent orbit is becoming more nearly circular, and after a few years the satellite can be observed accurately in all angles of position. The mass of Neptune from Prof. Hall's observations is $\frac{1}{19380}$, and the periodic time of the satellite is 5·876339 mean solar days.

We have received "Nouvelles recherches sur L'Aggrandisement apparent des Constellations, du Soleil, et de la Lune à l'Horizon," a paper by M. Paul Stroobant presented to the Belgian Academy of Sciences, accompanied by the reports of M. Van der Mensbrugghe and M. Montigny, who both advised its publication in the Bulletin of the Academy. Extracted and printed in pamphlet form, it is now published by F. Hayez, Rue de Louvain, 108, Bruxelles.

Mr. Twining has issued (Griffin and Sons, Garrick-street, W.C.) "Science for the Middle and Upper Classes," a suggestive memorandum for the consideration of persons interested in educational progress. Its keynote is "simplicity" in terminology, Dumas being alluded to as expressing himself to the effect that the complexity and uncouthness of modern chemical nemenclature were something gigantic, and that he found it impossible to keep pace with all the new theories and verbal alterations which were flooding his favourite science.

The chair of Agriculture and Rural Economy in the Royal Agricultural College, Cirencester, vacant by the removal of Prof. Wallace to Edinburgh, is to be filled by Mr. W. M'Cracken, of Greenleighton, Northumberland.

The inaugural address of the fifteenth session of the Durham College of Science was delivered last week by Prof. J. H. Merivale, M.A., who, after describing what had been done and what it is intended to do in the general work of the college, alluded to the necessity for universal science teaching and for the thorough training of mining engineers. According to Prof. Merivale, "the present system of technical education in England is in much the same state as was medical training some fifty years ago."

During the Congress of the Amalgamated

Society of Railway Servants, Mr. C. E. Stretton delivered a lecture on the "Past History of Railways," illustrated by models, and in the course of his remarks stated that there were fifteen brakes in use; but practically automatic air-pressure and automatic vacuum brakes were the two that deserved attention. Mr. Stretton gave an account of a run on the L. and Y. railway to examine the working of the latest form of vacuum brake, which appeared quick in action and automatic. No opportunity occurred to witness an "emergency stop." From the report of the general secretary, we find that the name of Mr. Stretton was suggested to the Board of Trade by the secretary of the society as a suitable candidate for the vacancy caused by the death of Col. Yolland, and in reply it was stated that the vacancy would not be filled up.

At the recent meeting of the North of England Gas Managers' Association, Mr. W. Hardie, in delivering his presidential address, stated that Dr. Sadler, of Middlesbrough, had discovered a method of economically using creasote and other common oil as fuel. Mr. Hardie said:—"After a series of experiments extending over some months, Dr. Sadler had the good fortune to hit upon a simple and effective contrivance, which not only burnt the oil without smoke, but produced caloric effects far in excess of anything that had ever been achieved before. Under the best circumstances, he is able with one ton of oil to do the work of three tons of coal; and under ordinary circumstances he can produce the effect of two tons of coal with one of oil. The apparatus is self-contained, and consists of a small super-heater for the steam, and an arrangement for admitting hot air by the suction of the injector, and a small pipe which conveys the oil; and the total cost complete does not exceed 30s. The extraordinary results obtained can only be due to the decomposition of the steam and its combination with the oil." It appears that the apparatus is chiefly intended for heating the retorts at gas factories; but it is a pity that more details were not given.

The International Industrial Exhibition at Edinburgh is now fixed for opening on May 4, 1886.

The opening of the Telpher line at Glynde has been unavoidably postponed.

The National Fish Culture Association have made arrangements for importing a large consignment of carp from Germany with the view of acclimatising the fish in the rivers and ponds of the United Kingdom. The German carp are said to be much superior to the species inhabiting our waters, and numerous applications have been received for supplies from many quarters.

An ingenious form of insulating stem for experiments in static electricity has been devised by M. Fonvielle. He uses a hollow rod of glass and inserts a spiral of platinum wire, which, being rendered incandescent by means of a small bichromate battery, heats the stem and keeps it dry—thus insuring perfect insulation.

An extraordinary aërolite seems to have fallen near Pittsburg, Pennsylvania, on Sept. 26. The "Earth Shaken by a Meteor" is the heading in American papers; but the shock was evidently alarming. A farmer near Sewickley saw the meteor pass through the air at great speed, and disappear southward. He described it as being "large as a barn door." At Middletown, Pennsylvania, it was reported to be the size of a tin cup. In passing over the town it burst, and detached pieces fell to the ground. It is reported from McKeesport, 14 miles south-west of the city, that a piece of the meteor, still hot, was discovered in a clearing in the woods. An Allegheny man, while walking across a field at McKee's Rocks, just outside the city and in a south-west direction, stumbled against a fragment of the meteor, which was also hot. It was sent to Prof. Zingley, professor of geology at Allegheny College, Meadville.

The chief geographical societies in Germany have resolved to erect a monument to the late Dr. Nachtigal, on Cape Palmas, where he lies buried—a monument so large as to serve as a landmark to seamen.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

MESSIER 31 AND NOVA 1885 ANDROMEDÆ.

[24879.]—MR. J. RAND CAPRON (letter 24849, p. 121), when he returns home, will find, on consulting Admiral Smyth's drawing of M. 31 Andromedæ, on p. 15 of the Bedford Catalogue, Vol. II., that the cluster of small stars to which I referred are on the *n. f.* side of the nebula, though, as he showed them, they were not projected on the nebula; but, as seen by me with the 4·3in. equatoreal and 69 power, they appear involved in it.

The Nova was about 10 magnitude on the 10th inst., and of a bluish cast, whilst to me it appeared to be yellowish when at its brightest early in September.

Those observers interested in double stars might examine a little triagle of 8½ to 9½ stars which have *comites* near them of more or less difficulty, and I shall be glad to learn the result in these columns. They are just *north* of H V 18 Nebula, which lies in the same low power field with M. 31 Andromeda.

Belfast, Oct. 12. **I. W. Ward.**

THE NOVA IN ANDROMEDA.

[24880.]—CAREFULLY examining Heis's splendid maps of the Milky Way, there is just a faint trace of its extending over the nebula. Upon searching the spaces concentric with the Nova, the brilliant clustering of minute stars all round suggests that we see in the field a faint cloud of Galaxy stars, overspreading the nebula, and distributed abundantly in its region. The old nucleus, it is known, showed a slight granular structure; but the Nova, appearing of the 7th magnitude, dazzles the eye, and renders the Nebula itself very faint by contrast; and with a large aperture, our English skies are seldom favourable to minute observations.

However, once this year I saw the companion to Sirius very distinctly; several minute stars near Vega; three stars immediately following the Ring Nebula, and one brighter star of 14th magnitude. The preceding edges of the wreath appeared thicker and brighter. D'Arrest only saw two of the three, whilst Webb says the American achromatics of 18½in. and 26in. aperture showed none of these stars. All the satellites of Saturn were also seen in the Eastbourne sky. On the whole, therefore, the climate and the glass at times admirably suit each other. I mention these facts to show that the rich region of minute stars covering this nebula is a suitable field for my 18¼in. Calver.

Weather permitting, I hope to see more into its structure. It is very remarkable, notwithstanding clear starlight, how the visibility of the smallest stars is affected by atmospheric changes; even at the Cape, Sir J. Herschel found all kinds of gyrations, fluctuations, expansions, and quiverings developed most capriciously, and in observing minute stars down to the 20th magnitude, the variability in their visibility is surprising.

Sir John's 18in. speculum-metal reflector and speculum flat could not give as much illuminating power as silver-on-glass reflectors; and, I suppose, for this reason his drawing of the great nebula in Orion was rather speckled than mottled into many brilliant patches, as seen in Lord Ross's 6ft., and in my 18in. silver on glass. [Sir John's 18in., 324 circular inches is reduced to 45 from 100 by two metallic reflections. 18¼in. silver on glass, 333 circular inches reduced to 82 from 100, so the quantity of light in the two is, for

18in. Sir J.'s reflector 324 × 0·45 = 145·8
18¼in. Calver 333 × 0·82 = 273· nearly,

which amounts to nearly double the light, and this explains many points which have greatly puzzled me in Sir John's reports.] Sir J. figured also only one star as preceding the Ring Nebula, whilst the 18in. here shows three minute stars following it. It is interesting to compare the quantity of light given by metallic and silver reflections in the following way.:—

Take Mr. Lassell's 2ft. reflector bequeathed to the Greenwich Observatory. According to Dr. Steinheil, reflections may thus be estimated—

	Brilliancy.	Loss of Light.
Direct light	100	0·0
Silver mirror	91	9·0
Metallic mirror (Lord Rosse alloy)	67·18	32·82

Second reflection from plane mirror:—

Brilliancy.
Silver ...... 91 × ·91 = 82 nearly.
Metal alloy 67·18 × ·6718 = 45 nearly.

Now, the number of circular inches in the Lassell 2ft. reflector is 576, and that of the 18¼in. is 333 nearly. The light reflected twice is reduced 55 per cent., and that of the silver 18¼: 18 per cent. The quantity of light in the Lassell and Calver, then, is, respectively—

as 576 × 45 : 333 × 82
or 7 × 45 : 4 × 82
or as 315 : 328

If both, therefore, were at their highest polish, the quantity of light in each would be nearly equal.

This calculation leaves a favourable impression on one's mind as to the powers of the two instruments, and encourages further research when the nebula is southing without moonlight.

G. W. Royston-Pigott.

THE VARIATION IN THE ANDROMEDA NEBULA.

[24881.]—THE stellar nucleus in the Andromeda nebula, was observed as soon as the news was received. On Sept. 1st, it was watched at intervals from 8h. 30m. to 11h. 15m. (75th meridian time), and again on Sept. 2nd, from 8h. to 9h. 15m., both nights being clear. On the first night it was so much brighter than what I expected to see that I am satisfied its brightness was overestimated by me, being put down at about 5th. But on the next night, when it was apparently of the same brightness, and when I had my maps at hand to identify the comparison stars, I satisfied myself that it was certainly no brighter than the 7th magnitude. From a careful series of comparisons made it is just about equal to a star that I afterwards identified as D.M. + 39°, 158, 7·0 magnitude, according to Argelander.

Owing to cloudy weather and a short spell of sickness, I was unable to observe it with the telescope again until the 9th inst.; but it had then faded fully two magnitudes. Two stars near at hand were estimated to be of nearly equal brightness to the nucleus. These were afterwards identified as D.M. + 40°, 145, 9·0, and D.M. + 40°, 149, 9·1 mag.

It was then thought to be "dull, though still very distinct from balance of nebula"; but this, I suppose, was due to the fact of not having seen it since the 2nd, and still retaining something of its former brightness in my memory. It then seems to have hung around about the 9th magnitude for some time; but about the 23rd inst., my notes seem to make it rather nearer to D.M. + 40°, 148, 9·5 mag. The night was extremely clear, and although the moon was full, two other comparison stars, between D.M. + 40°, 145, and the great nebula, were plainly visible with p. 60, and one of them with p. 25 steadily. Neither of these stars, however, are in the D.M., and I have not been able to identify them. One I estimate slightly under the 10th, and the other between 10½ and 11th magnitude. Within the last few days the nucleus seems to have dropped to about the 10th, although still very distinct at times. After its brightness had dropped below the 9th, estimates became more difficult, owing to the brightness of the condensation in nebula. It was difficult to separate the nucleus from the bright background upon which it was seen, and the eye would unconsciously retain an impression of this background while running back from star to nucleus. The only way I could avoid this bias was to try to concentrate my attention upon the nucleus, to the exclusion of the condensation, and then, having acquired a conception of its brightness, jump rapidly to the comparison star. When the definition was good this could be done pretty readily; but sometimes, owing to "execrableness" of the definition, the comparison star would be in a very bad condition for comparison, and then the observation would have to be gone over again. There appeared to me to be one peculiarity about the nucleus. After it had diminished to about the 9th magnitude or under, its intrinsic brightness seemed to equal stars of about the same magnitude, whereas on Sept. 1st and 2nd it was much larger. It had a rather flat and [illegible]gular look, and did not impress me as [illegible] of equal magnitude. It rather [illegible] stellar nucleus that formed so [illegible] Pons-Brooks comet, and wh[illegible] me on the night of January ever, may have been due to its shining through the nebula, but at the time it did not impress me as a star-point. It was *stellar* in the sense of being perfectly distinct from the nebula, but not *star-like*. The above observations were made with my 4in. Cooke.

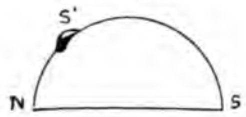
W. H. Numsen.

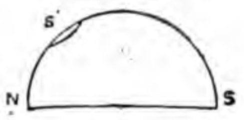
Baltimore, U.S.A., Sept. 29th.

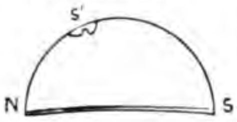
SUSPECTED WHITE MARKINGS ON MERCURY.

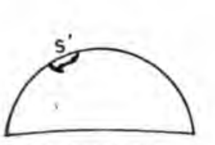
[24882.]—DURING the approach of the planet to eastern elongation from the 17th to 25th July, a decided white marking was noticed on the planet's bright disc, at about from 65° to 80° near, and on limb measured from the terminators (*South*, as seen inverted) north point round bright limb.

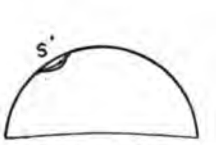
The accompanying diagrams will roughly point out its positions on different days.

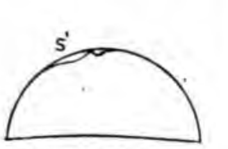

July 17, dusk.

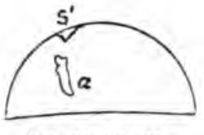

July 19, 11h. 30m.


July 21, 12h. 40m.


July 22, 12h. 30m.


July 23, 11h. 56m.


July 24, 13h. 14m.


July 25, 12h. 25m.

Time given is Rolfontein sidereal time. S' marks the suspected white markings, rather exaggerated on the diagrams, which are in themselves rough. July 25, *a*. A suspected white streak. N and S' are true north and south, not as seen inverted.

N.B.—Will a correspondent of "Ours" kindly send a diagram to scale, showing position of poles of planet for the dates given above?

The planet was of a dull reddish yellow, resembling very nearly that of 9ct. gold, while the "suspected white markings" were of a creamy yellowish white. Four different eyepieces were used, and the same markings seen.

Suspecting the instrument, it was turned on Venus; but no similar "markings" being seen on its very bright limb in the corresponding position, I felt certain of existence of such on Mercury.

These markings *varied* during the few days of observation, and seemed to shift southward round limb, probably indicating an actual southern extension of a huge white cloud belt on planet.

This note is recorded, in case others have also observed the planet, and further to direct attention to planet. An extract from the observations as entered in my note-book will be sent later on.

John Ballot.

Rolfontein, Transvaal, S. Africa.

REFLECTORS v. REFRACTORS.

[24883.]—IN the valuable article by Mr. Burnham, reprinted in "E. M." this week, he departs from his unassailable position as regards "Small v. Large Telescopes," to discuss the question of Reflectors v. Refractors. It is to be noted that Mr. Burnham says distinctly he has had "no experience in using telescopes of this form." I venture to think if he had, his opinions would change. But when he appeals to results he is on safe ground. If all the discoveries are made by refractors, that is enough to condemn reflectors as an inferior kind of tool. But, of course, the silver-on-glass reflector is a very modern instrument, and in making a comparison with refractors, all discoveries made before its invention must of neces- ty be excluded; otherwise it is like comparing glish and American history, and denying nerican greatness because they have no events rallel with English achievements previous to ndred years.

d is that nearly all the actors; therefore their m of instrument not yet c of dou

stars as medium and small telescopes simply because so many observers have used small ones and so few large ones. We do not, therefore, condemn all large ones. Yet this is a parallel case; the deficiency of results is equally good ground of condemnation in either case. But did none of the users of metallic mirrors ever discover any close double stars? I am quite ignorant on this point; but has neither Herschel, nor Lassell, nor Bird found a new close star?

Again, no one can imagine that Mr. Burnham's discoveries are simply the result of the 6in. Alvan Clark he used. If he had used a reflector he would have been equally as successful, no doubt, for his keen eye was the most important part of his telescope. Neither would any other observer have equalled his performances if in possession of his 6in. instrument unless equally gifted with himself in keen vision and perseverance. But when all is said, there remains untouched Mr. Burnham's challenge for results. We have now some very large silvered mirrors and some very excellent medium-sized ones in use. Will not some of their possessors do something to show their quality? Surely Mr. Common's great mirror can find a few close doubles to put the Washington observers on their mettle, or cannot the Rev. Mr. Perry do something more than measure known distances to the second decimal? I do not know that he has not; or cannot Mr. Gaudibert with his wonderful 8½in. With, find a new double of 0·2" or 0·3", instead of looking only at those found for him previously by refractors. If not, we shall have to knuckle under to Mr. Burnham's dictum: Refractors first—reflectors nowhere.

Allow me to assure "F. R. A. S." (letter 24845) that my remark on position of the Nova in Andromeda is to be taken for what it is worth—nothing at all. Mr. Tarrant has pointed out other apparent changes in the nebula itself, which would seem to indicate that the new star is actually in the nebula. I have a suspicion that the distance betwixt the star and the "knot" is widening; but the air is so bad it is difficult to say.

It has been argued that there is a connection bebecause the spectra are similar, but would not one — reasoning *à priori* — expect the spectra to differ even if the star were a condensation of the nebula? A sharp stellar point would surely differ from a diffused nebulosity. And is not the apparent similarity a proof of want of power in the instrument, rather than of identity in the spectra. It is not as if the spectrum of 31 M. were a very peculiar one, like the spectrum of Aldebaran, or β Pegasi. The only peculiarity we hear of is the absence of the red end, which seems to be the case with a number of celestial objects, and is not very striking as a peculiarity with such faint spectra as nebula and 6th-magnitude stars give usually.

Edwin Holmes.

REFLECTING TELESCOPES.

[24884.]—MR. BURNHAM has surely been very unjust to reflecting telescopes in his letter in the *Sidereal Messenger*, as given on page 117, of Oct. 9, in stating that they are *immeasurably* inferior to refractors in work requiring sharp definition," and in condemning them thus, because no very close pair has ever been *discovered* by a large reflector. Now, I should suppose the discovery of a double star is very much more likely to be made by professional observers, whose time is wholly occupied in astronomical pursuits, than by amateurs, by whom the reflectors are principally used, as few, if any, important observatories are fitted with reflectors; therefore, to judge of the merits of the two classes of instruments by that rule, is as unfair as to state that refractors are very inferior to reflectors, because Herschel made all his disco- ries of double stars with reflectors.

ctors—more especially those of large ften inferior to refractors in defie, pretty well known; but then the price given for a reflector is so very small by comparison with that of a refractor of similar aperture, that there is not the inducement to occupy so long a time in its production as in that of a refractor. And when a figure tolerably perfect is obtained in a large reflector the inducement to desist from further work on it, with the chance of getting a less perfect figure by repolishing it is great, from the price it will fetch when finished.

That makers can and do send out large reflectors equal in definition to refractors I can testify, having a 15in. of Mr. Calver's that shows a star equal to any refractor I have seen; but 7½in. is the largest aperture in a refractor that I have ever used, and the reflector is quite equal so far; but for very fine points of light, I confess I think the refractor is the best. Why, I do not understand; but such has been my own experience. So that it may be conceived that in planetary definition the fine points of light may be best seen in the refractor.

At the same time, one would expect that the thick glass of the large refractor would intercept more light than would be returned by the reflecting surface of a silvered mirror. Why is it not so?

Philip Vallance.

SMALL v. LARGE TELESCOPES—NOVA ANDROMEDÆ.

[24885.]—MR. BURNHAM'S opinion on the above, coming, as it does, from one who is without a rival in the discovery of difficult double stars, must necessarily carry great weight with it. It is, therefore, with much regret that I find him lending his name to an unwarranted attack on reflecting telescopes; whilst at the same time the productions of a particular firm of American opticians are gratuitously advertised in a manner that scarcely savours of good taste. It seems almost incredible that an observer of such eminence and experience should deliberately condemn a form of telescope which he has never used. Into the question of large *v.* small apertures I do not propose to enter, believing that Mr. Denning is quite prepared to hold his own in the argument. But I do notice that, with regard to the magnifying powers "usually" employed, Mr. Burnham's experience is in accord with that of most other observers when he says "Visitors usually wish to see objects with the highest powers, but the working astronomer finds, under ordinary atmospheric conditions, that the lowest power which will show a given object is best for real work."

Mr. Burnham overlooks two very important conditions that must materially affect his remarks. One is the part played by his own eye, which, by long training in a special department of work, has acquired a power of discrimination that is probably unique. Where, indeed, do we find any other observer, using even a Clark refractor, who can at all approach him in this respect? He must know, or ought to know, that the "man at the small end" is an integral part of the whole instrument, and one which is not safely ignored. The second point is that relating to climate. Everyone who has crossed the Atlantic is at once struck by the remarkable superiority of the American air over that of the British Isles. Its wonderful translucency and dryness tell enormously in favour of telescopic definition—at least, it did with a pocket telescope of good quality which was my constant companion when on that side of the "herring pond" last autumn. My limited opportunities with large instruments fully confirmed the view that what was good for terrestrial telescopes must likewise prove beneficial for the celestial "sky-scrapers." Possibly, too, this difference of climate may, to some extent, account for the peculiar views which Mr. Burnham entertains with regard to the use of stops. Certainly, he is at variance with the majority of English observers.

In this country perfectly steady and clear nights are but seldom combined, and very few of our observers could be found who would say that they never cut down the aperture on nights of unsteady definition. Something, too, might be said as to a "personal equation" in this matter. A well-known London optician, who had an observatory on the summit of a house in Fleet-street, used to take observations of stars when they vibrated equally on each side of the wire, and jocularly insisted that such a condition was preferable to perfect steadiness! On some such cognate principle would I endeavour to account for Mr. Burnham's curious antipathy to any reduction of aperture on a poor night. It is quite possible that an eye which can master double stars that are beyond the theoretical separating power of his aperture—as was undoubtedly done with the 6in.—can also, in a less degree, overcome, or get used to, a moderate amount of atmospheric disturbance. Of course, reflectors are more sensitive to atmospheric disturbance than refractors, because of their tubes being open at one end; and it needs, too, but very little consideration to see how, in a Newtonian reflector (to which construction the great majority of these instruments belong), the radiated heat from the body of the observer must affect the light rays much more than with a refractor—indeed, in the latter this would be infinitesimal. The rays pass parallel along the whole length of tube of a reflector, whereas in a refractor they converge inwards from the moment of entering the object-glass: consequently, if a warm hand were placed on the tube of the former, at any point whatever, on a cold night, a disturbance would be visible in the out-of-focus image; whereas the same experiment could only succeed with a refractor if placed near the o.g. end. Granting these drawbacks, I deny that a first-class mirror, such as turned out by Calver or With, when used on a really good night, is in any way one whit inferior to a first-class refractor, whether made by Alvan Clark or anyone else. Indeed, I would even go further, and say that a Newtonian reflector, with its true parabolic mirror and perfect plane, *must* be more perfect than any o.g. ever yet made. When chromatic aberration is completely eliminated, it will be quite time enough to talk of perfect object-glasses. This outstanding colour may not interfere with double-star work, but it does most decidedly affect the sort of definition that is required for the most delicate planetary markings. With all due deference to Mr. Burnham, there are even more delicate tests of definition in the heavens than those afforded by double stars. There is considerable difference between the intrinsic light emitted by those distant suns, and that reflected from the surface of our planetary neighbours. It is a notorious fact that these giant refractors have failed utterly with the planets; whilst it is equally true that each increase of aperture with reflectors has shown more detail, up to a point when the light becomes too great for the magnifying power which the atmosphere will bear; pushed beyond which, the detail is obliterated by the glare of light. Such being the case, it cannot be proved that because the 18½in. Chicago reflector fails to show some of the finer markings on Jupiter and Saturn, these markings do not exist, save in the imagination of certain observers. As for the quotation "that someone with a 4½in. instrument claims to see a belt on one of the satellites of Mars, or a pale lilac streak on Neptune," this may be intended as a fair specimen of Transatlantic wit: but such observations as these are much more likely to have been made with a 26in. o.g.

Again, with regard to double-star observations, the reason why most of such have been made with refracting telescopes is not far to seek. This kind of work requires, for its successful prosecution, several important adjuncts. First, a completely equipped equatoreal, with circles, &c., and this, to be efficient, must be a fixture, which means also an observatory, with revolving roof and other accessories, including a sidereal clock, observing chair, and so forth. Second, a micrometer, which, if good, is costly. Third, a driving clock, without which but little micrometrical work is possible; and this, again, is charged for most exorbitantly by the optician. Fourth, illuminating apparatus, not necessarily expensive, but generally rendered so. Fifth, some years of constant practice on the part of an observer before his results are acceptable. Where are all these things to be found, save in public observatories, and some few private ones belonging to wealthy individuals? Is it any matter for surprise that such work naturally gravitates to the professional astronomer? And do we suppose that professional astronomers would care to be bothered with the adjustments of a reflector, or the frequent resilvering of the mirror? Certainly not: their instruments must be permanent, and very properly so. But with an amateur, against whom, I am sorry to see, Mr. Burnham's animus appears to be directed, because they generally use reflectors, the case is wholly altered. In the majority of instances, perhaps, his telescope is carried out when required, and he dispenses with covered observatory, driving clock, illuminating apparatus, and other complications. Give him a good mirror and plane, with decent eyepieces; he may then use a rough wooden tube, and an ordinary alt-azimuth stand, and yet do work on the planets with these crude appliances, which shall rival that of powerful refractors placed in costly observatories. I repeat again, is it any marvel that the average amateur's work tends in this direction? But it can be shown, I think, that a reflector, where expense is no object, can be made to do good double-star work. At this moment there are several English observers doing difficult double-star work (and one micrometical work, too), with the much-despised reflector. If Mr. Burnham lives long enough, he may yet see some original double-star work published, made with reflectors.

In response to the inquiry by my friend Mr. Brooks (letter 24850), I may tell him that I saw the *Nova* in Andromeda decidedly *yellowish* on Sept. 3rd (as did also Dr. Copeland and others) and several succeeding nights. It was not observed again until the present week, when it was as certainly *bluish*, and about two mags. smaller. Instrument—11½in. reflector. **W. S. Franks.**

MEROPE NEBULA.

[24886.]—We are so far off that we do not often get a chance for a "say" at your astronomical readers: but the letter No. 24776, in which Mr. Goodacre asks for information about the Merope Nebula opens the way for some positive testimony.

I have seen the faint object on two occasions, and have failed also on many other nights.

It is best seen by gently moving the instrument about in various directions, and if the sky be dark and really transparent, the outlines of the nebula can be readily seen by the contrast with the darker sky outside of it.

I am persuaded that the failures to see may be set down to a faulty sky, and not having the object in the zenith.

The instrument is a 5in. Clark refractor, and I used power of 45.

Baltimore, Md., Sept. 29. **John R. Hooper.**

STELLAR PARALLAX.

[24887.]—Some months since a correspondent, Mr. Arkwright, asked for some cases of stellar parallax. The following list, which I have collected from various sources, includes, I think, the latest determination of the parallax in each case. I have omitted all below a tenth of a second.

Star.	Mag.	Parallax.	Authority.	Remarks.
α Centauri	1	0·918	Maclear	
"	1	0·75	Gill and Elkin	
α Tauri	1	0·516 ± 0·057	O. Struve	*M. N.*, March, 1884.
Lalande 21185	7	0·501	Winnecke	
61 Cygni	5	0·4783 ± 0·01381	Asaph Hall	
"	5	0·47 ± 0·03	Dr. Ball	*M. N.*, Feb., 1885.
6 Cygni		0·48 ± 0·05	Dr. Ball	" "
β Centauri	1·2	0·47	Maclear	
μ Cassiopeiæ	5·2	0·342	O. Struve	
Σ 2398	8	0·34 ± 0·034	Dr. E. Lamp	*Observatory*, Sept., 1885.
1618 Groombridge		0·32 ± 0·02	Dr. Ball	*M. N.*, Feb., 1885.
34 Groombridge	8	0·307	C. A. Peters	
Lalande 21258	8·5	0·260	Gyldén	
O. A. 17415	9·5	0·247	Krüger	
o² Eridani	4·5	0·223 ± 0·0208	Asaph Hall	
"	4·5	0·166 ± 0·018	Dr. Gill	
σ Draconis	4·8	0·222	Gyldén	*Observatory*, Jan., 1879.
Sirius	1	0·198	Gyldén	" "
α Lyræ	1	0·1797 ± 0·005612	Asaph Hall	*Ast. Register*, April, 1884.
70 Ophiuchi	4·2	0·169	Krüger	
1830 Groombridge	7	0·147	Gyldén	*Observatory*, Jan., 1879.
ι Ursæ Majoris	3	0·133	C. A. F. Peters	
Arcturus	1	0·127	C. A. F. Peters	

From the above it would seem that the nearest star visible in these latitudes is α Tauri (Aldebaran), a distinction long held by 61 Cygni.

Oct. 10. **J. E. Gore.**

HYDRAULIC RAMS.

[24888.]—In my letter 24862, on p. 123, first column half-way down, for "in valve," read "no valve," i.e., the snift is a plain hole and not a valve, and in third column, ninth line, for "any valve," read "my valve," i.e., the valve of the ram described above. **W. A. S.**

DOMESTIC HOT-AIR ENGINE.

[24889.]—In reply to "Motor" (letter 24864), there is a motor (hot-air) exhibited at Britannia Company's stand, No. 437, Group 4, Inventions Exhibition, exactly adapted for driving sewing-machines. But there appears to be no demand. The various spring-motor manufacturers have been ruined. Upon inquiry, I find only one hot-air motor has at present been sold for the purpose, although thousands of persons have seen the motor at work. **W. Edmunds.**

ELECTRO-MECHANICAL CLOCK.

[24890.]—The winding arrangement of the clock you described on page 92 in the English Mechanic, October 2nd, which you state can be seen at Mr. Watkins's, Leadenhall-street, is not new. In fact, the arrangement dates many years back. I constructed one fifteen years ago as a watchmaker's regulator. This regulator was so arranged as to send 30 currents per minute to 30 time indicators, in other words, a current every two seconds, the regulator being synchronised by Greenwich time current. I also adopted the same principle to a ship chronometer as regards winding, and also a special arrangement for controlling a turret clock with two-seconds pendulum. I have also a small clock wound by two electro-magnets; the clock is 8in. high, under a glass shade, which is arranged to send twenty currents per hour to twenty different timepieces or clocks to correct them if fast or slow. I have an old movement by me which is wound electrically, which was constructed in 1845. I may here mention that it is an easy matter for anyone possessing a good clock, a few tools, and a knowledge of electricity, to synchronise any cheap clock. I have several arrangements in hand of a different construction, which I think will be an improvement. With your permission, I may have something further to communicate on a future occasion. **An Old Correspondent.**

TRAINS AT 50 MILES AN HOUR AND UPWARDS.

[24891.]—I notice several errors in the interesting list of trains having a speed of 50 miles an hour and upwards which appeared in your issue of the 17th July (p. 432); also in "C. P.'s" letter on the same page. As these make some difference in the speeds and relative merits of the trains, I venture, as an old correspondent of your paper, and one who has devoted special attention to this subject, to point out some of them.

The distance from King's Cross to Grantham is stated at 105½ miles. It is correctly 105 miles, 26 chains, or only just over 105¼ miles. The difference is sufficient to alter the relative positions of the Manchester and Leeds expresses. The latter's run from Huntingdon to Finsbury Park, 56¼ miles, in 63 min., being the one referred to. The distance between Peterborough and Grantham is 29 miles, not "29½" or "29¾," as variously stated in the table. Grantham to Wakefield is 70¼ miles, not "70½." This distance was done during 1880 in 77 minutes, or at the rate of 54¾ miles an hour. The Kettering and Kentish Town run is 1 hour 21 minutes, not "1 hour 22 minutes," and so this reaches the 52 miles an hour standard. Willesden to Rugby is 77¼, not "77½" miles; and Paddington to Swindon is 77¼, not "77⅛." The time from Bristol to Bath is 16 minutes, not "14" as stated on the authority of an error in "Bradshaw." The correct departure time from Bath is 2.28, not "2.23," as in "Bradshaw." The time (by 11.45 a.m. "down"), Hitchin to Huntingdon, is 31 minutes, not "32." The departure time has been taken in error, instead of arrival, as also in the case of the up Leeds express. **C. R. M.**

Wellington, N.Z.

THE NEW ZEALAND RAILWAYS—ENGLISH MANUFACTURES — ENGLISH MECHANICS AND COLONIAL INDUSTRIES.

[24892.]—The Minister for Public Works (Mr. Richardson) in his official statement to Parliament, last night, made some remarks of so serious a character as affecting English manufactures, English mechanics, and the future prospects of importation of railway materials from Great Britain to New Zealand, that I send them for the benefit of your readers, who will, I feel sure, read them with interest. Mr. Richardson said:—

"The reports which have from time to time appeared in the newspapers of the Colony regarding the bad quality of a large quantity of material for waggon work, as also wheels and axles, will no doubt have attracted the attention of honourable members, and it has been considered desirable that the correspondence which has taken place betwe the department and the Agent-General on this su ject should be laid before the House, which wi done. From this correspondence it will be that the difficulty in getting redress English contractors has been so gr thought it necessary to discontinu articles from England at all. hope, will meet with general were called in the Colony of axles to supply the place of those condemned, but with little response; it therefore became absolutely necessary for the department to commence making them, and the result has been that we are now making not only axles, but wheels also, and at a price not exceeding that of those which were being imported. These wheels and axles, on being tested, are also found superior to many, and equal to the best, sent out from England, thus proving that we need import no more of this class. The manufacture of these items alone is providing work for a very large number of workmen, and is also keeping fully employed the very expensive machinery at Hillside and Addington, which had not previously been in full work. The work is as fairly divided between these shops as it can be, with due regard to economy, and the other railway workshops throughout the colony will be engaged in fitting up the new stock as fast as the wheels, &c., are sent to them. The whole of the new stock will, I hope, henceforth be made in New Zealand, excepting perhaps certain of the heavier class of locomotive which may from time to time be required, and such other articles as cannot at present be made in the colony. Amongst these will be some steel axles, which have recently been ordered by way of experiment. Honourable members will remember that I last year renewed a promise made by my predecessors in office, that tenders should be called in the colony for locomotives. I decided, after consulting the officers of the department, that it would afford the best chance of success to local manufacture if we arranged to build ten engines of one pattern. This was done, and the result has been that we received tenders from several of the best firms in the colony, and have let a contract for the manufacture of ten engines at a price not more than about 27 per cent. above the cost of those of the same class imported from England. The colony, through its representatives, having so determinedly expressed its desire that this experiment should be tried, the Government had no hesitation in accepting this tender, as we found that the price was proportionately as favourable as that now being paid in the Colonies of Victoria and New South Wales, where they have been building locomotives for a great many years. Before leaving this subject, it may be desirable that I should refer here to a transaction which has recently taken place with regard to some twenty locomotives which were ordered from England in July and November, 1883, to be delivered for shipment between June, 1884, and March, 1885. In October last I received a cable message from the Agent-General to the effect that two of these engines were shipped, and that they were so heavy that it would be necessary to strengthen all the bridges on the lines they were to run upon: and on inquiring as to how this could be, I found that the engines, with tenders as constructed, were ten tons heavier than they were specified to be. I immediately refused to take these engines, and after a very long and expensive correspondence by cable and letter, the contractors, finding that we would not take the engines as built, agreed to alter them in a manner satisfactory to the department, at their own cost. These engines, as altered, are now coming forward. In the mean time, being disappointed in not receiving these engines at the time they were expected, I was obliged to order others, and succeeded in making a contract with the celebrated Baldwin Company, of Philadelphia, to supply twelve engines on the same specification as that sent to England in 1883. The order left New Zealand on the 6th December, 1884, and we have had advices of the shipment of the whole number at New York by the 1st May, 1885—namely, within five months from the time of the order leaving here; and a still more satisfactory part of the business is, that they will be delivered for fully £400 per engine less than the English ones."

This will probably elicit some explanation on the part of the English firms implicated in Mr. Richardson's charges. Meanwhile, I quote the accusation as made.

Wellington, N.Z., Aug. 26. **C. R. M.**

COMPOUND LOCOMOTIVES.

[24893.]—IN reply to "E. L. P.," I understand that the power of compound engines is calculated from the dimensions of the low-pressure cylinder. The tractive force of the large compounds is, therefore, $30^2 \times 24 \div 75 = 288$, or, halving for two cylinders, 144. The piston area of a 30in. cylinder is 900 circular inches (706·86 sq. in.), to match which an ordinary engine needs an area of 450 circular inches (353·43 sq. in.) for each of its two pistons. The diameter of a cylinder with an area of 450 circular inches is $\sqrt{450}$, or 21·2; that is to say, the large compounds are equivalent to an ordinary engine with two 21·2in. cylinders. In the [illegible] it is found that the 26in. cylinder [illegible] force of 104, piston area [illegible] 04 sq. in.), being an [illegible] engine with a pair of cylinders of 18·38in. Mr. Rous-Marten seems to be in error in saying the compound tried on the South-Western had only equivalent to two 17in. cylinders; and his apology for its behaviour there, so far as based on this mistake, falls to the ground.

In letter 24712, p. 14, I advanced six specific contentions, of which no one could complain on the score of ambiguity (except that one was misprinted), and I challenged a reply. No one, not even "Adiabatic," has ventured to dispute a single proposition. The compounds are so little honoured in their own country, that we have to go all the way to New Zealand for an apologist; 11,000 miles being the least distance that will lend enchantment to the view. Closer familiarily would breed contempt.

The runs made by compounds, as quoted by Mr. Rous-Marten, do not in any way affect the position I have taken up. The most attractive run was that with the Irish train, making up 13½ minutes Holyhead to Crewe; but seeing that the up night boat train (the one probably referred to) is allowed nearly three hours to run 105 miles with only two stops, it was only a mediocre performance, after all. The time was made up because the train was so preposterously slow. However, I will not take up space by criticising the other runs quoted, though they are mostly open to remark.

Will "In favour of an Old Racer" kindly give some particulars of recent failures of compounds and also further details of coal consumption? Do any of the Crewe compounds burn less than 32lb. per mile; if so, how many? and what work are they doing? Also, has any reason been given by the authorities for ordering the compounds not to run to Carlisle? If the statements of "In Favour of an Old Racer" are correct, the sooner the directors improve the compounds off the face of the earth, the better it will be for shareholders and the public too.

A Ramsbottom 7ft. 6in. single on 30th September ran the first portion of the Scotch express, seven coaches, from Rugby to Euston in 14 minutes under time; the second portion, 15 coaches, run by a big compound, was 64 late Rugby, and 67 Euston. **Kappa.**

THE FERROUS OXALATE DEVELOPER—TO MR. PERKINS.

[24894.]—I WILL give a short *résumé* of the mode of getting the best results with ferrous oxalate, as soon as I can find time to write it.

S. Bottone.

THE SOARING BIRD.

[24895.]—IT would seem that Mr. I. Lancaster considers himself aggrieved by my letter in No. 1,067, for he implies that I misrepresent him therein as regards the soundness of his scientific opinions.

But I must disclaim any intention of so doing, as I wrote in good faith on the strength of the article on his tractate appearing in the "E.M." of Aug. 14. Seeing that he had offered no protest against any part of that article, nor had repudiated any of the assumptions that it attributed to him, I supposed that it was a fair condensation of his views, which latter so astonished my weak mind as to lead to the criticism of which he complains.

Perhaps he will be kind enough to tell us, who have not the privilege of possession of his tractate, in what context he has used the phrases (or their equivalents)—1. "A body doing work by falling without losing its energy of position." 2. "The possibility of a device enabling gravity to become a continuous motive power is established."

B. B.

"CLAMP" v. "CRAMP."

[24896.]—AS "J. H." does not appear to be satisfied with the admissions already made by me on this very weighty point, I wish to have the opportunity of making a remark, and of specifying a few admissions that I have not the least intention of making, though less than these would hardly make "J. H." and myself quite of accord.

Remark.—If the late Mr. C. Holtzapffel came of a German-speaking family, which, without much fear of a blunder, I think I may assume he did, he would most naturally call a vice-*clam* a clamp—as that is what it is in German—and it would be very unlikely that he would be told of such a *mistake* (as I persist in calling it) by any of his own men. Even if he noticed that one of these said *clam*, he would have been perfectly justified in assuming that it was due either to ignorance or defective pronunciation.

Next, as to admissions. To satisfy "J. H.," I must admit that Holtzapffel's splendid book is totally immaculate, and that any and everything therein appearing is consequently irreproachable. Also, I must admit that he ("C. H." or "J. H.") had or has a better knowledge of my language [illegible] "J. K. P." has. Also that a catalogue of [illegible] tools is a well of English, pure and un[illegible] from which we are bound to absorb draughts "neat, as imported." Also, that what I have mentioned as appearing under "Clamp" in the appendix to the "Imperial Dictionary," is not an obvious blunder, at least as far as London terminology is concerned. Incidentally, I may mention that I have had a slight experience in lexciography myself, having made vocabularies to Bergeron (*Manuel du Tourneur*) of all the woods, and of every word either not thoroughly familiar or else used in a special sense, or technical; also of Roret's "Horologie," and I may say, too, that derivation is one of my favourite studies. Finally, I may remark that there is a Latin proverb which runs somehow thus, "Cuilibet perito in arte suâ est credendum," and as I have had a good spell at both mechanics and English, if other folks do not choose to believe what I say, so much the worse for the other folks.

In my letter on p. 104 "extra here" should be one word—viz., Latin "extrahere"—to draw out or off.

J. K. P.

NEUTRAL SALTS AND POLARISATION IN BATTERIES.

[24897.]—"A. E. B." (24853, p. 121) misapprehends me when he says I appear to think he ought not to have written without knowing more about the subject. I wrote in his own interest. He appears to be expending time and money upon experiments, and thinking that he is finding out new information. I gave him sound advice on p. 63, when, while admitting that experiment is the source of all knowledge, I pointed out the disadvantage of experimenting on disjointed facts without a guiding principle, and, as a result, fancying that the facts are new additions to knowledge, while they are the mere chaff winnowed away by earlier workers. Of course the student can do no better than to write and inquire in these pages: he thus gains the advantage of the advice I gave.

The textbooks generally do not give this information, as "A. E. B." says, and for a very good reason. They have no space for any but *positive* information: they cannot describe the things which have been proved useless. Then, also, the textbooks are either mere *réchauffés* of earlier works, put together with a minimum expenditure of work, and with originality carefully avoided; or they are written by electricians who are thoroughly versed in the mathematics of the subject, but know very little about its chemistry. The facts in question will, however, be found stated and explained p. 139 of my "Electricity," and I am quite sure that the study of the chapter on Galvanic Batteries in that work would greatly economise the time of "A. E. B.," and clear away many misconceptions from his mind. For instance, he would never again say as he did, p. 87, "it is purely in order to get rid of these bubbles of hydrogen that copper sulphate is used in the Daniell cell, and concentrated nitric acid in Grove's and Bunsen's."

His use of the term "polarisation" is also incorrect. The term itself is a most unfortunate one, and its use in connection with batteries arose from mistaken early ideas as to the cause of the diminished E.M.F. This so-called polarisation does not occur at the positive plate—i.e., the zinc: it is a "counter E.M.F. set up by the products of the decomposition of the electrolyte: its most common cause is the presence of hydrogen at the *negative* plate, the copper, or carbon." Hydrogen at the zinc plate would act in the same direction as zinc; therefore could not generate or reverse E.M.F. Its only injurious action there is that it reduces the active surface by preventing contact of the zinc and liquid—i.e., it increases the internal resistance. This will answer the question put to me in par. 4, p. 121.

I will now explain the difficulty of par. 5. When zinc is immersed in pure dilute acid there is only a very small action upon it if amalgamated; but as soon as a little copper solution comes through, by endosmose, copper coats the zinc. This involves—(1) a waste of zinc limited to the quantity of copper sulphate decomposed; (2) a continuous local action of the acid upon the zinc plate by aid of the copper deposited upon it. Now, if the zinc plate is in a solution which it cannot decompose, only the first of these actions takes place: there is no further local action. Certainly, I advise sulphate of zinc as much to be preferred to sulphate of soda, not on the ground of conductivity, but from several practical advantages. Chloride should never be used in a Daniell. **Sigma.**

LEGAL MATTERS.

[24898.]—CHURCH BELLS.—NUISANCE.—REMEDY (57624).—WHILE I can thoroughly sympathise with all who suffer from the intolerable nuisance of the clanging and crashing of church bells, many of which seem cracked, and most of which are very badly made, I know of no legal remedy. It would be interesting to have the question fought out in the court by some bold man who would get up an indictment for nuisance. But I believe something of the kind has been attempted and failed. These bells are merely Mediæval survivals, for now that almost every adult in England, and certainly everyone who is likely to go to church, both carries a watch and has a clock in his house, they have become an unnecessary and inexcusable nuisance.

WATERWORKS ACT — FIRE.—The statutes mentioned by the querist can be obtained at the Queen's Printers, East Harding-street. I am not sufficiently well versed in this very complex branch of the law to answer the question, and I cannot find time to look into the numerous Statutes. But I do not think the Local Board has any power to compel the water company to put up hydrants, and I believe that the Acts make very little if any provision for a proper supply of water in cases of fire—a point in which they need amendment.

EMPLOYERS' LIABILITY.—NOTICE OF INJURY BY POST.—I think it may be useful if I mention a point that has lately arisen under the Employer's Liability Act, as it may not be generally known. The notice of injury which must be sent by the workman to his employer within six weeks after the accident, may be served by delivery at his places of business or residence—i.e., it may be served by handing it to a servant or workman at these places, or even putting it into a letter-box, and the service need not be personal. But if the notice be sent by post it must be registered. At the Lambeth County Court a workman had sent his notice in an ordinary letter, and its receipt had been acknowledged by the employer. At the hearing, however, it was objected that the letter had not been registered, as required by the Act. The judge felt bound to adopt this view; but he tried the case and gave leave to appeal. As the defendant succeeded, of course it went no further. Looking at the plain words of the statute, I think the judge was right, and I should advise workmen always to register the letter if they serve the notice by post.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall.

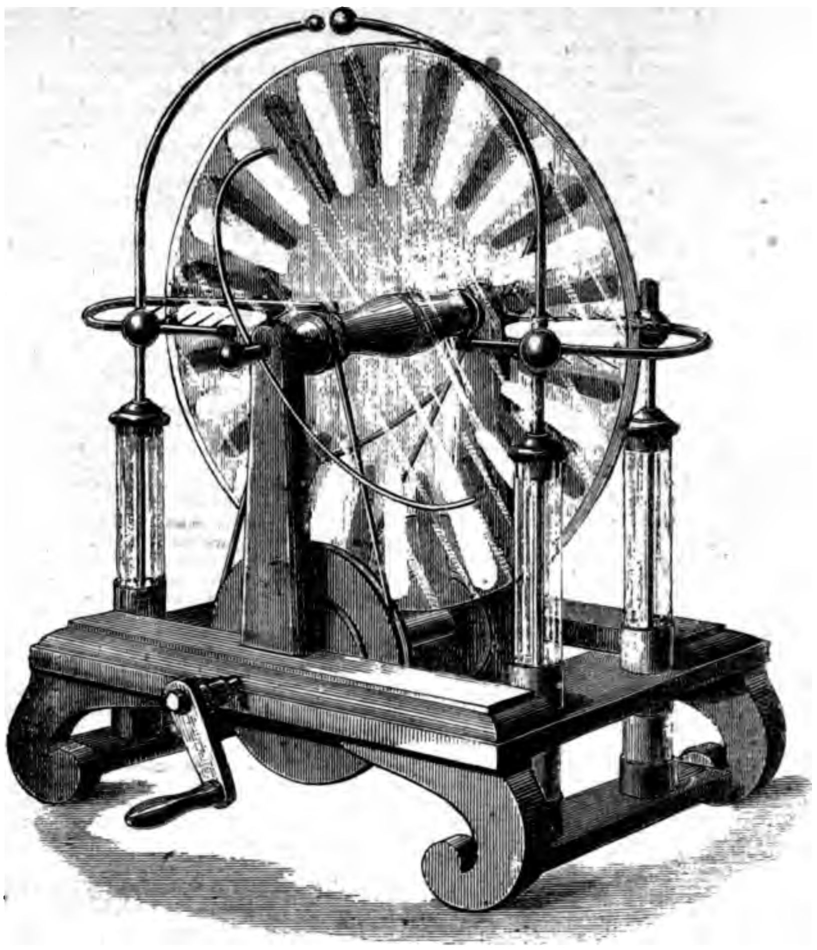
THE WIMSHURST INFLUENCE MACHINE.

[24899.]—THE less experienced amongst your readers will no doubt be glad to have the following practical instructions relative to the making up of one of the above-named machines. A simpler form was described in one of your issues of November of last year; but for good average results, and for all-round purposes the arrangements shown in the perspective view are perhaps the best.

The first thing to be done is to get a sheet of cartridge paper, and thereon set out the machine to full size, and then set off the essential points of each part separately. A little care given to this drawing, and afterwards in working to it, will be well repaid in the more satisfactory finish of the machine.

The Stand.—For this is required two pieces of mahogany for the sides, each 16in. by 2⅛in. by 1in. (Fig. 1); two pieces for the ends 12⅛in. by 3⅛in. by 1in. (Fig. 2); two pieces tapering in width for the stanchions 10¾in. by 2⅛in. 1¼in. by 1in. (Fig. 3); two pieces for the tables 10¾in. by 2⅛in. by ¾in. (Fig. 4); two pieces for the clamps which hold the driving spindle in place, 9⅝in. by 1¾in. by 1in. (Fig. 5), and four pieces for the scroll feet, 6in. by 3¾in. by 1in. (Fig. 6). All these should be planed up, the two sides should have a bold moulding cut upon their outer edges and ends, and the mortises cut in them; the stanchions should be fairly rounded upon their edges and tops, the tenons cut to properly fit into the mortises, and the scroll feet (Fig. 6) cut out with a turning saw to a pretty shape. Care must be given in shaping the latter so that they quite cover the ends of the tables which support the Leyden jars, since it looks ugly to show the end of this table through the space. These parts may then all be glued together, and as they are chiefly surfaces glued to surfaces, screws should be used as well as glue, only making sure that the points of the screws do not show themselves through the top of the stand. The tables which support the jars have circular pins cut upon their ends, which fit into holes bored in the scroll feet, and they must be glued into place in their proper order.

Driving Spindle and Wheels.—The driving spindle is 13in. long, ⅝in. diameter (see Fig. 7). Drill good centres into its ends, then true up one end for 1⅛in. length, and upon it put a good full screw-thread, then get a good thick iron ring, put a thread in it and screw it on tightly. This forms the collar against which the driving handle (Fig. 8) rests. Next bore a hole in a piece of mahogany, and drive the spindle into the hole, after which the spindle should be put back into the lathe, the mahogany turned, and its ends made to fit into holes, which must be bored in suitably large pieces of mahogany, which are to form the driving wheels. The spindle may then be trued up, and its ends finished; after doing this, glue on the driving wheels, and when dry turn them up. Let the groove be of good size, as the bands run better in large than in small grooves. If the mahogany is not tight upon the metal spindle, it will be desirable to bore a hole through wood and iron, and drive in a metal pin. Be careful that the driving wheels are about ⅛in. free from the table.



Clamps to Hold Spindle.—They should be made sufficiently long to fit against the ends of the frame, the corner portion, which fits under the scroll feet, being cut out, the small pieces, which are cut out neatly, are to be glued in their places between the scroll feet and the sides of stand, and the clamps are then held in place, each having two screws.

Holes for Leyden Jars.—The position of these holes should now be accurately marked, and the holes be bored 1¾ diameter. A good centre-bit will do this; but the holes must be quite vertical, and extend through the ends of stand, and about half through the tables.

Spindles for Glasses and Tubes for Bushes.—The former must be of steel wire, 10in. long and ⅜in. diameter. When selecting this take enough length for two spindles. The second spindle will be found useful in many ways. So also with the tube, which is required to fit closely on the spindle. Select, say, three or four times the spindle length; it is useful for additional experimental bosses. The wire is so true that merely cutting the length of it and slightly rounding its ends is all that is necessary.

Bosses for Glasses.—Select well-seasoned wood for these (Fig. 9). They are 4in. in length, and 2¼in. in diameter at the large end. First bore a hole through them from end to end, tightly push a length of the brass tube into the holes, and then put them into the lathe and true up—first for proper length, and afterwards to a pleasant form, being careful to keep the V-groove over the V-groove of the driving wheel.

Driving Bands.—The round leather for sewing-machines answers very well for this size machine. The joint is best made by cutting each end to scarph, letting the scarph overlap be about 1¼in. length, and stitching together with needle and stout thread.

Bottom Circuit for Leyden Jars.—This circuit is made by a small wire extending from the two Leyden jars on one end of the machine, and carried thence up to a terminal; the wire should, as far as practicable, be placed on the underside of the several parts. It may be attached by means of small staples or by small tacks, the wire being twisted round the tack just before it is driven close up. The other end of the machine is then similarly completed, and the circuit is then closed by means of a portable length of brass wire between the two terminals.

Brasswork.—We will now describe the bras and afterwards the Leyden jars and the glas

Rods for the Leyden Jars.—The four rods f Leyden jars (Fig. 9*a*) are made of tube, each 12 long by ¼in. internal diameter. At 1⅛in the one end solder on a nicely-shaped bras which forms the shoulder upon which the the comb rests; then polish up and lacquer.

Combs.—These (Fig. 10) are made by first a 12⅛in. length of ¼in. brass wire, the ends of are to be rounded. It may then be bent to shape as per drawing, then having got th cast balls, surface them up, and see that th through them are large enough to very free over the tubes. With a small round file cut one side of each ball a groove to just fit u bent brass wire. Having done this, drill th and fit in the collecting points. Five on ea will be found to be sufficient. At this stag the brass wire, the points and the balls t then polish up and lacquer.

Discharging Terminals.—These (Fig. made of brass wire, the size to just fit into t of the tubes (Fig. 11A) or rods for the jars, they are 16⅛in. long; file the one end taper, and on it solder the ball, bend to form, clean up, and lacquer.

Neutralising Rods.—These (Fig. 12) are 1¾ length of tube cut from the same size as to bush the bosses. At a ¼in. from the drill a $\frac{3}{32}$in. hole right through, and into t piece of brass wire 18⅛in. in length, the this wire must then be drilled up (say receive the brushes; solder the wire in place same time solder upon the end of the tube ball, to make a finish: polish up, then b wire to proper form and lacquer. The ends wire must be perpendicular to the surface plate.

Brushes.—Get some fine wire, such as is u the gilt-lace makers: a ¼oz. (costing 3d.) enough for several hundred brushes; the piece of metal plate, say 1¼in. broad, wind ten turns of the wire, take a knife, and c wire turns through at the one edge of the plate, slide the partly-made brush off the pl with the finger-nails tightly twist up th ends of wire; now slightly pull and bend th till they lie straight, and clip off the sharply- ends with a pair of scissors. The brush complete.

Driving Handle.—It is better to for this, and have it cast f requires to be surfaced u spindle should be scr over the driving pin

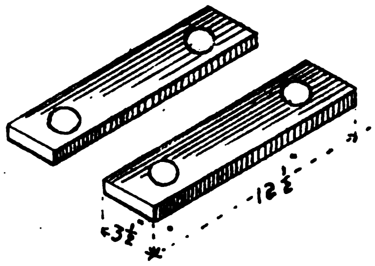


FIG. 2

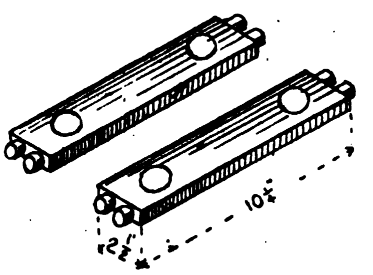


FIG. 4

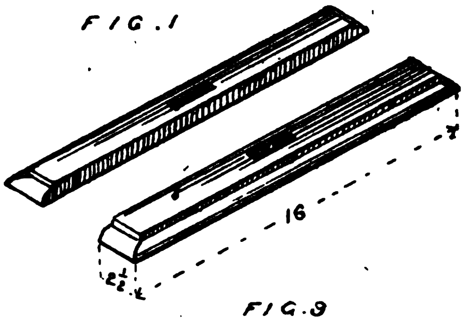


FIG. 1

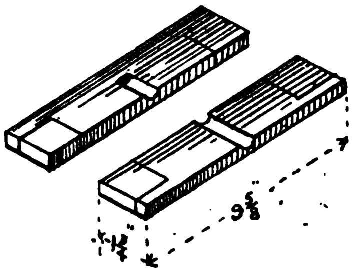


FIG. 5

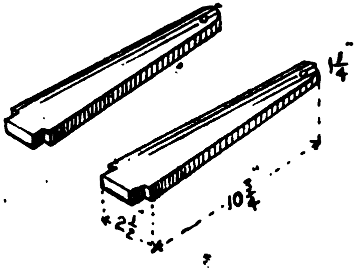


FIG. 3

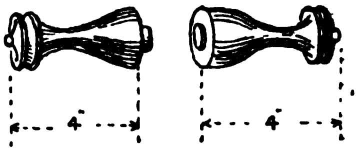


FIG. 9

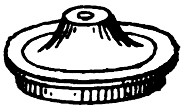


FIG. 11A

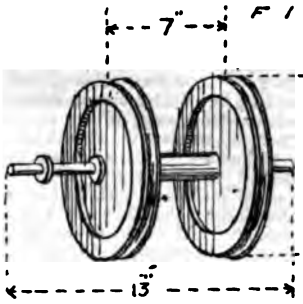


FIG. 7

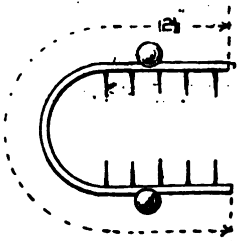


FIG. 10.

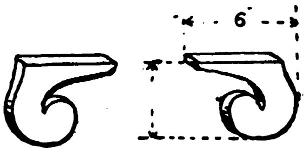


FIG. 6.

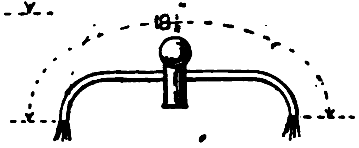


FIG. 12.

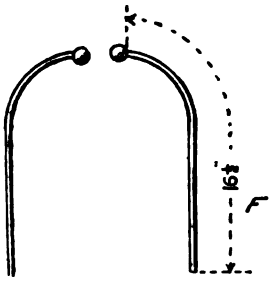


FIG. 11.

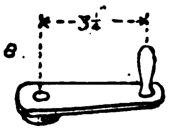


FIG. 8.

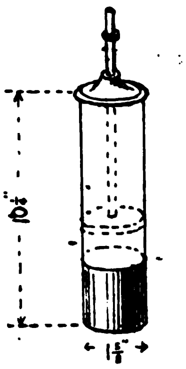


FIG. 13.

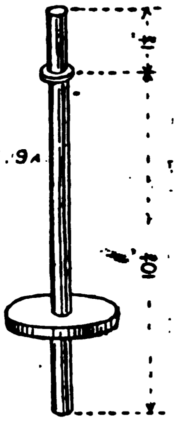


FIG. 9A

The Leyden Jars.—They are 10¼in. by 1⅝in. (Fig. 13). The tinfoil coating is about 4in. in height upon the inside of the jar, and about 3in. in height on the outside, besides which, on the outside of jar, is a band of leather, which takes the chafing of the hole in end of stand, and through which the jar passes.

Tops of Jars.—These are turned up from short lengths of wood. To put them, the tubes, and the jars together, the following order is perhaps the best:—First cement the top to the tube, leaving the shoulder of the tube at a proper height to carry the comb; then, at the foot of the tube, cement on a ring of wood, just large enough to enter the jar; coat this ring with tinfoil, so that it shall make the metal contact with the inner coating of the Leyden jar, then cement the top on to the jar, and lastly, drop down each of these tubes small sticks of wood, of just sufficient length to touch the bottom of the jar with their lower ends, while their top ends are at such height to carry the lower end of the discharging terminals; the balls on the discharging terminals must be kept high enough to pass over the tops of the glass disc. This provision is to avoid breakage through the balls striking the glasses.

The Glass Discs.—These are made of selected window glass; care should be given to the flatness and even thickness. The dark green-coloured [illegible] or some of it, appears to conduct away the [illegible] electricity; therefore, select the [illegible] They should be cut upon a [illegible] 17in. diameter, the hole at [illegible]. They must then [illegible] this [illegible] size upon a sheet of cartridge paper, divide it into 16 or 18 parts, and at each division mark out the sectors; place the glass upon this, and then with a little shellac varnish stick on the sectors. The sectors should be 4in. in length, 1⅛in. broad at the wide end, and ¼in. broad at the narrow end, the outer ends being placed ⅜in. from the circumference of the glass plates. Then again place the glass upon the revolving table, and with a small brush make rings of shellac varnish—one at the outer end of the sectors, the second ring being at the inner end of the sector. These rings additionally attach the ends of the sectors, and slightly insulate the extremities.

Shellac Varnish.—The better way to prepare and to keep this extremely useful varnish is to get a large-mouthed bottle—say a pickle bottle; fit to it a soft wood bung, bore a hole through this bung, and in it tightly fix the handle of a rather large brush (the brush always being inside the bottle), then about half fill the bottle with shellac, and cover the shellac with methylated spirits, occasionally shaking the bottle. In about 24 hours it is ready for use. The brush is then always quite clean and ready for use.

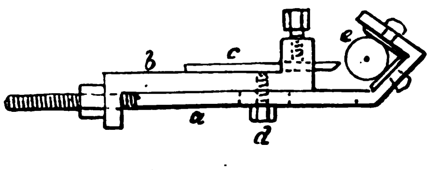
Where can the Things be got?—The knowledge where to get things is often a great help to the amateur; at the same time, giving a list of names and of places is, to some extent, an advertisement, and therefore improper in a paper of this sort. But I hope the Editor, in his desire to help his readers, will overlook the little impropriety of my giving such places as supply the raw material. Moreover, I may add, there are many other places equally as good as those named: the selection happens to be convenient to me, hence I give it, viz.:—The tubes and brass and steel wire may be obtained at Messrs. Smith and Sons, St. John's-square, Clerkenwell; the balls for the terminals and for the ends of neutralising rods, from Messrs. Clements and Hadley, of same address (these balls are known as "metal beads"); the larger balls for the sides of the combs are kept by Messrs. Frost and Son, brassfounders, Clerkenwell; the glass discs at the corner of Fetter-lane, in Holborn; the wire for the brushes may be obtained from any of the gilt-lace makers in Little Britain; and the Leyden jars of proper size at Messrs. Powell's glass works, Whitefriars.

In course of a week or two I shall be glad to furnish a few useful notes relative to the working and using the machine when made.

James Wimshurst.

CORRECTING DRUNKEN SCREW-THREADS.

[24900.]—If the irregularity in a screw-thread termed "drunken" is an equal and uniform wave line, as shown on a plane surface, it is possible to use such a screw for divisional or correctional purposes. In the machine for ruling micrometers on glass, invented and constructed by the late



George Jackson, the screw was slightly drunken-threaded. This error was eliminated by the use of a swivel-nut held in gimbals. A nut having a spherical contour, free yield in any direction in its setting, and held from rotation by a side-screw passing through a slot, would be a neater remedy. With this arrangement, the equal errors of advance and recession on opposite sides of the screw would neutralise each other; but the drunkenness of a screw is not always of this uniform character, arising from the absence of homogeneity or differences in the hardness of the material in the circumference of a rod. The error in a screw cut by an ordinary chaser may take the form of a sudden drop and a quick rise in close proximity. I doubt whether any form of swivel-nut would make such a screw suitable for dividing purposes. For a similar reason that a drunken tap will cut a true spiral (though with a malformed outline of thread), a drunken screw contains in itself the elements of correction, if properly utilised, however irregular the errors may be, as for every rise there must be in some other part a corresponding degree of fall. The opposing errors, by using the opposite side as a guide for the cutting tool, will be at last eliminated, as every traverse of the tool, by taking a light cut each time, will bring the thread nearer to a uniform spiral.

What "F. A. M." terms "the doctor," must, I think, have been generally used by the old "millwrights," many of whom had nothing better than wooden-bed lathes, and also found a place in the engineer's shops before screw-cutting lathes had come into general use. Many years ago such a tool came into my possession on two separate occasions amongst a lot of old lathe material, purchased in different quarters. The sketch represents the correcting tool or, so-termed, "doctor." A is a bar of flat iron, ½in. thick and about 2in. wide; one end of this was bent up into an angular form, as shown. The handle end was drawn down, and a screw cut thereon with a nut to fit; *b* is another piece of bar-iron of the same width, with the bottom end turned down square, with a round hole for the long screw handle to pass through. The top end above the bar is forged up with a squared hole through, to receive the chasing tool, which is held fast by the set-screw above; *d* is a screwed bolt tapped into the upper bar *b*, and passing through a slot in the lower one, serving to keep the bars closed together; there were two holes through the V end of the bar, through which a thin shell of lead could be cast, to serve as a bed for the screw *e*, running in the lathe, and which required to be "doctored." The use of the tool is obvious: the V end is passed over the end of a long screw that presumably had been first chased up by hand, and the cut of the chaser *c* entered by means of the nut and screw at the handle end. After the length had been traversed, the chaser was withdrawn by slackening the nut, and the runs were repeated till, by the feel of the pulse, the patient was cured. These tools were roughly made, being ordinary smith's work direct from the fire, without any machine finish about them, as no particular accuracy is required in their construction.

F. H. Wenham.

GERMAN LATHE APPARATUS.

[24901.]—By some mischance one of the drawings which should have accompanied my letter on p. 124 did not appear, and in consequence you will probably think it advisable to repeat the letter with the illustration of the slide-rest for milling conical wheels. The figures are from photos. of lathe appliances which will, I think, be new to your readers; they are also by Mr. Walz, of Berlin, whose agent's advertisement appears in your issue of Sept. 18th.

Fig. 1 is a dead-centre chuck. Here the centre which usually revolves remains stationary, whilst the band is removed from the pulley on the mandrel to its duplicate on the nose of the mandrel. Thus the driving pin revolves round the stationary mandrel and centre.

Fig. 2 is a frame with spindle to carry milling cutters for fluting or wheel cutting; the frame is mounted upon a slide which can be set to any angle as required in spiral fluting, bevel, or worm-wheel cutting: the whole apparatus is shown bolted into the tool-holder of a well-made slide-rest. The pulley is shaped so that the band may make a complete turn or a turn and a half round it, so as to give more power without gearing; the apparatus overhangs considerably, and would require the slide-rest to be capable of being withdrawn a long way from the centre line.

I am anxious to know whether Reichel's method of correcting screws is new to our practical men, and whether anything similar is used in England.

F. A. M.

FIG. 2.

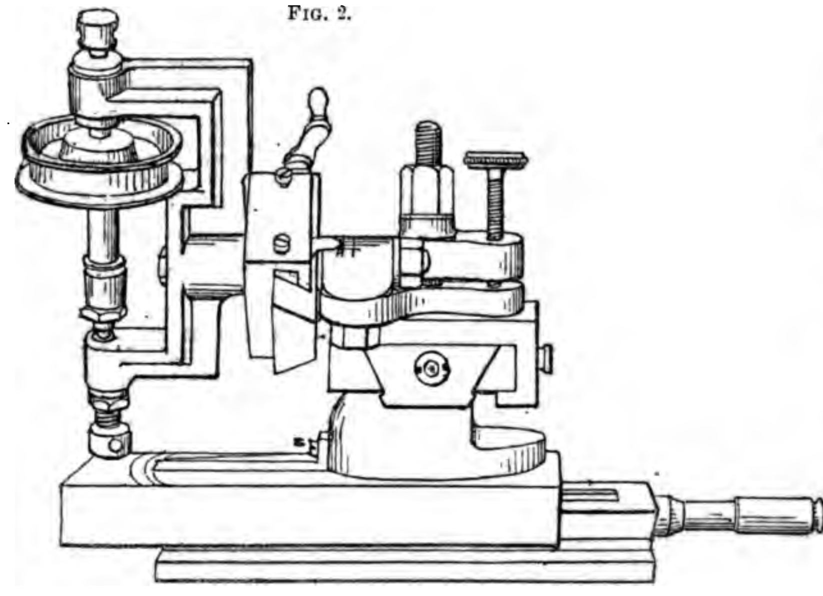
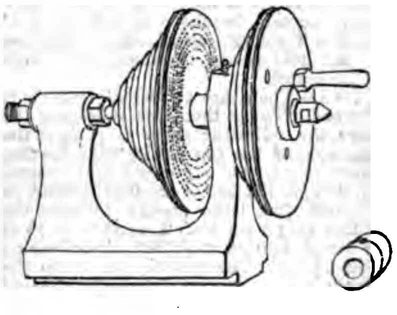


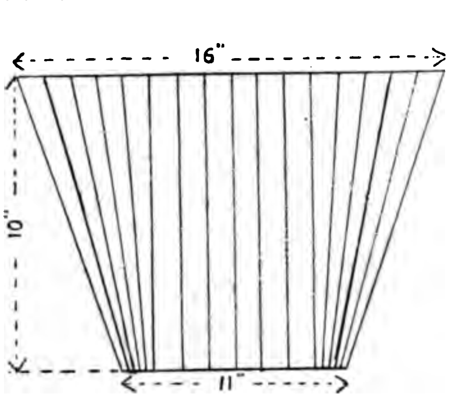
FIG. 1.



REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[57037.]—**Sewing - Machine Work.**—I am much obliged to "J. I. S." for his reply, and inclose sketch. He will see there are seven rows of stitching straight, and five rows of slanting stitching each side, and as I want them rather exact, I fear trusting to the eye would not do. Will he kindly advise whose machine is most suitable for the purpose? Calico or linen will be used.—J. W.



[57124.]—**Lifting Bar.**—"Crumby's" statement of the case amounts merely to this—that if we take up a loose bar near one end, and hold it horizontally steady, we feel that we are employing a greater power than if we held it horizontally by its middle part. Undoubtedly so, because, as he shows, we can only maintain the balance by a downward pressure with one portion of the hand—a pressure generally much greater than the weight of the bar itself, because much nearer than the centre of gravity is to the other portion of the hand forming the fulcrum, which latter portion has to sustain, by its upward pressure, the effect of that downward pressure, and the weight as well. But in my former note, I was discussing an entirely different point which had been raised—viz., how fatigue could be produced at all by holding the bar steady, no matter in what position. Fatigue implies exhaustion, and exhaustion implies work done; in other words, transfer of energy from the hand to the bar; and this I accounted for by supposing that the bar was not really at rest, but was moving alternately upwards and downwards through a very small space with great velocity, though the oscillations might not be visible to the naked eye. I should add that I understood the bar to be fixed at one end, which it appears it is not; but for the point I had in view this is immaterial.—A. E. B.

[57211.]—**Steam Launch.**—I regret I was prevented replying in time for last week's issue. Dimensions of boat are: Length, 35ft. over all; breadth of beam, 7ft.; depth amidships, 3ft.; draught of water at stern, 2ft., and about 9in. at bow. This boat was built for engine of the following dimensions: Single cylinder 6in. bore, 6in. stroke. The boiler is of the vertical type (Messenger's patent), working pressure between 50 and 60lb. to square inch; speed 8 miles. She has cabin holding six people comfortably, and was built by Mr. G. Brockbank, of Bowness, to whom I gave particulars of engine and working pressure of boiler. If "Essar" is in this locality next summer, he can see and judge for himself if he cares to do so, or I will be delighted to send any further particulars.—WINDERMERE.

[57324.]—**Wire on F.M.'s.**—I am afraid our "consulting engineer" has not had much experience with dynamo construction beyond, perhaps, "5-candle power" machines. The proportions for efficient working in a well-designed dynamo are as I have stated. Of course, if the machines are badly designed and constructed, it will be necessary to wind the magnets with higher resistance coils to get a sufficiently strong field. This especially applies to small machines with cast-iron magnet cores, and too large a clearance between the pole-pieces and armature. I would advise Mr. Bottone to read Silvanus Thompson's "Dynamo-Electric Machinery," the lists of several of the chief dynamo manufacturers, and the electrical papers. In the case of shunt-wound machines, the resistance of the field-magnet coils must be 200 or 300 times that of the armature. Whatever the external resistance, the ratio remains the same.—ELECTRICAL ENGINEER.

[57357.]—**Tinfoil.**—To "S. R."—Thanks for reply; but I think you are a little at sea, as I was. You say it is not the foil or mercury, but inexperience. Well, I may say I have found it is the foil. I bought it for pure, but it is far from that. It does not amalgamate. I need no weight for my purpose. If the foil was good and thin, it dries very soon.—FOIL.

[57382.]—**Deepening Colour in Red Bricks.**—Might deepen the colour by adding some hammer scales or iron rust to the stuff in the pugging-mill; but as to strengthening the brick, it would be necessary to have an analysis. If making in large quantities, [illegible] the opinion of a chemi man who keeps a drug

3.]—**Painting Bath.**—The best white xed with varnish.—C. T.

5.]—**Piston Rings.**—As the cylinder is ʻal, it will be a difficult matter to make the tight by any arrangement. Much better e cylinder re-bored.—ESSAR.

9.]—**Heating Coils and Connections.** querist does not say whether the arrange- s on the high or low-pressure system. A n. internal diameter might answer; but 'e not sufficient data given to arrive at any conclusion.—NEMO.

5.]—**Steam-Launch Engine.**—Has this looked up his back numbers? It seems to . he should obtain measurements from some ; engine which has worked well, and then ; upon them if possible.—SEAMAN.

6.]—**Steam Launch.**—The method of cal- ; the horse-power of engines has been given, d think, a hundred times or more—very ', too. It can also be found in the text- Of course, the querist says nothing about ssure of steam he intends to use—one of t important factors in the sum.—ESSAR.

0.]—**Zinc in Boilers.**—Zinc in steam is supposed to be oxidised, and the hydro- ' other element of the water decomposed, sed to accumulate on the face of the iron nd keep the deposit or "scale" from ad- –T. J. M.

1.]—**Aniline Marking Ink.**—I believe recipes for aniline marking inks have been but I have no time to look them up.—NUN.

3.]—**Subaqueous Excavations.**—I be- e process referred to consists in sinking ron piles through which water is forced at essure at the foot, and removing the sand, mits the pile to sink.—G. H.

7.]—**Calcium.**—It is not likely that this ill be answered. The gentleman has simply mistake about obtaining "calcium" that t oxidise. We all do it.—S. R.

1.]—**Engineers' Charges.**—The usual to double the actual cost in the works; overs rent, &c., wear and tear of plant, and -M. S. and F.

5.]—**Exhaust Injector.**—I thought these injectors would force water in under any :. I do not see what answer can be given gineer," except the advice to procure an y injector to work with live steam.—

3.]—**Goldbeater's Skin.**—This is sup- be sold without any dressing. What is nposition" like? It seems absurd to use ter's skin to make a "plaster."—E. G. M.

5.]—**Hoist.**—To construct an hydraulic tted with accumulator, and set of pumps of lifting a truck carrying eight tons (with :k, say, twelve tons in all) at a moderate rough a distance of 16ft., the power to umps being provided by the works, will cost, mplete, say, £750. This, in my opinion, is the best method under the circumstances by "Forward."—F. M. ROGERS, 21, Finsvement.

7.]—**Hydrostatic.**—The querist should ven the title of the book in which he found ement.—T. J. M.

8.]—**Pig Iron.**—In a cupola, for which nt numbers.—NEMO.

3.]—**Lathe Overhead.**—"Somerset Lad" ; find the overhead described last week of for metal. It is only a simple method of eccentric chucks and cutters for ornamental or which it answers very well. It has little and when used on a cutter has only a range t 8in. The pulleys may be 3in. or 4in. in 'r; but as they are only mediums of con- motion from the lathe wheel, their dimen- e not arbitrary.—T. HUGHES.

3.]—**Lathe Overhead.**—I am obliged to ghes and "R. W. F." for their replies *re* The arrangement indicated in the sketch take my fancy as being sufficiently com- all purposes, although it will do very well nental work. Being detached from the stitutes a very good feature. I scarcely the Kennan arrangement. I have several le an effort to obtain the back volumes of ," but without success. Can I not, there- ade "R. W. F." to give a fuller descrip- "D. H. G." overhead, if possible, with I am sure it will be of interest to many. vans is amongst us again, and promises the overhead motion; but he made [illegible] time ago. Anyway, if it est something later than . Surely, "F. A. M nething good in [illegible] would like to kno

if the long parallel drum on front shaft runs heavy?—A. F. H.

[57473.]—**Legal.**—It is presumed from the query that the property is freehold, and was left to the daughters as tenants in common. In such case, it descends to the deceased daughter's eldest son. Had the devise been to other than issue of the testator, it would have lapsed by the death of the devisee in his lifetime; but the Wills Act made a special exception in favour of children or other issue of a testator predeceasing him.—KAPPA.

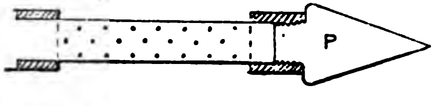
[57511.]—**Slide Valves.**—ERRATA.—In my reply on page 126 please read:—"The travel of the valve will be—

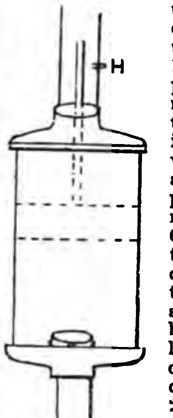
$$2 \times (S + \text{lap})."$$

The constant for a cut-off = ¾ths is 1; that for ⅝ = ·69. The two have run together.—GLATTON.

[57516.]—**Tube Well.**—In answer to "J. W. E.," I have put down many of these wells in Western Canada and the United States. When water would not rise within 70ft. or 100ft. from the surface it would be necessary to bore a 6in. hole; and if the soil was a stiff clay, it would not need casing. I constructed my auger from a piece of old boiler plate about 2ft. long and 7in. wide, slit one end of it in the middle for about 2in., and turned one piece one way and the other the reverse, and by repeated heatings and putting in the vice each time and twisting, I got a very fair sort of an auger, which, when welded on to a piece of stout iron rod and a gas thread cut on the top to fit a ⅝in. gaspipe, answered very well. You would want about fourteen or fifteen 5ft. lengths of ⅝in. pipe to be connected on as you bored down. In the States we can buy points and cylinders all ready-made; but if you have to make your point, you must get, say, 2ft. 6in. of 1¼in. gaspipe, drill a series of ¼in. holes in it thus (Fig. 1), and screw a steel plug, P, in the bottom, with the shoulders larger than your pipe to give clearance for the pipe when driving. I forgot to say you must cover the ¼in. holes with brass wire netting of from 60 to 120 to the inch, according to the soil you get the water from. This must be soldered on. The cylinder for this depth should be 2½in. diameter, with, say, 8in. stroke, the cylinder-cover screwed for 1¼in. gaspipe, inside of which pipe works a ⅝in. gaspipe connected with the plunger. If the soil is loose gravel or sand, it will be necessary to case it, which I have done with wood, as that is cheapest in western parts of Canada. Get the sawmills to cut you out some pieces 6ft. long by 2in. wide, 1in. thick; then with a pair of compasses strike out a circle the diameter of the hole you are going to bore; draw lines from centre to circumference 2in. apart, and cut a thin piece of wood for your bevel, and plane them true to it, so that, when fitted together, they will be like staves in a cask, only straight; but mind and break your joints by putting them together, the first lot alternately 4ft. and 5ft. in length, and skew-nailing them, and drive the tube thus formed well down every time you draw the auger. The bottom of this tube ought to be shod with iron; and if the soil is at all difficult to work, you should commence with a 10in. hole, so that if your casing got stuck, you could use a smaller auger inside, and put a smaller casing inside also. For water at 20ft. to 25ft. from surface, I used to dig a square hole, say, 7ft. deep, and then drive in pipe from one corner (which gives room to work your gas-tongs in screwing up), and then just above the cylinder, at the place marked H, I filed with the edge of a half-round file a small cut across, just enough to allow a small leak, which, being 7ft. below surface, effectually prevented the intense [illegible]osts of that country from bursting the pipes, and [illegible] kept the water cool in summer. If "J. W. E." requires further information, and will advertise his address, I will endeavour to help him.—G. B. P., Southsea.

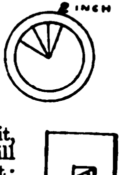
F I G. 1.

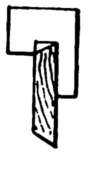




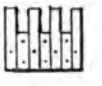
F I G. 2.

F I G. 3.





F I G. 4.



[57516.]—**Tube Well.**—To "J. W. E."—In Norton's pumps and tube system the tube is, of course, driven by a heavy circular weight or monkey surrounding the tube for, say, 1ft. or 2ft. deep, worked by chains or ropes attached thereto, going over a pulley in frame fixed at top of tube, and falling on a movable collar attached at top of tube. As lengths of tubes are required they are easily connected, and driving goes on till water is reached. The pump, pump-rods, and working barrel (latter placed, say, 10ft. off water surface) are then fixed, and the thing is complete. There is another (by J. Warner and Sons) kind of tube well where the hole is bored by proper tools, lined with iron, and then another iron pipe put inside containing the working barrel (placed at bottom of tube), pump rods and the pump case fixed at top. They do not, however, recommend it for greater depths than 40ft. At your correspondent's depth the Crescent deep-well pump (lift and force) or No. 75 would answer all purposes.—BREAM'S BUILDINGS.

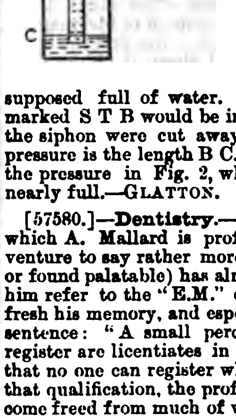
[57526.]—**Heat in Dynamo**—Is probably due to bad ventilation of the armature. A blast of air driven between armature and pole-pieces might remedy this.—ELECTRICAL ENGINEER.

[57529.]—**Cupola.**—ERRATA.—Read "Line furnace with firebrick, and daub with Sheffield ganister or fireclay, ground."—SAND RAT.

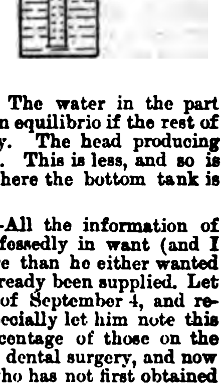
[57535.]—**Legal.**—If at the time of finding lost property the finder knows who the owner is, whether by means of marks on the property or otherwise, and fraudulently converts it to his own use, it is larceny; but if the owner was not known at the time, to detain the property after subsequently discovering him is not larceny, and will only render the finder liable to a civil action. If the owner is not known, the finder is entitled to keep possession. It is not his duty to hunt up an owner, whether by means of the town crier, the police, or otherwise. When the owner is found, the finder can claim no reward for restoring what does not belong to him. When lost property is of value, to endeavour to trace the owner may be a moral duty; but where the value is small the best thing is to appropriate the thing found to one's own use, and be thankful.—KAPPA.

[57547.]—**Gas Tank.**—I am afraid J. Laundy's tank, as sketched on p. 107, would not equalise the pressure. In the annexed figures, the siphon is supposed full of water. The water in the part marked S T B would be in equilibrio if the rest of the siphon were cut away. The head producing pressure is the length B C. This is less, and so is the pressure in Fig. 2, where the bottom tank is nearly full.—GLATTON.

F I G. 1.



F I G. 2.



[57580.]—**Dentistry.**—All the information of which A. Mallard is professedly in want (and I venture to say rather more than he either wanted or found palatable) has already been supplied. Let him refer to the "E.M." of September 4, and refresh his memory, and especially let him note this sentence: "A small percentage of those on the register are licentiates in dental surgery, and now that no one can register who has not first obtained that qualification, the profession will gradually become freed from much of what at present degrades it, and the public cease to be victimised by ignorance and quackery." If A. Mallard will insist upon enlightening the readers of "Ours," he had better take up some subject which he understands a little better than he does dentistry, for with every desire to do him justice, it is impossible to think otherwise than that "998" was correct in saying as he did in his reply of the 16th ult., that "A. Mallard is evidently not a dentist, and evidently has a very crude notion of the actual work of a dentist."—DENTAL REFORM.

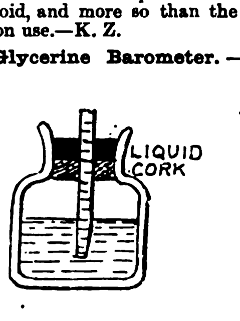
[57584.]—**Dynamo.**—Prof. S. Thompson's is the best work yet published on the subject; a great deal of what you require will, however, only be found out by experience.—ELECTRICAL ENGINEER.

[57585.]—**Casting Zinc.** — Hot zinc is very rotten. Let the castings be well cooled before turning out of moulds, and they will be all right. —DENS.

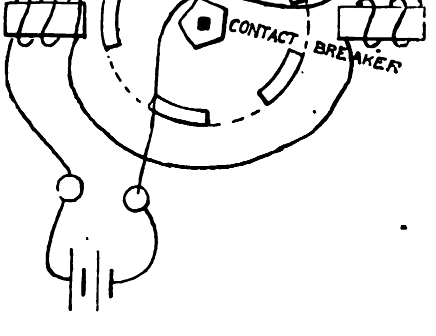
[57585.]—**Casting Zinc.** — Some years ago I had to cast some zincs, and my first attempt was like "Cathode's." I succeeded at my next, and have never had any trouble since, and can have zincs soft or hard. First, I take care to not put the crucible on a very strong fire, only a moderate heat, and as soon as the last bit of zinc is melted, I lift the crucible off the fire and set it on a hot tile, or something of that kind. I then let it set till I find the surface getting a thin film of cooled metal. This is the time to pour into your moulds if you want soft, kindly metal. When I want zincs for Leclanché cells, or the like, I make my moulds with good strong paper, soaked in a saturated solution of alum. I roll the damp or wet paper round a bit of brass tubing of the required size; twist the one end before taking the paper off the brass; set 3 or more in porous cell; fill up the spaces with whiting to keep them steady; pour in the zinc, and wait till I am sure the metal is well chilled before I disturb it. By attending to the above, I have no trouble with zinc more than lead or brass.—BRIAN BORU.

[57587.] — **Glycerine Barometer.** — I cannot agree with Mr. Evans that this instrument is of little use as a barometer. I constructed one at the time your article appeared, and the results given by it have been most satisfactory. To render it perfectly airtight I used two indiarubber plugs, with a layer of glycerine between them, and to protect it as far as possible from changes of temperature, I inclosed the bottle in an old round tobacco-box, packing the space all round (about an inch) tightly with flour. In this instrument I find that a variation in height of about 8in. would correspond to the three degrees—28 to 31—commonly given on dial barometers. As an example of its performance I may mention that a rise (i.e., a fall) of nearly 2in. occurred just before the sudden change of weather on Tuesday, the 6th. With the precautions taken, the variations caused by changes of temperature are so small that they need not be considered, and do not affect the general result. For purposes of accuracy a mercurial barometer is of course desirable; but, carefully conctructed, this instrument seems to me quite as reliable as an ordinary aneroid, and more so than the mercurial dial in common use.—K. Z.

[57587.]—**Glycerine Barometer.** — Place a liquid such as mercury or glycerine over cork, as in the figure.—ELECTRICAL ENGINEER.



[57595.]—**Electric Engine.**—The above is a drawing of connections; two Bunsen or bichromate batteries ought to be sufficient. See that the contact-breaker is all right and clean at points, and that it cuts the magnets out when an armature is directly over them. To insure good contact, clean the ends of the wires with emery-cloth. Should be glad to know if it will work, and help you further if necessary.—ELECTRICAL ENGINEER.



[57598.]—**Chemical Problem.**—It would be well if correspondents sending questions of this sort would state whence they are taken. This one is from the Honours paper of the Science and Art Department last May, and the weight of the aluminium should be 5·2632, not 5·2362, as printed in the "E.M." In calculating out results from data such as those given, everything depends upon the formula assigned to the compounds of the element, whose atomic weight has to be found. Taking the usual view of aluminium—namely, that it acts as a pseudo-triad resembling iron in the -ic series, we have for the action of caustic soda on the metal the equation—

$$Al_2 + 6NaHO = Al_2H_6O_6 + 3H_2$$

The displaced hydrogen corresponds to three molecules of water weighing 53·88, so, if we denote the atomic weight of aluminium by x, we have—

$$5{\cdot}2632 : 5{\cdot}2562 :: 2x : 53{\cdot}88$$

whence—

$$x = \frac{5{\cdot}2632 \times 53{\cdot}88}{5{\cdot}2562 \times 2}$$

Working this out, somewhat hurriedly, by logs. I find $x = 26{\cdot}976$. In the next case we have an equation which, for this purpose, may be written—

$$Al_2Br_6 + 3Ag_2 = Al_2 + 6AgBr$$

and calling the atomic weight of aluminium x, we have—

$$2x + 478{\cdot}5 : 645{\cdot}96 :: 8{\cdot}6492 : 10{\cdot}4897$$

whence—

$$20{\cdot}9794x + (478{\cdot}5 \times 10{\cdot}4897) = 645{\cdot}96 \times 8{\cdot}6492$$

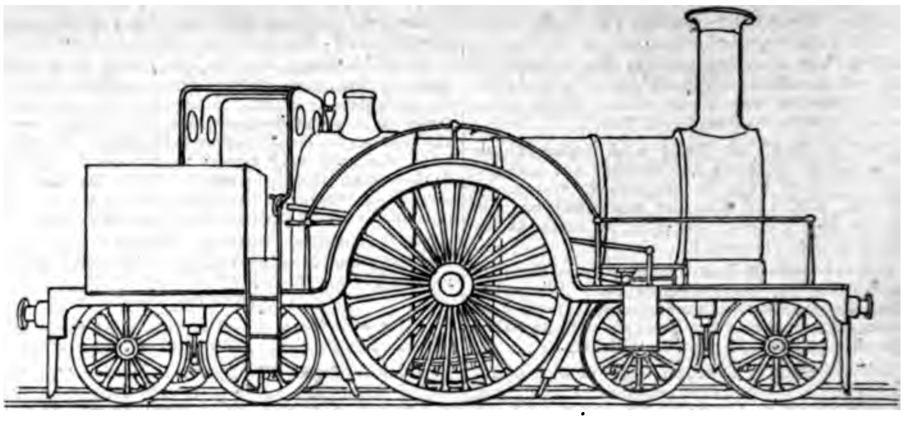
$$\therefore x = \frac{(645{\cdot}96 \times 8{\cdot}6492) - (478{\cdot}5 \times 10{\cdot}4897)}{20{\cdot}9794}$$

Using logs I make $x = 27{\cdot}060$. Both these values are somewhat lower than the one usually received. Baubigny made a determination by converting the sulphate into oxide by ignition, and found Al = 27·064.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-upon-Tyne.

[57607.]—**Dynamo.**—TO MR. EAVES.—I am quite correct in saying that the current passes through the field magnet coils; it can only pass through the F.M.'s when there is a short circuit between the iron and the coils. With regard to the manner in which the current is shunted round the F.M.'s, the operation is simple enough. The ends of the shunt coils are connected to the terminals of the machine, therefore when the current reaches the terminals it has the choice of two paths, one through the external circuit, and one through the shunt coils, the current dividing itself in the two circuits in proportion to their respective resistances. Wire for 10 light compound: Shunt coils, 24lb., No. 20; series coils, one layer, No. 14. I have in hand a 10-volt machine, to give 70 ampères, and if this would suit you, I will in a few weeks give you the necessary particulars for its construction.—W. H. EAVES, Coventry.

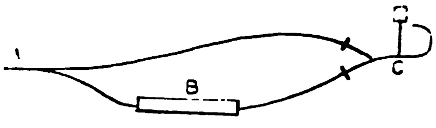
[57631.]—**Electro-plating.**—I think your solution is too rich in silver and too poor in cyanide. Take a small quantity of it and dilute it, and add a little cyanide; then try a small article in it. You could experiment on, say, a wineglassful of your present solution; as long as it gives a deposit on a bit of clean brass immersed for a few seconds (not connected with battery) it is too strong—remedy, more water. I always give an article a rub over with a rag dipped in a dilute solution of nitrate of mercury till it has a thin film of mercury all over. Don't do this with lead or pewter, which should have a coat of copper before putting into bath. If you don't succeed, write again.—WATCHMAKER, Youghal.

[57618.]—**G.W.R. Loco.**—In reply to this query I send outline of 9ft. B. and E. tank. These engines were built by Rothwell and Co., of Bolton, and had 9ft. driving wheels and inside cylinders 17 by 24. The diam. of the bogie wheels was 4ft., and the engine carried two underhung tanks. Since the B. and E. ceased to have a separate existence, these engines have been rebuilt by the G.W.R. with 8ft. wheels, which, like the rest of this class, are flangeless, and have been converted into tender engines.—B.

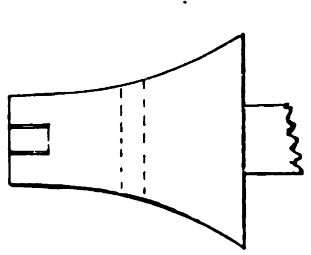


[57624.]—**Legal.**—The noise caused by the eternal ringing of a peal of bells is doubtless an abominable nuisance to many persons; but if only rung in the daytime, and not causing more substantial inconvenience than alleged, I do not think there is any remedy. They may put an end to musical attempts; but who knows that this may not be to the immense satisfaction of the adjoining householders?—KAPPA.

[57638.]—**Limelight.**—"Portable" will find the best and safest way of using the ether light is the following:—A, tube from oxygen bag; B, brass tube, 2in. diameter by 18in. long, filled with cotton wool saturated with ether. I should think it does not matter if the etheriser is on the floor or not; but I should not advise him to use fluid ether.—EOS THE SECOND.



[57652.]—**Brass Steam Tap.**—I would make this preferably with the body made of cast-iron, and the plug of steel, and would not have it of the ordinary taper form, but as shown in the diagram —A., Liverpool.



[57653.] — **Scale in Boilers of Portable Engines.**—I think if "New Subscriber" will only try one pound of common washing soda per day until he gets rid of his scale, then use half a pound per day after, he will find his boilers will not scale much. I am doing the same.—S. B. R. M.

[57670.]—**Glycerine Barometer.**—I made one of these about a month ago, and have found it to answer very well, recording the barometric pressure fairly accurately. It is, as "Surveyor" says, liable to variation with the temperature; but this I allow for by a simple device. I found the variations due to temperature by putting it, together with a thermometer, in water, and marking the height of the glycerine; then increasing the temperature 10°, and continuing the process. I then constructed a movable scale. To take a reading, I place the scale to correspond with the temperature, and read the height of glycerine from the other side. To obtain the height of the mercury from this barometer, it must be compared to a mercury barometer and marked; in this way a scale will be gradual built up. Of course it records in the oppo direction to a mercury barometer. The [illegible] would be of no use whatever to variations of perature caused by summer and winter barometer the rise for 10° of and for a fall of 1in. of the In wet weather the air pr than in dry weather.—

ve of Stability.—Having noticed
"Chief" as to the method of pro-
f stability of a vessel, I venture to
a very simple and efficacious way
ntirely supersedes the usual tedious
lation. The *modus operandi* is as
re a supply of gummed cartridge
prick off from the body plan of
ber of immersed sections taken at
apart; the water line up to which
ections are taken should, of course,
h the centre of gravity was found.
is out with a pair of scissors, and
er in their relative positions. The
llection of sections represents the
he ship; by suspending this from
nts, and taking the intersection of
drawn through the points of sus-
ition of the centre of buoyancy is
on the body plan a number of
arious angles of heel, all the lines
the centre of the upright water
is before the immersed sections
the first inclined water-line, and
her. The actual floating-line at
el may be obtained by cutting off
om the tops of the sections until
e same as those in the upright
dinary merchant steamers with
rd the inclined sections would be
han the upright sections at any
gle of heel. It is, therefore,
ting out the sections to leave a
e inclined water-line. Find the
cy as before by suspending them
The distance between a vertical
gh the new position of centre of
ound and a vertical line through
vity of the ship is the leverage at
of the vessel acts to right herself
inclination. By repeating this
rent angles, a complete curve may
he interval between the angles
practical purposes. With regard
y, I infer that he is referring to
f so, I think the following formulæ
ed:—1st. When area of a midship
nd P = horse-power, A = area of
p section in square feet, and
niles per hour,

en $\sqrt[3]{\frac{P}{A}} = V.$

cement of hull is taken,

n $\sqrt[3]{\frac{P}{D^{\frac{2}{3}}}} = V.$

wick.

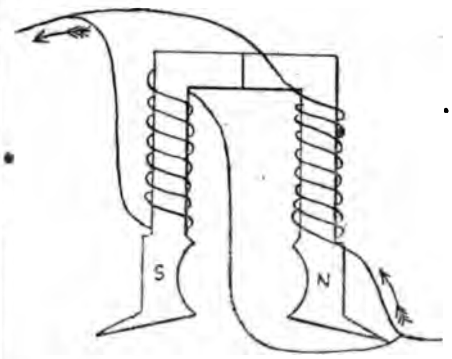
V. H. Eaves, Coventry.— I am
10 to 15 lights would be more than
ld light. No. 14 wire is also a
ck for your purpose. With No.
l armature, the E.M.F. would
lts. To get 50 volts, you must
e with No. 18 d.s.c. No. 18 will
from 6 to 8 ampères, so you can
peres from the machine. Whether
louble magnetic circuit are less
.'s with a single magnetic circuit,
point with electricians. A large
Edison Hopkinson type of F.M.'s
approach of the iron bedplate to
If you can wind the armature
ill send you the directions for
. H. Eaves, Coventry.

chmaking and Jewellery.—
Saunier's Treatise."—Watch-

romate Battery for Lamp.—
considerably more than you will
attery. As a bichromate, you
ight a 2½ to 5 candle for some-
our.—C. L.

romate Battery for Lamp.—
ate battery will do well if it
lamps effectively. It may only
ill depend on the resistance of
y case the light will not last
a hour, and if there is little space
ation, it will not last so long. The
solution is useless to produce a
rs' duration, unless some means
p the liquid in motion. Abiding
te, the best solution to use is
ves a higher E.M.F., and renders
constant. This produces a light
x hours' duration, but the zinc
ly amalgamated by the repeated
cury till a thick coating has been
nly difference between Trouvé's
olution is that, in the former the
dded drop by drop, so that heat
ery gradually, and the whole of
issolved. Connect the cells for
nnect the carbon of the fir
d and the ca
d, and so
carbon of the one to the zinc of the next. This leaves the carbon of the first and the zinc of the last cell free. To the wires from these connect the lamp.—Bobadil.

[57675.]—**Dynamo. — To Mr. Bottone.** — The resistance of the wire on the field-magnets is at least five times as great as it should be. Wind the field-magnets with 7lb. of No. 16, leaving the armature as it is, and you will be nearer the mark. Or, if you know how to do it, disconnect the wire of the field-magnets, and join the four ends up in such a way as to reduce the resistance—*id est*, couple the two limbs of the F.M.'s in parallel arc. By so doing, you will reduce the resistance to one-fourth what it now is. Perhaps the annexed sketch will explain how to do this:—



Are you quite sure you have coupled up correctly. —S. Bottone.

[57689.]—**Faulty Dynamo.**—Supposing all the rest be right, the amount of wire on the field-magnets is too large for the amount of wire on the armature; hence the F.M. resistance is too high. Get at the ends of the wires round the legs of the F.M.'s, and couple them up in parallel, taking care that you join your end so that the pole-piece, remain N. and S. By coupling them in parallel, the resistance becomes one quarter what it was, and you will find that your machine will give better results. Remember, this machine will light five or six twenties, but will not light one alone.—S. Bottone.

[57691.]—**Developing and Retouching.**—You can darken the spots in your negative by careful working with a hard flat-pointed lead-pencil. If the negative is varnished, roughen the surface by a very slight rub with powdered rosin on the tip of your finger. Sit, facing the window, with a sheet of white paper on a table before you. Hold the negative on a slope, so that light is reflected up through it by the paper, and shade the side nearer you from direct light. Then you can see what you are doing. In future, when developing, use a flat camel-hair brush to remove air bubbles, and you will be spared much of the annoyance of blotches and pin-holes.—W. Taylor.

[57691.]—**Developing and Retouching.**—It depends upon where the spots come. If in the sky, it is possible to paint them out with Indian ink; but it is very difficult to do it so as not to show. If it comes in the middle of a lady's dress, I have sometimes cut the gelatine completely away round the border of the dress, and painted another costume; but it need hardly be said that it is quite impossible to make a good job of it, and it is only worth trying when another negative cannot be taken. I am afraid there is no means of mending matters by chemical means, as the sensitive portion of the plate is, of course, entirely gone after it has been through the hypo bath. It is quite fatal to use too little developer. —R. A. R. Bennett.

[57692.]—**Storage Batteries.**—"Serra" cannot know the extent of the work he proposes to undertake. For the capacity he mentions, he would need a few tons of lead, and an amount of knowledge and skill which can only be gained by experience. The best forms of plate are protected by patent: and if "Serra" wants to use the cells before 1887 he had better buy them. They would cost less, and might be some good.—W. Taylor.

[57694.]—**Granule Carbon Battery.**—Twelve quart cells should be quite sufficient to light a 2½ c. lamp. Have you got a good solution? How are your cells connected up—not in arc, are they?—C. L.

[57695.]—**Electric Lighting.**—By dynamo and gas or steam-engine. Accumulator costly and wasteful. Could not be successfully charged with hand-dynamo.—S. Bottone.

[57695.]—**Electric Lighting.**—Your query is
uite for a useful reply. Probably the
ould be to work the lamps direct from dynamo, driven by a gas-engine. The size of these must depend on the amount of light required. The combination of hand dynamo and accumulators would be costly and troublesome.—W. Taylor.

[57695.] — **Electric Lighting.** — A one-horse Otto, indicating 1¾ h.p., will, with small shunt-wound Siemens machine, drive, say, 7 to 8 20-candle power Swan lamps, 45 volts, or will run a small arc lamp. This is the cheapest method of a really practical character that I know of. No doubt an accumulator could be charged by a hand dynamo; but "J. B." would find it expensive if his time is of value, and a rather tiring matter for his muscles. —F. M. Rogers.

[57695.]—**Electric Lighting.**—It is not possible to answer this query clearly without knowing the area of the shop "J. B." wishes to light. How many gas-burners are required to light the premises now? On this will depend the size of dynamo and gas-engine. For indoors the incandescent system is the best; but its ecenomy has not yet reached the "most economical" stage. When one has the dynamo, it is less trouble and more economical to discard the use of accumulators, and light from the dynamo direct. An accumulator to light a 2½ or 5 c.p. lamp can be charged by a hand dynamo, provided the driver is able-bodied, and rich in the virtues of patience and good temper; but considering it practically, the game is not worth the candle.—Bobadil.

[57696.]—**Gas Stove.**—The fault of burner may be bad pressure of gas, inlet for air too small, hole or holes in brass nipple too small; or, perhaps, the stove is fixed in a draughty position, as when there is a back or down draught atmospheric burner always lights back.—George Jaggs.

[57696.]—**Gas Stove.**—"Resroc" will most likely find that the holes in the ring are too large for the supply of gas. See if it is better when the gas is turned full on. Leakage at the air-holes may be detected by bringing a light near.—W. Taylor.

[57696.]—**Gas Stove.**—In reply to "Resroc," in case of any fault with a gas-stove, apply to the maker. If he is not ashamed of his work, his name will, no doubt, be on the apparatus. If he is ashamed to put his name on, "Resroc" may safely take it for granted that the apparatus is worthless, and throw it away.—998.

[57697.]—**Forcing Pump.**—The water could be forced up by an engine of one-baby power; but the question is, at what rate do you want it pumped—*i.e.*, how many gallons an hour? One horse-power should deliver about 1,500 gallons an hour. If 1 man-power is ⅛th of a horse-power, it would deliver 187·5 gallons per hour. A pump of 1½in. diam. × 6in. stroke, double-acting, making 50 double strokes per minute, would do this.—Glatton.

[57697.]—**Forcing Pump.**—"H. M." must say what quantity of water per minute he wishes to force: the weight multiplied by the vertical head will then give the power required.—F. M. Rogers.

[57698.]—**Deposit in Boilers.**—Try tannate of soda.—F. M. Rogers.

[57698.]—**Deposit in Boilers.**—My query last week contains a mistake. It should have read in third line: "The scurf about 1in. diameter," not 1in. thick. There is not a single plate where scurf is more than ⅛in. thick in all three boilers.—T. E. F.

[57699.]—**Kilns.**—If you can connect the top of your kiln with a good draught chimney, there appears to be no reason why even glazed bricks should not be produced in it; but as an intense heat is necessary to fuse the rather refractory glaze that is employed for all durable goods of this class, I do not think your kiln unaided would answer. I presume your kiln is a "muffle" furnace; should this not be the case, all glazed wares must be most carefully protected by wadded saggars. Make your experimental articles as thin as will suit your purpose; use rather quick clean non-soldering coals; and if you cannot connect the top of kiln to a good draught chimney, try the effect of a pair of blacksmith's bellows to finish with.—Pottery Tech.

[57702.]—**Coil.**—Two or more of the alternate plates of the condenser must be touching each other. Take it to pieces, and remedy that fault.—C. L.

[57702.]—**Coil.**—This looks as if there were a leak in the condenser, through which current passed instead of through primary.—J. Brown, Belfast.

[57702.]—**Defective Coil.**—The condenser must be defective, not the coil. The insulation of condenser appears to have broken down; hence current passes through it instead of round the coil.—S. Bottone.

[57702.]—**Coil.**—The fault is probably in the connecting, which you do not describe. Connect the ends of the condenser, one to each secondary terminal of the coil; don't try to send the current through the insulation, and be sure it is sound.—W. Taylor.

[57702.]—**Coil.**—The cause of the contact-breaker of the coil stopping when the condenser is attached is probably due to the condenser being short circuited—*i.e.*, two adjacent sheets of tinfoil touching. I had the same difficulty with mine; but after I had remade the condenser it worked all right.—J. H. G.

[57702.]—**Coil.**—If "Cousin Benedict's" contact-breaker simply refuses to vibrate on attaching the condenser, that apparatus is probably too large for the battery-power used, and he should make up a smaller one; attaching it to the coil and adding sheet by sheet until the spark at the break almost vanishes. If, however, the hammer is attracted and sticks to the core, the two sides of his condenser communicate with one another, and it must be remade.—B. H.

[57702.]—**Coil.**—Your condenser is in fault; it evidently closes the primary circuit, and, of course, prevents the current from passing through the contact breaker. The condenser is an important part of an intensity coil, and should be carefully made. Examine the insulating sheets, and do not use any that have pinholes in them; then if you properly arrange your series of tinfoils with one perfect insulating sheet between each, you will find that your condenser will reduce the spark at the platinum point, but will not stop the contact breaker.—T. Perks.

[57703.]—**Electric Lighting.**—The half h.-p. gas-engine would have a comfortable load with six 20-candle power lamps. The affair would cost about £40. As to the expense of working and the necessary experience, intelligence and cleanliness will keep good plant in good order for years, and make the cost, in your case, as low as that of gas.—W. Taylor.

[57703.]—**Electric Lighting.**—Electric lighting by incandescent lamps will cost about 1s. per hour. On the arc system it will be much cheaper. Dynamos don't last for years without requiring repairs any more than other machines, and the life of an incandescent lamp is from 700 to 1,000 hours. An inexperienced attendant, I am afraid, would not be of much use. See reply, p. 263, of last volume.—Bobadil.

[57703.]—**Electric Lighting.**—Your engine would run a 10-light dynamo easily, but anyone who told you that your engine would run a 16in. dynamo for 10 to 30 lamps, must have been, to say the least, slightly "stretching it." If you were running only six lamps, any waste of power would be prevented by the engine governor. The cost of 10-light dynamo would be £22 10s., the £2 10s. representing the extra for fly-wheel, loose pulley, and extra bearing; leads would cost about 12s., lamps and holders, with the necessary switches and fixtures, would cost £2 10s. Lamps last about 800 hours. Dynamo will last many years, the only wearing parts being bearings, brushes, and commutator. A lad could manage the installation when once put up. You would get 30 per cent. more light if you burn the gas in the engine than you would if the gas is consumed at a burner.—W. H. Eaves, Coventry.

[57704.]—**Scratch-Brushing.**—Some use stale beer, others soapsuds. The one is used about as much as the other, and both are equally good. Articles ought to be rinsed in clean water before being placed in the sawdust, and it will be perfectly safe to have the sawdust in a pan over a Bunsen burner.—Bobadil.

[57706.]—**Dynamo (Faulty).**—Apparently insulation is defective; hence, with the higher E.M.F. generated at the higher speed, the current leaks through the magnets. To ascertain this, while the machine is moving, touch the iron fields with the wires used as electrodes, first one and then the other. A spark will show itself if the machine leaks. Remember that a dynamo (series-wound) that can light five twenties cannot light one alone.—S. Bottone.

[57706.]—**Faulty Dynamo.**—The fault in your dynamo is easily explained. Perhaps the commutator does not run true; in this case the commutator must be trued up, or the pressure of the brushes increased. Perhaps the brushes have not enough lead; but I strongly suspect that it is the fault of the brushes not making good contact with the commutator. While the dynamo is running, press the brushes on the commutator with the fingers, and then test it. Do not forget to put a glove on your hand first, or the machine will extract an uncomplimentary expression from you.—W. H. Eaves, Coventry.

[57706.]—**Maiche Battery.**—From your description, the Maiche is a modification of the Leclanché; use a solution of sal-ammoniac.—C. L.

[57709.]—**Repousse Work.**—If "Dick" will turn to Vol. XXXVI. page 119 of the "E. M." he will find a description of this work by A. François in reply to a query of mine. As he may not have the volume at hand, I will just give a short account of how it is done. A piece of rolled brass is cut to the required size and roughly polished, the design is then transferred to it, and it is attached by a peculiar cement to a stone or wooden block. As soon as it is cold it is ready for chasing, which is the first part of the process; this is done with small tools and a hammer, the outline being gone over first and the ground afterwards. The plate is now taken up, cleaned and replaced on the block face downwards; the parts of the design intended to be in relief are beaten up with suitable tools. When this is finished, the work must be cleaned, and if the nature of the design requires it, laid down again on the block face upwards, and any parts beaten down that require to be lower than the surrounding surface. When completed, it should be polished and lacquered. I shall be happy to help "Dick" further if I can; but I think he will hardly do much without lessons from a professional. When I began it was quite an occult art and entirely confined to the trade; even the tools could not be bought, as chasers always make their own; now there are several who profess to teach it, amongst whom is Mr. A. François, Ryland-road, Birmingham, who advertises constantly in "Ours." It is a most charming and fascinating art, and "Dick" will never regret having taken it up.—Fal.

[57711.]—**Engineer's Taper and Parallel Rimers.**—Whether the rimers are intended to be round or square, it is advisable to use round steel. In making taper ones, I should advise you to first turn them in a lathe to the required taper, and construct them so that there are two cutting edges only, or you will never make a true hole. By this I mean that there should be about one-third of circumference left untouched, and the diametrically opposite end and the adjacent sides should be filed flat (and not grooved) down to form the cutting edges; the distance between the two corners should also be marked off equal to one-third of circumference. In the case of parallel rimers, I should recommend you to have three grooves of a radius equal to half that of a rimer and file, or what is termed "backing off" that part of circumference to the left of cutting edges. The square for wrench should have diagonals equal to the diameter of rimer. When polished up, heat it to a cherry red, and temper down to light straw colour. "C. E." should bear in mind that there is a slight contraction after hardening, which he will have to allow for if he wants to make them to any standard sizes.—W. G. N., Chiswick.

[57713.]—**Strong Paste.**—Try roughening the surface of cloth with glass-paper, and use ordinary gum or paste.—W. Taylor.

[57715.]—**Lathe Bed.**—A straightedge will show along each length, whether it is flat or not; a gauge made to fit between the gap, and passed along, will prove whether or not they are parallel, and by looking along the top edges of two parallel strips placed laterally, one at the extreme ends of the bed slides, and the other across the nearest ends of same, will indicate whether they are in the same plane. I scarcely need say that the longer the parallel strips are, the more obvious will the discrepancy, if any, appear.—G. W. N., Chiswick.

[57716.]—**Prepared Emulsion.**—Both the ordinary gelatino-bromide and the collodio-chloride answer to this description. T. Robinson, of "Ours," used to advertise 2oz. bottles of the former emulsion. An inquiry to him would probably elicit a response. The latter has gone out of date. I can give details of manufacturing the former if you desire. The former is exquisitely sensitive; the latter about the same as wet collodion.—S. Bottone.

[57723.]—**Grinding Flints.**—The flints are first washed with water, then burned to full redness in conical kilns similar to lime kilns. The burned flints are then crushed, usually through a "Blake" or a "Mason's" crusher, and then thrown into a flint pan—i.e., a large iron or wooden circular pan or tub, about 12ft. diam. and 3ft. high, paved at the bottom with flint stones obtained from North Wales, and having a cast iron centre tub about 16in. by 11in. secured to the floor, through which passes an upright driving shaft. Attached to this shaft are four cast-iron curved arms, the ends of which project to within 6in. of the pan side, and these ends are firmly connected to each other by a strong wrought iron hoop; these projecting arms propel huge "runners" or chertstones rapidly over the paved floor, and when the flints are thrown into the pan with sufficient water to prevent dust and excessive friction, they pass under these "runners," and, in course of ten hours, are run off the pan, levigated, and the thin slip is then settled to the desired consistency.—Pottery Tech.

[57725.]—**Ball-Room Floor.**—Have the floor well scrubbed, then make a mixture of one gallon of boiling water, 1½lb. of yellow soap, and ¼lb. of wax. Stir while boiling till well dissolved. Wash the floor with this, and when tolerably dry powder it with French chalk and polish with a long handled brush sold for that purpose, rubbing the way of the grain.—Eos the Second.

[57718.]—**Annuities.**—The formula in the question is an approximation to the equation—

$$P(1+r)^n = \frac{A}{r}\left\{(1+r)^n - 1\right\}$$

which is the general equation for annuities at compound interest. It is obtained in the following manner:—Let both sides of the above equation be expanded, and we have—

$$P\left((1 + nr + \frac{n(n-1)}{2}\, r^2 + \propto c\right) = \frac{A}{r}\left(nr + \frac{n(n-1)}{2}\,.\, r^2\right)$$

in which, since r is a small quantity, it may be allowed in some cases to neglect terms involving higher powers of r than the square, and then—

$$P\left(1 + nr + \frac{n(n-1)}{2}.\, r^2\right) = An\left(1 + \frac{n-1}{2}.\, r\right)$$

If we divide both sides by $\left(1 + \frac{n-1}{2}.\, r\right)$ we have—

$$P\left\{1 + \frac{n+1}{2}.\, r + \left(\frac{n-1}{2}\right)^2 r^2\right\} = nA.$$

But if we choose further to neglect the term in r^2, we have—

$$P\left(1 + \frac{n+1}{2}.\, r\right) = nA,$$

And this is the formula given in the question. If it be desirable to use such a formula for questions in annuities, it should only be in cases for very short periods, otherwise it would lead to very absurd results. To take an example: Suppose it were required to find the present value of an annuity of £70 for 59 years at 5 per cent., then $A = 70$, $n = 59$, and $r = \cdot 05$, and the approximate formula gives—

$$P\left(1 + \frac{60}{2} \times \cdot 05\right) = 59 \times 70$$

$$\therefore P = £1{,}652.$$

Or the formula supposes that £1,652 should be given for an annuity of £70 to continue for 59 years. But if £1,652 were put out to interest at 5 per cent., it would yield a perpetual income of £82 12s. If we compute by the general equation the result is P = £1,321 6s.—Milverton.

[57724.]—**Soapstone**—Is magnetic silicate. Its formula is $MgSiO_2$. Its value per ton I'm afraid I can't tell you.—R. A. R. Bennett.

[57724.]—**Soapstone (or Steatite)**—Is hydrous silicate of magnesium, $Mg_2Si_2O_6 + 2Aq$ for ordinary forms of this mineral.—Bream's Buildings.

[57724.]—**Soapstone.**—Steatite or saponite (hydrated silicate of magnesia, with some alumina) is used for several purposes—recently for gas-burners. The price varies according to nature, the harder kinds being valuable for the latter purposes.—F. M. Rogers.

[57729.]—**Sanitary.**—In answer to your correspondent "Y. N.," I have annexed method of calculation for his outfall sewer, but I notice one thing in his question, and that is, he does not state whether any rain comes down in his district or not. I have used the formula $55\sqrt{r \times 2\,L}$; this gives velocity in feet per minute, which, multiplied by area, gives discharge in feet per minute in cubic feet. 15,000 people × 5 = 75,000 cubic feet of sewage in 24 hours, half of which = 37,500 cubic feet to pass off in six hours; this I have calculated for. 1ft. 9in. × 1ft. 2in. oval sewer, area = ⅔rd. full = 1·0287ft., and radius = ·3683ft., rate per mile in feet = 8·8ft.

8·8 ft. per mile fall.
2
17·6
·3683 radius
√ 6·49208 (2·546
55
140·039 ft. velocity per minute.

Taking 140ft. velocity:

1·0287 area of sewer.
144·0180 discharge cubic ft. per minute.
60
864 × 1·0800 discharge cubic ft. per hour.
6
5184 × 6·4800 = 51,846 cubic ft. in 6 hours.

As will be seen, this is more than is [illegible] shown above, but it should not be to [illegible] rainfall.—X.

[57729.]—**Sanitar**
information than is

design a sewer properly, it is essential to know—*a*, area of land to be sewered; *b*, character of population, manufacturing or residential; *c*, annual rainfall; *d*, greatest rainfall in, say, one hour; *e*, what is the water supply, whether from waterworks or from wells; *f*, character of town, is it paved or gravelled? *g*, the length of sewer proposed, from the last junction, with a branch sewer to the outfall; *h*, is the town likely to increase? All these are elements to be taken into consideration, and unless the information is supplied, the answer to his query cannot be accurately given.—SURVEYOR.

[57732.]—**Gear Wheels.**—Can be cast in loam moulds, the pattern being made in halves, and each half screwed out of loam. Top and bottom of mould sand.—GLATTON.

[57732.]—**Gear Wheels.**—Certainly; a skew-gear is merely a section of a very coarse-pitched many-threaded screw, and in withdrawing from the mould the pattern—so to speak—is unscrewed, and from this you will see that an armed wheel is not allowable. For small gears, the pattern can be cut sufficiently accurate by inclining a fly-cutter and running it through at the necessary angle to form the spaces between the teeth.—A. F. H.

[57732.]—**Gear Wheels.**—By skew gears I understand you to mean angle wheels, not skew bevels, since it is obvious that the latter can be cast easily enough. I have made angle wheels both by pattern and by moulding machines, and have seen those also which have been cut by machine for use as patterns. A well-made hand-cut pattern is quite equal to a machine-cut one. The pattern is made similarly to that of a worm (Vol. XXXVII., p. 307), the lines of the tooth points being marked on a sheet of paper and wrapped around the block from which the teeth are to be cut. The precaution must be taken of drawing the diagonal lines to the development of the lines on the outside or largest circumference of the block, and not to that of the pitch line, because the obliquity of an angle wheel tooth is so much that there is a very considerable difference between the one and the other. Neglect of this will produce error in the angle of the teeth, while it would have no appreciable effect in the case of a worm. The teeth also require most careful working with a templet held at right angles with their axis, so that its position varies at every point. Slight errors in the way of holding the templet will cause the tooth spaces to be unequal. The pattern is moulded with its ends in the horizontal position, and is twisted out of the sand at an angle conterminous with that of the teeth. To prevent the sand from being pulled up, a perforated plate embracing the teeth outlines is often laid on the face of the mould, and through it the pattern is twisted out.—J. H.

[57733.]—**Lathe Flywheels.**—I quite coincide with your remark: it is frequently overdone. The makers know that if they increase the weight and diameter of flywheel they will get more energy or capacity for work; but they apparently ignore the fact that you must first of all put the work into the flywheel.—W. G. N., Chiswick.

[57734.]—**Lathe Flywheels.**—There are supposed to be rules for getting at weights and diameters of above; but one maker's rules will give totally different results to those of others. My experience would support the adoption of a moderately heavy wheel, 80lb. to 90lb. for a 5½in. or 6in. lathe, perfectly balanced; not as ordinarily understood when speaking of lathe flywheels—i.e., with a counterpoise to bring footboard to a convenient position for starting. If this compensation for weight of treadle gear is thought necessary, let it be attached at the back of treadle-shaft, or in some other way, as I think it very desirable that the lathe-fly or driving-wheel should be an evenly-balanced one. This is a subject I should like to see thrashed out in our correspondence columns.—A. F. H.

[57736.]—**Quicksilver in Loaf of Bread.**—The only time I have ever heard of the method alluded to was from an old fisherman, who implicitly believed in it, and complained of the waste of time the modern method of dragging caused. I cannot think that J. Barron is serious in asking such a question. It savours of the description given of the properties of quicksilver by the alchemists. What possible attraction could there be between the two inert substances spoken of?—QUIZ.

[57736.]—**Quicksilver in Loaf of Bread.**—A fact?—of course it is! I wouldn't employ any baker whose bread I couldn't depend upon to find me a corpse at a moment's notice. It is hardly [illegible]essary to say that it must be a cottage loaf; [illegible]y bread is of too frivolous a nature, and even [illegible]e-made or brown bread is not always to be [illegible]. The cause is, no doubt, the magnetic [illegible] exists between the hair of the [illegible] the quicksilver contai[illegible] [illegible]rtune is that [illegible]s of dead cat[illegible] dogs are present, the loaf is apt to get puzzled and make mistakes. In the case of a suicide, the loaf would of course turn completely upside down. Any further information the querist may require could be obtained from Scotland Yard, where full particulars would no doubt be supplied, and possibly a loaf warranted to answer the purpose might be obtained at a small cost.—R. A. R. BENNETT.

[57736.]—**Quicksilver in Loaf of Bread.**—If this were a fact, is it likely people would go to the trouble of employing drags or divers for the purpose of discovering drowned persons!—J. BROWN, Belfast.

[57738.]—**Belting and Shafting.**—The best way to vary the speed is by using two reverse cones. This method is, however, only suitable for small powers. There are scores of books published which will give information as to the method of computing speeds of pulleys. The speed of engine being known and the size of driving pulley, multiply the speed of driving pulley by its diameter, and divide by the required speed of driven pulley, which will give the diameter. Ordinary gas-pipe is frequently used for steam heating purposes. To convey power 200ft. I prefer either cotton or raw hide rope; but wire rope can be used if expense is no object.—F. M. ROGERS.

[57738.]—**Belting and Shafting.**—"Amateur Engine Fitter" can vary the speed of a machine by having on it a cone pulley driven from another on the shafting. The large end of one must be opposite the small end of the other, and the belt may be moved along by means of a fork and set screw. To calculate the sizes of these cones, or those of any pulleys you may require for obtaining certain speeds, multiply speed of driving-shaft by diameter of its pulley, and divide product by required speed of driven shaft. Result will be the diameter of driven pulley. You may measure speeds in revolutions per minute, and diameters in inches. Ordinary iron barrel would do for heating purposes. As to whether a belt or wire rope would be better for driving 200ft., much depends on what amount of power you wish to transmit. A cotton rope might be better than either.—W. TAYLOR.

[57738.]—**Belting and Shafting.**—In cotton mills two taper drums are arranged, one to drive the other by a belt. The thick end of one is opposite the thin end of the other. By moving the belt along the driver, the speed can be varied. Will someone who has seen this arrangement tell me how the belt is kept from riding towards the largest diameter of the drums? I do not know of such a table. Let—

D = diameter of driving pulley;
d = diameter of driven pulley; both in inches.
t = thickness of belt in inches;
R = revs. per minute of D;
r = revs. per minute of d;

$$d = \left\{ \frac{R}{r} (D + t) \right\} = t.$$

I have used gas-pipe for the purpose, and carried 75lb. of steam. I should prefer the wire to a belt; but a shaft would be better.—GLATTON.

[57738.]—**Belting and Shafting.**—Your idea, I am afraid, would fail for want of power, owing to having decreased the tension of the belt and surface of contact; but if the power is not required to be great, and the belt is as long as it is stated in your following query, the weight of it alone on the pulley would be sufficient to answer your purpose. Wire rope, I think, would be the best agent; but for a shorter distance it is not recommended, owing to violent oscillations. Unwin gives the limit to be 130ft.; but although the resistance to bending is greater than that of leather belts, and thereby reducing the arc of contact on the pulley, we get the same driving power, but the pressure per square inch of contact must be greater, and therefore more severe upon the material; but then, again, its enormous strength can stand it. Gas piping would do for ordinary heating purposes, but the steam would condense before it had travelled very far. To calculate the speed of your shafting—

$$\frac{\text{Driving pulley diameter in inches by revolutions per minute}}{\text{Diameter of follower}}$$

will give number of revolutions per minute.—W. E. N., Chiswick.

[57738.]—**Belting and Shafting.**—The regulation of speed for your machine can be done by the ordinary series of cone pulleys in use on almost every lathe. Or if the interruption caused by changing the belt from one pulley to another is undesirable, then use a single pair of "reversed cones"—driver and driven—on which the belt may slide smoothly as wanted at any speed by means of a traversing belt fork. Such may be seen every day in work on the self-acting mule, or in some of the drawing machines for cotton. The arrangement you suggest would act very unsatisfactorily, if at all. For working out speeds of shafting, &c., you only need the rule of three—you ought to work it out sooner than you could find your "tables." Speed of engine being known, the speed of all shafting, &c., in front of it is in direct proportion to the diameters of the pulleys used as driver and driven. (This is near enough for practical purposes, although in exact calculations the thickness of the belt on each pulley has to be reckoned.) For example, a 24in. pulley driving a 12in., the 12in. will go just twice as fast as the 24in., and so on. As to the last question, I should think that for 200ft. distance a connecting-shaft would be better and less expensive than either a belt or a wire rope.—KUNST MACHT GUNST.

[57738.]—**Belting and Shafting.**—To get various speeds use coned pulleys, like those in a lathe, if the speed is to vary by steps or plain long cones with slow taper and a belt traversed by a guide for speed, varying gradually as required; otherwise a contrivance, used here in flax machinery, for altering the size of the driven pulley, consisting of two cones sliding on a shaft point to point, and so cut as to slide into one another. The driving rope runs between them on the pulley thus formed. If this would suit querist, I should be glad to procure one for him, on his advertising address. The proposed slack belt arrangement would be very clumsy and inefficient. The rule for calculating speeds is too simple to need a table. The speed of the driving pulley multiplied by its diameter, and divided by the speed of the driven pulley, gives the diameter of the latter; in other words, the speeds of the pulleys are inversely proportional to their diameters. Wrought-iron gas pipe will do for steam at a few pounds pressure, otherwise steam tubing is safer. I should think rope gearing, either hemp or wire, according to the amount of power to be carried, would answer best for such a long span as 200ft. Molesworth's pocket-book of "Engineering Formulæ" would be found useful by this querist if he has much work of above kind on hand, and is, or could become, acquainted with the nature of the simplest algebraical forms of expression.—J. BROWN, Belfast.

[57738.]—**Belting and Shafting.**—As I understand your query, the conditions you put down are fulfilled in everyday practice all over the country, and as you say, you can not have much experience in such matters, not to know of the practice referred to. Your plan of a loose belt would, I am afraid, disappoint you. I need scarcely point out why. Either two stepped cone pulleys (which you can have made to give any ratio of speed you please), one being placed on each shaft, or two taper cone pulleys or drums similarly arranged will give you the desired results. In both arrangements one belt is sufficient; but with the stepped pulleys you only get as many variations in speed as you have steps on one pulley, whereas by the latter method you can obtain any gradation contained within the maximum and minimum speeds the relative diameters of the two cones will allow. The rule for calculating speeds of pulleys, shafting, &c., is very simple; i.e., multiply together the diameters of all the driving wheels, and this again by the speed of the first wheel; divide the result by the diameters of all the driven wheels multiplied together, and the quotient will give you the speed of the last wheel. Most iron tube made for gas is unsuitable to put steam through under pressure. For your last query I should advise a sound hemp rope. A compensating pulley will be required at some point in a span of 200ft. beside the guide pulleys.—A. F. H.

[57741.]—**Galvanometer.**—TO MR. BOTTONE.—Either of the batteries you mention will do; but, unless constancy of current is of importance, a bichromate is very convenient for quick work.—S. BOTTONE.

[57742.]—**Galvanometer.**—One Daniell is quite sufficient. You might heat your wire and spoil your galvanometer if you were sending too strong a current through it.—C. L.

[57742.]—**Silver Solutions.**—The recipes mentioned are not for solutions at all, but for dry powders to be moistened and rubbed over metals; they are used for clock-faces and such-like work requiring a dead surface. The simplest plan—not the best, however—is to dissolve an ounce of cyanide of potassium in a pint of water, and pass current from a silver anode till deposit begins to form on an iron plate contained in a porous cell.—SIGMA.

[57744.]—**Dynamo.**—TO "W. H. E."—As you have now wound on your armature 34lb. of wire, the E.M.F. will, of course, be increased, and so you may increase the resistance of the shunt wire; but I do not think you need wind on more than 50lb. If, however, the F.M.'s will hold it, the extra 8lb. will do no harm.—W. H. EAVES, Coventry.

[57746.]—**Commutator.**—By far the best form of commutator for a dynamo of any size is that used in the Hochhausen machine. This consists of L-shaped castings bolted to a disc of slate or vulcanised fibre. This commutator is easy to make, and cannot possibly short circuit. The commutators of most other modern machines are almost worthless, and are very expensive and difficult to construct.—ELECTRICAL ENGINEER.

[57746.]—**Commutator.**—To "W. H. E."—The method of holding the bars together was described in my first letter on the 30-lighter. The bars should have ¾in. radial depth, and should be 3¾in. in their longest, and 3in. in their shortest length; insulation, vulcanised fibre. The commutator is one of the most difficult jobs you will meet with in the construction of the dynamo. Most of the best methods of fixing the bars are patented, and I am at present using a method which I intend to protect. The commutator you require would weigh about 20lb., and if you have to get it made, it would cost you from 45s. to 50s.—W. H. EAVES, Coventry.

[57747.]—**Power Required.**—To maintain 200lb. pressure with the 4in. supply-pipe will require 19·8 h.p., and with the 1in. supply-pipe 317 h.p., without allowing for loss by friction, &c.—G. PINNINGTON.

[57749.]—**Small Boiler.**—The boiler, if cold, would burst with about 490lb. per square inch. To blow off at 245lb. the weight would be 14·8oz. As brass loses strength when hot, such a low factor of safety would be most dangerous and unwise. I should allow a factor of safety of at least 10, as estimated from the cold strength. This brings working pressure down to 49lb., for which the weight would be 2·9oz. Before I can say if it will do for your cylinder, I must know its heating surface. Assuming that steam is cut off at three-fourths stroke, by the rule given on p. 565, Vol. XXXIX., heating surface should be 1·5 × 1·5 × 2 × 15 = 67·5 square inches. I should think your boiler will have about this amount of surface, and if so, it will do.—GLATTON.

[57751.]—**Rain Gauge.**—Let d be the diameter of the circular top of the funnel in inches, w the weight in ounces of the water that has fallen through the circular area, then the area of the circle = $\cdot 7854 \times d^2$ square inches, the volume of the water collected = $1\cdot 728 \times w$ cubic inches, the depth of the rainfall in inches = $\frac{1\cdot 728}{\cdot 7854} \times \frac{w}{d^2}$ = $2\cdot 2 \times \frac{w}{d^2}$. In the particular case when the diameter of the circle = 4·697 inches, and the weight of the water collected = 6oz., area of circle = $\cdot 7854 \times (4\cdot 697)^2 = 17\cdot 3275$ square inches, volume of 6oz. of water = $1\cdot 728 \times 6 = 10\cdot 368$ cubic inches; corresponding depth of rainfall = $\frac{2\cdot 2 \times 6}{(4\cdot 697)^2} = \cdot 5983$ inch. If the same funnel of diameter 4·697 should always be used, then the depth of the rainfall would be = $\cdot 0997 \times w$ inches, or the rainfall would be found, by multiplying the weight of the water collected by the constant multiplier ·0997. The meaning of the saying, "An inch of rain has fallen," is that when a shower of rain falls at any place, if it were possible for all the rain to be retained on the surface, forming a sheet of water of uniform depth—say, 1in.—then it is said an inch of rain has fallen.—MILVERTON.

[57752.]—**Tinning Wire.**—Boiling water, 6 quarts; ammonia alum, 17¼oz. When dissolved, add protochloride of tin 1oz. Clean wire, and immerse until sufficiently tinned.—W. TAYLOR.

[57752.] — **Tinning Wire.**—Fill a tinned copper vessel with alternate layers of wire and plates or pieces of tin (not tinned iron), pour over the whole a sufficient quantity of saturated solution of cream of tartar (potassic bitartarate) to cover the whole, place the vessel on the fire, and boil for five or six hours.—S. BOTTONE.

[57753.]—**Photos of Diagrams.**—"R. M. P." must make an extension to his camera to get his focussing screen further from the lens. If he wishes to reproduce a plan the same size, his lens must be midway between the plan to be copied and the focussing screen. An ordinary camera has not length sufficient to copy; but if "R. M. P." is anything of a mechanic, he can soon rig up an extension. —EOS THE SECOND.

[57754.]—**Gas Supplies.**—Messrs. Glover publish a small book on the management of meters made by them.—F. M. ROGERS.

[57754.]—**Gas Supplies.**—Read the figures that the indicators on each of the three dials have last passed. Write them down in the usual order, and add two ciphers, and the sum then shows the state of the meter. From this deduct the sum when last taken, and the remainder represents the quantity since consumed. To detect waste, turn off all the house taps, set the main cock full on, note the indicator on the small dial at the top of the meter, and if it moves there must be an escape somewhere. The quantity escaping can be easily calculated, as this dial shows a consumption of only 5ft. for each revolution. Should it remain steady, there can be no escape in your pipes.—J. HUGHES.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

57165. Course of the Wind, p. 507.
57167. Wood Planer, 507.
57168. Separating Oil from Tallow, 507.
57188. American Popcorn, 507.
57191. Tuning Clock Bells, 507.
57194. Punch, 507.
57196. Preparation for Hair, 507.
57198. Valves in Compound Engines, 507.

57378. Condensing Engine, p. 19.
57386. Throttle-Valve, 19.
57387. Hopkinson's Valves, 20.
57388. Telescopic, 20.
57391. Compound Tandem Engine, 20.
57393. Fish Curing, 20.
57402. Broad-Gauge Engine, 20.
57404. Legal, 20.
57408. Power from the Waves of the Sea, 20.
57414. Brakes, 20.
57418. Hot-air Bath, 20.
57420. Incubator. To Mr. H. Rowton, 20.
57422. Lathe Tools, 20.
57424, Fireworks for Balloons, 20.
57426. Bull-Headed Rails, 20.
57427. Double Headed Steel Rails, 20.
57428. Shutter Springs, 20.
57432. Gas Engines, 21.
57442. Replacing Broken Bubble of Level, 20.

QUERIES.

[57755.]—**Wimshurst Influence Machine.**—Can any of the numerous readers of "Ours" give a satisfactory theory by which the rise of potential, which takes place on working the above machine, is explained? My difficulty lies in the fact that the same sectors on which a charge has been induced when acting as carriers, immediately afterwards act as inductors to the sectors on the opposite plate, without having had the charge which they possess augmented in any way. How can a charge of higher potential be induced on the sectors acting the part of carriers whilst in momentary contact with the metallic brushes than is possessed by the sectors acting the part of inductors on the opposite plates?—OLD SMINGS.

[57756.]—**Wimshurst Machine.**—I have just completed one of the above, and have followed the design of Messrs. Tudsbury, as illustrated in the "E. M." some months ago. I have cemented the glass plates to gunmetal bosses and have 14 sectors on each plate, fixed ⅛in. from rim. The plates are separated by a small vulcanite washer, 1-16in. thick, and are pretty true. I have fixed the neutralisers on the spindle which carries the bosses, and have set them to make contact on both sides of the plate at the same time, thereby coupling four sectors at once. I have not been able to get the smallest indication of electricity from the machine, much less a spark, although I have run the machine at a high speed and reversed the motion and neutralisers in every possible way. Are the metal bosses at fault, or ought the neutralisers to be insulated from each other? A reply from Mr. Wimshurst would be gratefully esteemed.—C. P. C.

[57757.]—**To W. H. Eaves, or S. Bottone.**—I am building a house in the natural-gas district, where it is cheaper to produce electric light from natural gas than to burn oil. Will you, therefore, please give me dimensions and wiring of a dynamo to run eight 16 c.-p. lamps, which lamps require a current of 110 volts, 9 am.?—PENNSYLVANIA ENGLISHMAN.

[57758.]—**Plumbing Joints.** — Can any of our readers describe the new system of clear-bore joints said to be used by the Manchester Waterworks Corporation, and which do not require skilled labour?—A. Z.

[57759.] — **Ancient Lights.**— Can any reader of "Ours" tell me whether a recent Act of Parliament has decided that 12 years' possession of a light or window constitutes a right, instead of 20 years' possession as formerly? Also, if so, when was this Act passed, and its title?—J. B.

[57760.]—**Fire Gilding.**—Could any brother mechanic give me full instructions for fire gilding?—WATCHMAKER.

[57761.]—**Fire Gilding with Alloyed Gold.**—Is it possible to gild with alloyed gold, say 15ct., by fire gilding, or any other process?—WATCHMAKER.

[57762.]—**Hand-made Paper.**—There is a manufactory in Devonshire where paper is made by hand process alone—very little machinery. It is used for ledgers; is sold for 1s. per 30 sheets (foolscap size). Could this paper not be made by machinery? It is of light blue colour, of rough surface.—AMATEUR JACK.

[57763.]—**Steam Launch.**—Would any of your correspondents kindly inform me if a Government longboat or cutter would do for a steam launch? These boats are, I think, about 30ft. long and 4ft. 6in beam, and very finely modelled lines. I wish to have a launch, but cannot afford a proper one, so that if I could get one of the above cheap I could fit engine, &c., myself. If unsuitable, in what respect do they differ from an ordinary launch?—LONG BOAT.

[57764.]—**Nickel-plating.**—I have a nickel-plating bath, but cannot get the plating quite to my satisfaction. Will some of "Ours" kindly say what is the reason of the article to be plated turning black?—and also a dark-coloured powder is deposited at the bottom of the bath. I use 3 pint Bunsen cells. How should I prepare iron and steel before plating?—WOULD-BE ELECTRO-PLATER.

[57765.]—**Gramme Dynamo.**—To M
Would you kindly give me rough drawing
work of a Gramme dynamo to light about 2
power? Also the sizes and amount of wir
E. H.

[57766.]—**Fossil.**—I have a good specim
wood (apparently oak), recently taken from
Will any correspondent inform me how to
the same?—ENQUIRER.

[57767.]—**Adhering Photographs**
What is the best liquid for above and mann
glass to appear quite transparent and free
dry?—NEGATIVE.

[57768.]—**Organ-Accordion.**—Wishi
harmoniflute, or organ-accordion, will a
"E. M." give me necessary information fo
with four stops? and also best place to get
for same, the instrument to be 3½ or 4 oc
rows of vibrators?—AMATEUR MUSICIAN.

[57769.]—**Dynamo.**—To MR. BOTTON
my dynamo, which, according to your ki
former query of mine, should light eight
lamps. I found that it would only light one l
and that running at 3,000 revolutions pe
attaching two lamps, it only brought them
first tried two lamps in parallel; all con
soldered, conducting wire No. 12 d.c.c.; len
no result. Tried various shunts, some 12in.
wire and No. 16 copper wire; no result. Co
lamp about 26in. from machine with No. 2
while at above speed, and obtained splendid
lamp). Tried both lamps with same con
result, dull red only. On inserting a shunt of
the A. was brought to a stand-still almos
meanwhile lamps (two) became exting
machine is series wound, laminated H.A.,
F.'s. Kindly say how I shall get all the lam
have plenty of power, and whether to be in
wise, and if the distance of lamps from dyna
affects the E.M.F. of machine? How is
machine lights one lamp so well and not t
did not try any more, as I found it did not
inserting shunt.—ONE IN A FOG.

[57770.]—**Engine.**—Will some reader
me how to level and true a flywheel shaft w
horizontal engine?—H. H.

[57771.]—**Commonplace Book.**—I w
commonplace book or index rerum. Can
kindly inform how to make one?—MUTINE.

[57772.]—**To Mr. Bottone.**—On refer
XLI., I find no mention of electro-motor sui
boat. I have looked through index, bu
Please say, have you not made some mi
anxious to make one soon for a boat abou
E. H.

[57773.]—**Wimshurst Influence**
have been very unfortunate in fixing the bo
plates, about half-a-dozen having broken a
cemented on. They generally last about a
any fracture appearing. The bosses I use a
vitæ," 2½in. in diameter, and I have tried h
out in the middle so as to leave very little
connection with the glass; but this also wa
should be extremely obliged to any reader w
me full information on the subject.—A. F.

[57774.]—**Coupler to Harmonium**
harmonium with two rows of reeds, to whi
attach an octave coupler. Would Mr. G.
one, oblige by giving particulars how to pro
the probable cost will be? I propose buy
sary fittings.—J. H. A.

[57775.]—**The Telephone and the**
telephonist, and am much concerned as t
almost constant use of the telephone is injur
I have, for some time past, been conscious th
hearing, on that side where the instrumen
been diminishing, and some days, probab
atmospheric conditions, I experience aching
every time the instrument is applied. I sh
hear if any of our readers are similarly cir
of any information from practical electrician

[57776.]—**Japan.**—Will some of "Ours
me a good receipt for black and white Japan
how applied?—JAPANOS.

[57777.]—**Electric Bell.**—To MR. BOTT
a circuit, total length of wires is 1½ mile, res
have a dynamo working at 100 volts, and I
the bell, which is to be single stroke, off th
kindly give res. of wire which should be on
so as not to absorb too much current?—ELE

[57778.]—**Shunt Dynamo.**—To "W.
the dynamo described by you (30-lighter)
suitable for charging storage cells, or m
certain ratio between res. of dynamo and
ELECTRA.

[57779.]—**Gower Bell Telephone.**—
above, should the cells be connected in series
—PARCH.

[57780.]—**To "J. C. L."**—I notice th
spondent is again to the fore, and rememb
year or more since he wrote on the Dialyte
in a letter, or reply, numbered 21553, he offe
for any correspondent interested, a large ac
for "corrector." Will he kindly say if he
information to give us on the subject
largest size corrector, &c., he has been
Also would he help anyone who adverti
FINEM RESPICE.

[57781.]—**Tracing Paper.**—
paper put on drawings to take a tr
is the colour put on? I find it
wrinkles, which will not come out.
Should tracings be coloured same
drawing, or only a bit at the
instructions for using tracing-pa
obliged for, as no book that I
instructions for its use.—G

[57782.]—**Laundry.**—
up collars with that gloss p
hot or cold starch be used, an

3.]—**Dynamo.**—To Mr. Bottone and Others. . thinking of building a tandem dynamo, one to be fields of the other, so that the whole current of ond could be used for external circuit. Would e any advantage in this arrangement?—Alpha.

4.]—**Strength of Materials.**—"Unwin" gives of area and modulus of different forms of section. ybody tell me how to apply this to obtain the E of different materials? Also explain what is by the bending moment, and how obtained? Also meant by moment of inertia, and how obtained? don't refer to back numbers.—Young Designer.

5.]—**Ship Designing.**—Will someone inform w the weight of a vessel is obtained?—Young ker.

6.] **Something Worth Knowing.** Will ind reader inform me, through your valuable paper, stant subscriber, the contents of the instructions issued to county-court bailiffs, informing them of fferent articles, say, for instance, bed, bedclothes, jewellery, pictures, cheques, money, &c., that they seize? This may be a new Act within the last four months or an old one revised. I have seen one of papers, bearing a stamp of a Crown, &c., but did not t would ever be useful to me.—One in Trouble.

37.]—**Induction Coil.**—I have the base and for a large coil, consisting of a primary of two of No. 14 cotton-covered wire, wound on a core of n wire, inclosed in a split iron tube, 18in. long by meter, the whole fitting into an ebonite tube ⅛in. I wish to finish the same by adding the secondary, ould like to know the quantity and size of wire for e, proportionate to above dimensions, what length k I should get, and the battery power required to t? Also the most approved and modern method of ction? I am acquainted with the plan advised by ctorium" some years ago in "E. M.," and also that rgusson." Do either of these methods give results ensurate with extra trouble of construction? I that most coils exhibited for sale are wound on the al plan, in continuous layers. A friend of mine pur- a 2in. spark coil, by a well-known London maker, the central disc was only a ring of ebonite outside condary; was this a sham, or ornament only? Any that will enable me to finish my coil so as to obtain sults will greatly oblige—Banbury Cross.

88.]—**Electric-Bell Action.**—To Mr. S. Bot-, or "Sigma."—I am desirous of connecting a series bells to be actuated by the same number of organ How could I apply the connecting wires from the ies to the bell hammers and keys, so that the bells continue to sound as long as the keys are held down, op immediately the keys rise? I require an independent action for each key, and also to know the number ower of batteries required to work the whole arrange- A sketch of a successful arrangement would greatly —G. Fryer.

89.]—**Propelling Ships by Compressed** · This subject was mentioned in these columns a few es ago, and by apparently common sense and well-d engineers was regarded as impracticable. Notanding the cold water thrown on the scheme then, I ne that the many advantages of such a method of lsion will induce many experimenters to try again, until beaten. I have lately heard of one who has obtained a measure of success as to falsify the predictions of failure then made. Do any of our correspondents of it, or of any further advance being made in any ion?—Kunst macht Gunst.

90.]—**Rusty Boiler.**—We have recently had a ire-grate, oven, and boiler put into our kitchen. The , from rust, continues to make the water so red that ot fit to use for general purposes. Will some of your spondents kindly say what is the best remedy? We tried tallow and lime-wash; the first failed entirely, he latter is but a partial, and not a lasting, remedy.—

791.]—**Silver Battery.**—I made one of these bat- as follows:—Chloride of silver, spread on silver foil, Inside zinc, sol. of common salt. It worked for about ours, then stopped; took it apart, found zinc covered with a whitish soft powder. What is the matter? was made according to "Gordon." Fused chloride of spread on foil as above gives about the same result, il in this case being blackish. As an old reader of M.," I have made many cells of other forms of bat-, and thought I knew all about battery-making, until I my hand at this form. Will someone speak from ience of these, and say what is the matter?—Lear.

92.] **Dynamo.**—Would Mr. S. Bottone kindly iten me by answering yet another query as regards namo (Dynamo, 57583)? What would be the best nce for insulating the Pacinotti ring preparatory to ling? I think if I used something thin I could get ut 4lb. of single cotton-covered wire of 20 gauge. this size and quantity be right as regards resistance? nswer to this query would probably interest the nan—seemingly a believer in psychology—who signs "One in a Fog" (Dynamo, 57689). His dynamo, from the description, is suffering from the same int, and required the very same words of explana- hat of—C. E. O.

.]—**Workshop Light.**—Can any of your readers iform me the best and safest light for carpenter's re gas is not obtainable?—Aladdin.

—**American-Organ Blower.** I have a l American organ, with two rows of keys. Would suggest a means of mechanical blowing at a ost? Water is not come-at-able. I thought a ine, power at handle 7lb., 50 up and 50 down ute when playing with full organ.—Organist.

Orbit of Comet.—I find that it is necessary e points in the orbit of a comet in order to orbit. Can its orbit be determined from the of the three positions only, or shall we be [illegible] the R. A. vectors of the three points [illegible] nly)?—A Constant Subscriber.

Developer.—Would of your readers and [illegible] loper he uses? have not suc-

ceeded in getting one that can be used over and over again to the last drop, and have, therefore, found it rather wasteful.—Hiram.

[57797.]—**Cane Sugar.**—Will some of our chemists suggest a ready means of detecting the admixture of beet root sugar with cane? Also why do some sugars blacken upon the application of sol. tannin? This is often used by grocers as a test, which, they imagine, proves the presence of beet; but, to my mind, it only proves the presence of iron in some form, and, if I am correct, how does the iron come in the process of manufacture?—Hiram.

[57798.]—**Crystallisation (Practical).**—Will some chemical friend kindly give a few wrinkles on above subject? Means of ascertaining exact period when it will commence, of obtaining crystals instead of powders, and of drying when obtained.—Ignoramus.

[57799.]—**Dynamo.**—To Mr. S. Bottone.—I have a dynamo which is ready for winding, F.M.'s cast in one piece, sides 4in. high, 15in. long, 2¼ wide, armature four-sided form, double wound, after Siemens' style, but double, 12in. long, cast on steel spindle. The groove for wire on F.M. is at the bottom, and as far up sides as possible, without touching armature. Appearance of machine, when fitted up, is similar to long stone trough, with half the armature projecting above it. Please say if this is a good form. Man I got it from states it will light twenty 20 c.-p. lamps. What I want to do is to wind it as a good motor, and to be able to use it as a dynamo, and get, say, six 10 c.-p. lights by means of foot-lathe. Please say if I can do this and what is No. of wire to use. F.M. is ⅜in. thick and 5½in. across.—Nemo.

[57800.]—**Spermaceti Emulsion.**—Could Mr. Grey, or any of our chemical friends, kindly give a method of making spermaceti soluble in water.—Maschera.

[57801.]—**Cylinder Pivoting.**—Will any of our readers please give me a hint as to the best way to get out the top plug of cylinders that are a tight fit?—One that Tries.

[57802.]—**Ostrich-Feather Dyeing.**—I shall be glad of any information as to the dyeing of feathers a good black.—C. H.

[57803.]—**Amateur Photography.**—Having bought a small ¼-plate camera, have been doing my best to produce some decent photos., but, am sorry to say, I have failed utterly in the toning part of the business. My negatives come out all right, and am able to print fairly well from them, but on putting them into the toning bath it turned them a most wretched colour, and in some cases a light slate colour. The formula I have used is: chloride of gold, 1 grain; acetate of soda, 30 grains; water, 5oz. I have been very particular about weighing out the quantities and using distilled water, and when the prints were in the bath a black deposit was thrown down, and, thinking my bath a little too acid, threw in some carbonate of soda, which certainly bettered it for a little while, though, when I came to use it the next day, it ceased to act altogether. Would some of our readers kindly give me a little advice on the subject?—Negative.

[57804.]—**Watch Movement.**—Some little time ago a watch was introduced denoting the hour without the use of hands. This is attained by three dials carrying figures near the circumference, said figures showing themselves in succession as the dials rotate through apertures cut in watch face. I wish to know the means by which these wheels are actuated; more especially as to how the discs remain motionless until the minute or hour be competed, and the means by which they then alter their position with such rapidity? Does one wheel receive power and drive the train, or does each of the three discs receive power and the discs carry a trip motion which allows of the motion above indicated? The motion is so quick that I do not think a star wheel can be used. Should be glad of a diagram plainly showing the motion.—A. F. H.

[57805.]—**Locomotive Model.**—I have one that will not hold steam two minutes. Dimensions: cylinders, 2in. by 1½in.; boiler barrel, 12in. by 4½in.: firebox, internal, 5in. by 4½in. by 3½in. high; four ⅜in. tubes. Burns charcoal freely. How would lining the cylinders down to ⅜in. do? and, if this was done, would the valves or ports require alteration? I would also like to fix an easily-made self-acting pump.—R. B. W.

[57806.]—**Legal.**—If I leave my whole property to my wife I can appoint her sole executrix; but if I wish her to have the use of it until death or second marriage only, and then to be given to my daughter for her own, is it absolutely necessary to appoint two executors? If so, can my wife act as one? Please say.—J. S. D.

[57807.]—**Brush Dynamo.**—To Mr. Bottone.—Please accept my thanks for your last reply. The length of wire on each coil on A. is 120ft.—i.e., 240ft. in each pair of coils, and, according to my idea, is about 2 ohms resistance. The resistance I gave you in my last was copied from a report some friends sent me, who offered to test my machine. Will you please say what relation the F.M.'s should be to A. in resistances?—Williams.

[57808.]—**Sifting.**—I want to separate an impalpable powder from a coarser one by washing and pouring off fine particles. Can any reader tell me what plant is required to do this accurately?—E. M.

[57809.]—**Resisting Acids.**—Can any of our readers give me the mixture for resisting acids? Having a few centrifugal pumps to make entirely of brass to resist acids, &c., I have made one, but it will not stand the acid, &c., it has to work with.—Hugh Hughes.

[57810.]—**Dynamo.**—To Mr. Bottone.—I have made a dynamo same as that given by you in No. 1007. The F.M.'s are 17in. high, the pole-pieces being 8in. and the arms 9in. high; the arms are 1¾in. thick, and the pole-piece 3in. wide, the armature being 7½in. diameter, made out of sheet-iron, laminated, being in four sections at arms, wound with 2½lb. of No. 18 c.c. wire, and the fields are wound with 10lb. of No. 16 c.c. wire. Will you be kind enough to tell me what size and length of iron wire to use as a simple shunt, to be used the same as spoken of by you in your article on the dynamo? I want to use the shunt to light two 20 c.-p. lamps of 45 volts resistance, and to use another length of iron wire as a shunt to light, say, four 20 c.-p. lamps. Say at what speed to drive it at, and the total ting power of the machine, and if the same resistance to for the Pacinotti ring with twelve cogs wound with me amount of wire.—W. H. H.

[57811.]—**Boiler.**—To Invicta.—Will you kindly say if the following boiler will do to drive an engine of 2in. bore and 3½in. stroke? It is made of 3-16in. iron plate, riveted with 5-16in. iron rivets, and it is 3ft. 6in. over all by 16in. diameter, the fire-box being 1ft. 4in. and the water-space 2ft. 2in. by 16in., with one 4in. flue right through for the chimney, and tested at 30lb. I want it to drive a dynamo to light six 20 c.-p. lamps, weight of dynamo 63lb., speed to average 2,500 revolutions per minute, and will you say if the boiler will require stays?—W. H. H.

[57812.]—**Hat Stretcher.**—Is there anything made or sold for the purpose of stretching hats? I have one (a Bowler), which has plenty of breadth, but is not long enough, and, consequently, painful to wear. Perhaps one of "Ours" who has experienced a similar difficulty can help me, either by a sketch or particulars. I find that by stretching a stick between the hat it gets warped and twisted out of shape.—Nous Avons.

[57813.]—**Gramme Dynamos.**—To Mr. W. H. Eaves. I should be glad to know if there is any rule for the distance required between the pole-pieces of Gramme dynamos; also if the magnetism requires to be equally distributed round their exposing surfaces. I have constructed a Gramme of the usual form: F.M.'s wound with 18lb. of No. 14 d.c.c. wire, A. (6in. dia.) wound in 24 segments with 3lb. No. 17. My insulation is perfect, and brushes are movable, but I cannot get any result. If I charge my F.M. with four Bunsens they are most powerful at their extremities, and in the centre I get nothing. Please let me know if that is usual with this form of machine, or suggest the probable cause of my failure.—Pickwick.

[57814.]—**Mathematical.**—Will some mathematical reader kindly explain the meaning of the term "extrapolation," as used in astronomical competition, for instance, in the correction of the phoronomical elements (e, P, T) of the orbit of a binary star? An example would oblige. Also the best way of solving the equation $u - e \sin. u = m$, to find u in degrees, e and m being given.—Light.

[57815.]—**N.E. Railway Engines.**—Can any of your readers give us full particulars of the new class of express engines lately put on, built at Gateshead? Are they any larger than the previous 7ft. coupled class, Fletcher's design? To my mind, these are among the finest-looking engines now running, their appearance being greatly improved by the new style of tender. Details as to heating surface, centres apart of wheels, height of centre line of boiler &c., would be much appreciated by many of our readers.—R. H. G.

[57816.]—**Carbolated Chloroform for Toothache.**—I believe this preparation is used by some surgeons and dentists to relieve toothache and to destroy the nerve. Can any subscriber give the proportions and method of making the same?—Torquay.

[57817.]—**Patenting Steel Wires.**—In Sheffield and other places a process is used to increase the tensile strength and flexibility of steel wires. This is called patenting; but, so far as I can search, it has not been patented. The process is a process of repeated temperings, I believe. Can any brother reader throw light upon the subject, and give any details as to the nature of the processes of tempering, if heating and cooling? and, if so, heating how and cooling in what? I wish for the information to aid me in an investigation in which I have been busied for some time, on what I may term the molecular physics of steel, and particularly in connection with mechanical telephony.—Torquay.

[57818.]—**Legal.**—I hold a situation at 23s. per week, under an agreement, one month's notice to be given either way. My employer holds, as security, £40 of my money, for which he is to pay me four per cent. How should I stand in case of my employer's bankruptcy? Would my money be returned to me, or should I be scheduled as a creditor? There is not anything mentioned about the point in the agreement.—J. J. H.

[57819.]—**Perseus.**—Will some astronomical writer kindly inform as to finding the cluster in Perseus? I know whereabouts it is, but am quite unable to hit upon it with my 3½in., and I do not know what to expect as to shape and general appearance.—J. S. C.

[57820.]—**Enlargements on Paper.**—I wish to make a developing dish for the above, with glass bottom and wooden sides. To make it water-tight, would paint worked into the cracks do, or would it spoil the developing solutions? If it will not do, what must I use to prevent leaking?—C. J. Ryan.

[57821.]—**Storage Battery.**—Will "Bunsen," or others, give me the total surface in square inches of perforated lead plate in a storage battery of six cells required to light a 5-candle lamp for four or five hours, that is, to give 1·3 ampère for that time? I propose charging it in parallel with a battery giving 3 volts, during the day, and using it in series at night. What number of ampères, and how long will it take to charge it?—Volta.

The Poison of Hymenoptera.—The denticulated sting of bees, wasps, and hornets is charged with poison secreted by two glands. According to M. Carlet of Grenoble, the secretion of one of the glands is acid, and that of the other alkaline. The poison only produces its customary effects when both acid and alkaline fluids are present in the poison, which is, however, acid in reaction. In wasps and hornets the venom is injected by means of a vesicle with contractile walls. In bees the poison-bag is not contractile, and there exists a kind of piston, that works in the fang as a syringe, so that the syringe is charged and emptied with each stroke of the piston.

The famous violoncello by Stradivarius, which belonged to the two Servais, father and son, the violoncellists, is offered for sale at Brussels. It is reported that the highest bid, 60,000f., has been made by Herr von Mendelssohn, of Berlin, but that Madame Servais has fixed the price at 100,000f.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 14, and unacknowledged elsewhere :—

SMITH AND COVENTRY.—D. Brown and Son.—Hadfield's Steel Foundry Co.—W. H. Bailey and Co.—J. Rawlins.—T. Fletcher.—E. L. Trouvelet.—G. Percival Smith.—John.—Induction Novice.—B. B.—Bolton.—R. W. F.—C. J.—C. L. Woodside.—Gwent.—One in a Fix.—Jay Bee.—J. N.—Aster Sebright.—Volt hacker.—Private Individual.—Mechanic.—Barium.—F. A. R.—One in Doubt.—Colonel.—Temeraire.—Rev. J. Pearson.—J. C.—J. W. Thompson.

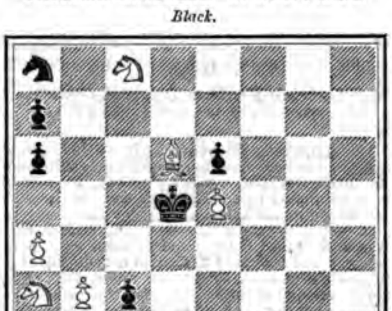
BEDFORDIAN. (See recent numbers, which contain a great deal of information about electric lighting.)—AN ENQUIRER. (We do not recognise the electric lamp to which you refer. Your description is inadequate; but any electrician will make one if you cannot find sufficient particulars in back numbers—which you will if you look.)—ENGINEER. (Really, we thought some of our readers would have complained that we were giving them too much "dynamo." See recent numbers, and the indices of the last two or three volumes.)—F. H. HAWLEY. (Mr. Bottone's articles on "How to Make a Dynamo" appeared in Vols. XXXVII., XXXVIII., and XXXIX., and have since been published in book form by Messrs. Swan Sonnenschein and Co., Paternoster-square, E.C.)—ENQUIRER. (We do not know the charges of American patent agents for obtaining patents in this country, nor of British agents. An inquiry direct would be the best method of ascertaining. The term "communicated" is affixed to the official list because it is so ordered by law; but any foreigner can apply himself to the Patent Office, whether resident in this country or not. An Englishman can apply personally for foreign patents.)—R. DUNN. (Messrs. Griffin, Garrick-street, W.C.)—W. H. STEVENS. (It has been stated over and over again that the Leclanché is not suitable for electric lighting. 2. Yes, by means of a turbine. 3. See recent numbers.)—SUBSCRIBER. (It dissolves in mineral naphtha and in bisulphide of carbon. 2. French chalk.)—H. J. R. (We do not know. Should be advertised for.)—MULTIPLEX TELEPHONE. (The conditions are very different.)—A. + L. (See the indices. It is not quite clear what you want.)—PERPLEXITY. ("Model" gas engines cannot be expected to work well at all times. By the way, you speak of your intention to make one, and in the same breath as if you had already tried several methods of making an existing engine work. Which is it?)—MAGIC FAN. (You know the old saying, "Try, try, try again." Suppose you divide the portion mentioned into 20 equal parts, and then at each of the points marked rule two lines 2·38in. apart. Sorry you have not time to point out "other errors." It is easy enough to give information; but, unfortunately, no one can impart "understanding.")—JACOBIN. (You will find recipes for invisible ink in back numbers. One of the simplest is—Dilute sulphuric acid, used with a quill or glass pen. It turns black when heated.)—SMITH. (Depends much on the nature of the fabric; but you can easily form an idea by testing it on some old materials.)—J. G. (Do you mean the "Whitworth Papers"? If so, any bookseller will procure them for you.)—FIDGET. (Most of your questions are answered in the ordinary handbooks, and the rest your can easily answer yourself by making a few experiments.)—S. B. R. M. (French polish is made by dissolving shellac in wood spirit or naphtha. A favourite recipe is 3oz. of shellac, ½oz. of benzoin, to the pint of wood naphtha. Keep in a warm (not hot) place until dissolved.)—KAISAR-I-HIND. (Kindly look through the indices and recent back numbers.)—BIRD. (Not that we know of. Most unlikely.)—MOTOR. (See indices.)—A. J. A. (The *Electrical Review*, 22, Paternoster-row, E.C., 4d. weekly. We never heard of any journal specially devoted to the interest of philosophical instrument makers.)—PRIMROSE. (Question is not quite clear; but 28in. would hold more than two of 14in. 2. Breaking-weight of wire ropes in the pocketbooks. 3. Diameter is right.)—HIGHLANDER. (There is no good practical book on organ-building; the nearest approach is that by the Rev. W. E. Dickson, published by Lockwood and Co., Stationers' Hall-court, E.C., price 2s. 6d.)—W. B. T. (For tanning skins with the fur on, see p. 431, Vol. XXXVII.; for dyeing sheepskin mats see p. 74, Vol. XXXIX. There are many recipes and directions in back volumes.)—W. F. DENNING. (Any comments must be made in the usual way. The fact that a letter has appeared elsewhere is a strong reason why it should not be inserted in our columns.)—TORQUAY. (Procure Sprague's "Electricity," published by E. and F. N. Spon; but any textbook or pocketbook gives the values and meaning of volts, &c. See back numbers.)—A. MELLOR. (Has not sufficient information been already given? Look up the indices of recent volumes.)—R. RINGWOOD. (Which articles do you mean? There were two or three series, but we think all the numbers are now out of print.)—GEYSER. (Put the question direct to the makers. We should think they would object.)—ERNEST. (See back numbers about horse-power of engine, and also for tractive power of locomotive: you must have dimensions of cylinder and driving-wheel, and pressure of steam as well.)—SWEET MUSIC. (Perhaps you did not get suitable glasses. The best quality ring like a bell when flicked with the finger. Common glass gives little or no sound, and that for only a moment.)—T. GRIFFITHS. (Has the experiment been tried, or is it only an idea?)—WHITWORTH. (There is E. J. Reed's "Shipbuilding in Iron and Steel," Grantham's "Iron Shipbuilding," Thearle's "Practical Naval Architecture," one of which might suit you.)—ENQUIRER. (About 103°; but see a letter in next number.)—J. J. LAPISTON. (Answered before. By entering at the Indian Engineering College, or by being articled to a civil engineer.)—W. J. GREY. (Because corners must be filled up, and it is as well to occasionally repeat facts of that kind. All our readers do not know such facts as those.)—J. BLACKLEY. (Please send.)—J. W. THOMPSON. (Drawings like those sent do admirably. Let us hear from you again soon.)

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLXI.—BY W. T. PIERCE.

Black.



White. [8 + 6

White to play and mate in three moves.

SOLUTION TO 959.

White.	*Black.*
1. Kt-Q Kt 6	1. Anything
2. Q, R, or Kt mates	

(Three variations).

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 958, by E. Stanley Follwell, H. Culmer, V. S. Pochin.

To 959, by F. O'N. H., A. Bolus, E. Stanley Follwell, Rev. W. Anderson (Old Romney), and A. A. E. Lecluse.

To 960, by E. S., H. Culmer, R. A. Bennett, A. S. Olver (a first-class problem), Streetgate (splendid), and E. Stanley Follwell (capital).

F. O'N. H.—Thanks for your suggestion, which we will bear in mind.

P. ROSLING.—How if 1. $\frac{\qquad}{\text{B takes Kt}}$?

THE three solutions of 958, credited to J. A. Miles in the last number, should have been to F. O'N. H.

IN the last line of the examiner's report in last week's column the word "faint" should have been "fatal."

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bellows; exchange excellent harmonium, complete excep
case.—W. JOHNSON, Moxley, Wednesbury.

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man; sent in exchange anything to value 1s.—125, Colt
Hull.

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class working order. Want offers.—J. H. STAFFORD, Sewin
Repairer, 112, City-road, Hulme, Manchester.

2½in. centre **Bench Lathe**. 2ft. bed. with tee
also Foot Motor, worth £3. Would take a small vice i
ment.—P. GRIFFITH, South Bank, Bromley, Kent.

Thirteen volumes "**Mackenzie's Nation**
CYCLOPÆDIA," cost 156s. new. Wanted, Microscope.—
to J. T. KETTLE, Church-street, Shipston-on-Stour.

Wanted a good F **Piccolo**. 6-keyed, in exchar
keyed D Piccolo.—W. HARINUP, jun., Hurst Green, Sas

What offers for **Steel Tricycle**, specially
for application of mechanical power, cost £35.—R. H. H.,
street, York.

"**Science for All**," 5 volumes, in crimson
gilt edges, cost £3 12s. 6d. this month. What offers?—S
of Coates, 1, Shipstone-street, New Basford, Nottingham.

Wanted, good **Parallel Vice**. Exchang
Bench Drilling Machine for power, 1½ spindle, 6in.
ELVIDGE, Driffield.

Breechloader, top lever, 12 gauge doubl
rebounding locks; Perambulator Wheels, ⅝ rubbers, a
complete. Approval. Exchange.—Letters, W. SMITH, B
Wolverhampton.

Good, massive **5in. Centre Lathe**, with
tools, and appliances, by good maker; offered, a bargain.
letter to—F. UNDERWOOD, Beverley.

Swan Lamps.—Two 50 volt, 20 candles, q
Exchange for 5 candles, or offers.—H. PAIGHAM, 7, M
Brockley.

Model Horizontal Engine, slide valve
1in. bore, 3in. stroke, mounted on brass bed plate, and
brickwork wood block. Offers wanted.—H., 209, Chest
Cambridge.

Air Pump Barrels, 1¼in. bore, plate 5
change for Model Launch Boiler, or offers (no rubbish) w
ROBINSON, 72, Albert-road, Kilburn, London.

50in. Bicycle, half-plated, balls both whe
change Tricycle, also Gem Camera, new, takes 12 on plate,
lantern.—EVERS, Wath, Rotherham.

Encyclopædia Britannica.—Forty
published at 15s. each, six volumes supplements publis
each, in good order internally, binding scuffed; will be
for good amateur Lathe with overhead motion and eccen
or good Microscope with accessories, or full-plate Pho
Camera and good lens, with instantaneous shutter,
Ardeen Larne, co. Antrim.

Tough Mild Weldable Steel, —
section. Will take exchange for [illegible] quantity.—
road, Sheffield.

To Cutlers.—Want
exchange for handsome K
Baldwin.—K. CECIL, 1, Adelp.

for, with the growth of the parcels post, it is not unlikely that the Post Office will eventually possess a Telpherage system, and become altogether independent of the railways. The development of the Telpherage system met with a check last summer in the untimely death of Prof. Fleeming Jenkin; but fortunately Profs. Ayrton and Perry are co-patentees, and the latter has charge of the arrangements adopted by the company in its first line for doing actual work, which was opened on Saturday last at Glynde, near Lewes. Visitors to the International Inventions Exhibition will remember the working model of a Telpher line, which gives a practical demonstration of the capabilities of the system, for the miniature skips are heavily loaded for their size, and they run round the tolerably long endless line without a hitch. The experiments made at Weston have enabled the company to remedy minor defects, and to so far perfect the system that it is now put forward as an economical and useful method of transit for goods, and as time develops it and opportunities occur for passenger traffic. At Glynde, where a line has been erected to carry clay from a pit to the railway siding, whence it is transported in waggons to the works of the Newhaven Cement Company, the "wires" are carried on supports about 18ft. high. They consist of steel rods ¾in. in diameter, and the posts forming the supports are about 66ft. apart, the actual distance varying with the nature of the surface of the ground (where a river has to be crossed, for instance, the span might be longer without disadvantage). Each post carries a T or cross-piece, 8ft. long, and a wire is supported on each end. The line at Glynde, which is nearly a mile in length, is a double one, and is at present supplied by two "trains," one of which will, however, suffice for the present to convey the quantity of clay required by the cement company. The skips are iron trough-shaped buckets, each holding about 2cwt., and are suspended from the line by a light iron frame, at the upper end of which is a pair of grooved wheels running on the steel rod. A train is made up of ten of these skips, which are in electrical connection with each other, and with an electrical motor which is placed in the middle of the train, having five skips in front and five behind. At a point about midway of the length of the line is the engine-house, in which is a steam-engine which drives the dynamo. From this the current is led to the line, and thus to the electrical motor which moves the train. At the charging end the skips are loaded each with about 2cwt. of clay, the train thus carrying one ton. A labourer, by touching a key, starts the train, which travels at a speed of from four to five miles an hour along the overhead line to the Glynde Station. Arrived there another labourer upsets each skip as it passes over a railway truck, into which the clay is thus loaded. This upsetting, however, will eventually be performed automatically by means of a lever on each skip, which will come in contact with a projecting arm as it passes over the truck. The labourer at the discharging end of the line has full control over the train, and can stop, start, and reverse it at will, as can also the man at the other or loading end.

There are two trains at Glynde, but only one is at present used, that being found sufficient to deliver 150 tons of clay per week at the station — the minimum quantity required by the cement company. The trains need no attention when running, as they are governed to run at the same speed both on rising and falling gradients, by ingenious devices invented by Profs. Ayrton and Perry, and, as will readily be understood, many "trains" can be run on the same line without fear of collision, there being an automatic and absolute block, accomplished by simply cutting out one of the "cross-over" sections. A shunt dynamo and Willans' governor keep the E.M.F. constant at the near end of the lines, and the motors run in parallel arc at an average rate of 1,900 revolutions. The speed and power are controlled by a centrifugal governor of novel construction, the weights and springs being so combined as to be in unstable equilibrium at the critical speeds. Thus at 2,100 revolutions, say, the weights will fly out, breaking the contact sharply and widely; and they will not return until the speed has fallen to 1,900 revolutions. A permanent arc at the contact is thus avoided, and the contact surfaces are further protected from injury by means of a carbon rod as a secondary contact, which latter is very slowly consumed. We understand that all the little details connected with sidings, with keeping the truck wheels on the line, and with the necessity for providing the locomotive with the required grip have been overcome; while in order to show the capabilities of the system, rather severe gradients and sharp curves, together with complicated supports and corners, have been purposely introduced at Glynde. The cost of carrying the clay at the present rate is stated to be 7½d. per ton; but if the quantity were 100 tons per day the cost would be about 3d. per ton, and if the line were, say, 10 miles long, and worked to nearly its full capacity, the cost, which includes coals and wages, and 12½ per cent. for interest and depreciation, would be only 2d. per ton. At present the Telpherage system does not come forward as a competitor with railways for the rapid transmission of parcels; but the working of the line at Glynde will be watched with much interest, for there are many places in this country where a cheap method of transporting large quantities of materials, whether refuse or not, will be welcomed.

CHEMISTRY OF PIGMENTS.—V.*

By J. M. THOMSON, F.R.S.E., F.C.S.,

Demonstrator of Chemistry at King's College, London.

Thenard's Blue.

THIS is another blue containing cobalt, and somewhat similar to the pigment just described. It is formed by mixing the pink gelatinous precipitate, obtained by adding sodium phosphate to a cobalt salt, with alumina, and after drying, heating the mixture to redness in a crucible. Thenard's blue, when carefully prepared, is reported as an extremely permanent colour, withstanding the action of heat, light, noxious gases, and even acids and alkalies. Under certain circumstances this colour loses its pristine brilliancy; but this may readily be restored to it by heating the pigment with a small quantity of mercury oxide. The mercury volatilises, and the oxygen, passing to the pigment, revivifies it in a very decided manner, pointing to the fact that the brilliancy of the paint probably depends on the state of oxidation of cobalt in the mixture.

Smalt.—This colour is well adapted for coarser kinds of work, but is not much used in the fine arts. It may be regarded as a double silicate of potash and cobalt; in fact, glass coloured blue by cobalt, and then crushed to a fine powder. The pigment is prepared on the large scale by roasting cobalt ore, which converts the larger portion of the metal into oxide, but still leaves a considerable quantity of arsenic and sulphur in the ore. The residue is then fused with potassium carbonate and crushed quartz, which forms the double silicate of cobalt and potassium, whilst the other metals, such as iron, copper, and nickel, combining with the arsenic and sulphur, form a slag at the bottom of the crucible. The blue glass is poured into water so as to render it more friable by the sudden cooling. The intensity of the colour depends upon the quantity of the double silicate which the pigment contains, and the absence of iron in any quantity. It varies from a clear to a decided blue in shade. To be of good quality, smalt should not be at all sandy in its nature, but should be in fine powder, holding together like flour; and when thrown into water, the deposit should exhibit the same tint all through.

Cœlin or Cerulean Blue.—This pigment is probably a compound of cobalt and oxide of tin, this body being accompanied by a certain quantity of calcium sulphate. It is a beautiful transparent blue, with a slight greenish tinge.

Prussian Blue.—Under this title may be arranged all these blue pigments which are known under the names of Antwerp, Berlin, Paris, and Turnbull's blue, and which have been considered as different compounds of iron with cyanogen, but which may often possess an identical composition. In these colours we find the iron, which is combined with the cyanogen, in two conditions, one of which is termed the ferrous (Fe''), the other the ferric (Fe''') condition, and the colour of the body produced varies according to whether the iron salts employed are in the one or other condition. The cyanogen compound which is generally taken to form these pigments is the potassium ferrocyanide or yellow prussiate of potash; and I will now show you the difference in the body produced according to the iron salt employed. In these two jars I have solutions of ferric chloride and ferrous sulphate; now I add to both of them a solution of potassium ferrocyanide, when you see a deep blue precipitate formed in the jar containing the ferric salt, but in the jar containing the ferrous salt, a very much lighter body is obtained the first of these bodies prepared in the proper manner constitutes the true "Prussian blue." When a solution of ferric sulphate is added to potassium ferrocyanide, a variety is obtained: which is soluble in water and which is employed to a great extent by calico printers under the name "soluble Prussian blue." This variety contains potassium as well as the iron and cyanogen, and may be represented by the chemical formula ($K_2Fe_2FCy_2$). When, however, potassium ferrocyanide is added to ferric sulphate, the precipitate formed is insoluble in water and may be represented by the formula (Fe_4FCy_3). Prussian blue may also be prepared from the green vitriol or ferrous sulphate, but in this case the substance formed must be exposed for a considerable time to the air, as the precipitate at first obtained is nearly white in colour, having a different composition ($K_2Fe''FCy$); this body, however, on exposure, becomes converted into the true Prussian blue by oxidation. I can easily show you the formation of this white variety, and its subsequent change into the blue, by shaking some iron filings with a solution of sulphurous acid, and filtering this into a solution of weak potassium ferrocyanide, when you perceive a dense white precipitate is at once formed. On pouring this, as I now do, on to a plate, you perceive that immediately it changes to a light blue, finally becoming much deeper in colour round the edge of the mass where the action of the air is more acute. The blue pigments derived from these sources are moderately permanent, except in the presence of alkalies, which rapidly decompose them with the formation of ferric oxide. This decomposition may be seen when I treat this Prussian blue, which I have here suspended in water, with some warm caustic potash, the alkali rapidly decomposing the blue, and changing it into a brown powder. The formation of these different substances may be seen in the diagram on the wall, where the first equation represents the formation of the variety insoluble in water; the second and third the formation of the white variety from green vitriol, with its subsequent change into the insoluble blue pigment; and the fourth the formation of "soluble Prussian blue."

$$\text{I. } 2Fe_2(SO_4)_3 + 3K_4FCy = 6K_2SO_4 + \overbrace{Fe_4FCy_3}^{\text{Insoluble Prussian blue.}}$$

$$\text{II. } K_4FCy + FeSO_4 = K_2SO_4 + \overbrace{K_2Fe''FCy}^{\text{White variety.}}$$

$$\text{III. } \overbrace{6(K_2FeFCy)}^{\text{White variety.}} + O_3 = 3K_4FCy + Fe_2O_3 + \overbrace{Fe_4FCy_3}^{\text{Insoluble Prussian blue.}}$$

$$\text{IV. } 2KFCy + Fe(SO_4)3 = 3K_2SO + \overbrace{K_2Fe_2FCy_2}^{\text{Soluble Prussian blue.}}$$

Little care is taken in the purification of the yellow prussiate of potash for the preparation of the common blue pigment, but it must undergo re-crystallisation for the preparation of the pure variety of blue, which is sold under the name of "Antwerp blue."

Mountain blue is a basic copper carbonate, somewhat resembling the green carbonate in its constitution. It is very difficult to obtain the substance in a state of purity, and many experiments have been made to obtain, artificially, a pigment which will possess a colour resembling the natural body. The best results in this direction are probably those of Pelletier, but the artificial variety, however well prepared, does not possess the permanency which belongs to the natural variety used by the older painters, and still to be seen in a brilliant condition in some of their [illegible] paintings. The qualities to be sought for in all pigments, whether taken from a natural source or artificially prepared, may briefly be stated as follows:—The substance should have great richness in the special tint required, and as great durability as possible. It should cover the surface to which it is applied with ease, and for this purpose it must possess the property of mixing thoroughly with the vehicle in which it is suspended. It is essential that the pigment should be insoluble in water, and should dry properly when spread on the canvas. Finally, care must be taken in the selection of the different colours [illegible] no substances are employed which [illegible] decomposition with other pig[illegible] be attained by the colour[illegible] nature of the ingredie[illegible] chemical constitution. [illegible] become all the more ne[illegible] tion in later years of artificially prepared pigments, which, although presenting greater variety of tints, have not that stability which characterised the more simple natural bodies employed by the older painters, and which has permitted such pigments to withstand the action of exterior agents for so long a time. Much depends also on the nature and purity of the vehicles with which the pigments are spread, and the varnishes which are used for the subsequent preservation of the pictures. I should have liked, had time permitted, to have taken into consideration some of the more important chemical points with regard to the nature of such vehicles, and their probable action on different pigments, but I find it impossible in the space at my disposal to carry out this wish.

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* The substance of the Cantor Lectures delivered before the Society of Arts.

ZINCOGRAPHY.

THE term zincography, formerly applied exclusively to processes in which impressions were taken from a flat surface of zinc by means of what is known technically as lithographic ink, is now used to designate the processes in which zinc plates are etched by acid in order to produce surface-printing blocks with the lines to be impressed in relief. Commonly it is spoken of as photo-zincography, and as a rule the drawing is transferred by means of photography; but at times the draughtsman draws upon the zinc itself. The biting-in or etching is, however, effected by the same means, and we herewith give two processes which are known to work well—the first, which is described as the "best photo-zincographic process," being that of C. Clausnitzer, of San Francisco; the other, a patented process of B. C. Le Moussu, of Manchester. Clausnitzer speaks merely of a process for reproducing drawings, wood, copper, and steel engravings, crayon drawings, and the like, of which reversed and intense negatives are obtainable by the aid of photography. Very fine steel or copper engravings yield good results only when the drawings are enlarged a trifle, whereas, from pen-and-ink drawings or woodcuts, excellent results may be secured even with a considerable reduction. The main features and advantages of his process are the following:—1. All transferring and repeated copying is done away with. 2. The work can be obtained in greasy transfer ink sufficiently strong without any rubbing up or strengthening, such as is necessary in other processes; and 3. In half-an-hour's time, including the making of negatives, the plate can be made ready for etching. The requisite reversed negative must be made on a perfectly level glass plate, so that the same afterwards may get into the closest contact with the zinc plate. It is necessary that the negatives show all lines and dots of great intensity, as only such negatives will give satisfactory results. Taking it for granted that not every photographer is thoroughly acquainted with and able to make a negative, he gives some explanation on the subject. The principal thing to be looked to is the exact time of exposure. By over-exposure the fine lines will be filled up later on by the developing in strengthening the negative. In the ordinary development process, the developing should be stopped as soon as the drawing appears distinct in all its details, and the plate should then be washed off at once, fixed with cyanide of potassium, and after this washed again for a longer period. Next a solution of sulphate of copper, 1oz.; bromide of potash, 1dr.; water, 8oz., should be poured over the plate, and left until the film appears nearly white (the solution may be used again); after that the plate should be thoroughly rinsed, and a solution of nitrate of silver 1 part to 10 parts of water poured over the same. It will be found that the plate turns at once black. Should it happen that the fine lines fill by the application of sulphate of copper, then the negative was exposed too long to the light, or over-exposed; but if the exposure has been properly timed, all the white parts (of the paper) will show opaque, and the line work will be perfectly transparent. The negative having thus been made ready, a well-polished zinc plate of the proper size should be taken and polished once more with the finest pumice powder and water. After washing the plate with clean water, in a dark room, over the still wet zinc plate should be poured the following solution:—The white of a fresh egg, beaten to a froth, with 6oz. of water and 30gr. of finely-pulverised bichromate of potash, allowed to settle, and then filtered. The first quantity poured upon the plate may be allowed to run waste, but after that the solution may be run off again to the bottle to be used repeatedly. The plate held at a somewhat inclined angle, should be dried over an oil-stove or gas burner, but care must be taken not to get the plate hot. When dry and cooled off, the plate is ready for exposure. Lay now the negative face [illegible] the prepared zinc plate in a regular [illegible] photographers use for their [illegible] the springs, a good [illegible] plate and [illegible] the [illegible] ing to the nature of the work. It is best to make the exposure in good sunlight. Take the frame back to the dark room, and "roll-up" the zinc plate with a good, fine-grained lithographic roller, using good transfer ink, not too thin; the stiffer the ink, the better will be the result. The plate, thus rolled up, must be put into a vessel with clean water, and with a thoroughly wet cotton dabber the superfluous transfer ink washed off in the unexposed places. This should be done by moving the hand in narrow circles, and ought to be tried at first in the corners, proceeding nearer and nearer to the work very slowly and carefully, as a rapid movement might take away isolated fine lines and marks. If the exposure was properly timed the drawing will be easily developed; if the plate was over-exposed, the ink will stick to the plate, and cannot be easily removed, and there is always more or less danger of damaging the work. If the exposure to light was not sufficiently long, or an under-exposure, the work is readily washed away, especially in places where there are fine parts. In both instances it is best to polish the plate once more with a strong solution of potash and fine pumice powder, wash off clean, and repeat the entire procedure. From a careful noting of what has been said, and with a little practice, the experimenter will readily determine the proper length of exposure. If this was correct, and all superfluous transfer ink removed, clean the plate in water and dry by warmth. When cold again, put resin upon it in the finest powdered state, rub in well, and remove the superfluous resin; next warm the plate until the resin begins to melt. This may be detected by its taking a slightly darker appearance; then etch, allow the plate to get cold, repeat the rolling up, and resin again; heat, and continue the operations until the necessary deepness has been secured.

M. Le Moussu gives the following description of his process, which is a modification of that for which, in conjunction with Mr. G. Moire, he obtained a patent in 1878:—In the first place, I coat the zinc plate with a varnish which is photographically sensitive; I prefer bitumen as it is usually applied for taking photographic impressions. On the coated plate I place the subject to be copied; it may be a transparent photograph, or a drawing, or print on paper, more or less translucent, or rendered so by applying wax, or the like substance. Exposing this to the light, I obtain on the bitumen an impression which, when developed and washed, presents all the parts corresponding to the darks of the original as exposed parts of the metal, those corresponding to the lights of the original remaining covered by the protective coating of bitumen. I then subject the plate to the etching action of dilute acid, thus hollowing out the exposed parts corresponding to the darks of the original; after cleaning off the bitumen, and washing and drying the plate, I heat it and serve it with molten fusible alloy, composed preferably of lead, tin, and bismuth. I work this into the hollows with a pad of fabric moistened with chloride of zinc solution, and thus the alloy becomes soldered to the plate and into the hollows thereof. After the alloy is set by cooling, I carefully scrape the plate so as to uncover all the zinc surface, and subject it to a second etching, whereby the alloy, not being attacked by the acid, the zinc is hollowed out, leaving the alloy standing in slight relief. I now, with a roller, apply over the plate a fluid varnish, consisting, preferably, of bitumen and suet dissolved in turpentine. This, besides coating the summits of the ridges of alloy, flows also down the sides of these ridges, giving them a protecting coating. I now subject the plate to a third etching, and, if necessary, to a repetition of the rolling with varnish and etching several times, whereby the hollows are deepened, the ridges of alloy being left in good relief, and held securely, as the zinc on which they are based is not eaten away, owing to the protection given by the varnish. The plate is finally subjected to an acid bath without any varnishing, and is thus ready for use as a forme for surface printing.

AN IMPROVED BORING TOOL.

THE improved boring tool and head shown in the engravings were devised by Mr. A. F. Landis in order to retain an accurate size, and he sends a description to the *American Machinist* for the benefit of all interested.

In the engraving, Fig. 1 shows an elevation, and Fig. 2 an end view of this boring head, with cutters intact. A is the head mounted on a bar C, having a tapered hole to insure perfect truth of the head in removing and replacing other size heads on the same bar. A key should be set in the bar on this taper to insure no slipping of the head. F represents a nut to draw the head tightly on the taper, while the nut E is used to remove the same from the bar without the use of the hammer or other harsh means likely to do damage. B B are the cutters, of cylindrical form, with a threaded shank which screw into the head. D D are set screws with left-hand thread, or rather a contrary thread to the one on the cutter shanks; this is done to prevent the cutters from turning in the head. The broken lines *a a* represent the inside of a hole that this cutter is supposed to be boring. The cutters B B are chambered out on the end to the depth of the pitch of the thread on the shanks; at *b* they are milled in with a cutter on their face, from the periphery into this chamber, which forms the cutting edge; they are also cut across their periphery as shown. The face or end of these cutters is cut spiral, having the exact pitch of the screw on the shank of the cutter, thus affording ample clearance on bottom or end of cutter. The clearance on the periphery or edge of cutter is due to the cutter being cylindrical; the corner is beveled, which is also in a spiral.

Now it is clear that the cutter has a proper clearance for cutting, and as it wears it is simply ground on the face of cutting edge at *b*, and the cutter set around on an exact line with the centre of the cutter itself and the centre of the boring head, rather a little late than in advance, but works well when exactly in line. It will further be seen that the cutting edge, owing to the spiral face on cutter, of the exact time or pitch of screw on its shank always retains the cutting edge exactly the same distance from the head when it is on an exact line across centres, consequently both cutters being a like distance from the start, always remains alike no matter what turns up. Should one cutter have a large piece broken off, by grinding it up to an edge again, and setting on line, the cutter has a proper advance.

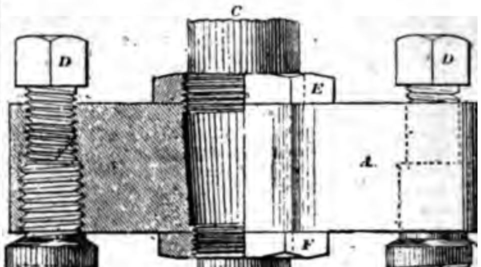

Fig. 1

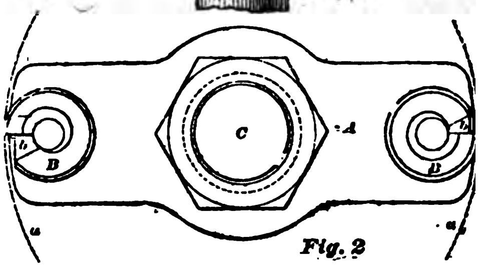

Fig. 2

Another feature of merit is that these cutters can be ground to almost their whole circumference before they are actually worn out, which will give long service.

I have no doubt some of your readers will suppose (at first sight) this to be an expensive tool to make, and very difficult to get correct; but this is not the case when taking the proper plan for doing it. The plan is as follows: First, bore out the head, face it on the sides, and turn off the edges a little less in diameter than the hole to be bored; I turn up a plate perfectly true on its sides with a hub on one side to fit the hole in the head. Now I chuck this plate on the face plate of a lathe, with hub sufficiently out of centre to bore hole for the cutter. The head is now clamped into correct position for boring one hole (independently of the plate); the hole is bored. Now I loosen the head after having one hole bored, and swing the head around on the hub, in position to bore the other hole, which should be exacely opposite the one already bored. This makes these holes equidistant from the centre of the head, thus insuring perfect truth on the periphery of the cutters.

The holes being bored, we proceed to chase the thread for the cutter shanks. After having one hole chased without uncoupling the screw on the lathe, we swing the head back again into its former position, and chase the hole first bored with the same setting of the tool. This makes the thread enter on both the holes in the same relation to the centre of the head. Thus the advance is equal on the cutters when cutters are made alike.

We now have a correct head, and one that will remain so. The holes for the set screws can be tapped, as there is nothing very accurate required in them. To make the cutters alike, after chasing them we screw them in a chuck on the lathe, so that they will bottom on the end; then turn them to the proper length (and of same length), and chamber out the end; then screwing into a similar chuck on a milling machine, the cutting edge *b* is formed in exact relation to the thread, and, by retaining the same position of the chuck, they are practically alike. After this they are screwed into the chuck again on the lathe, and the face cut spiral by gearing lathe to same pitch as the thread on their shanks, and cutting the face down by turning the lathe back and forward until the surface is cut spiral to the cutting edge, and the cutter is ready for hardening. In boring the head for the cutters, we get the diameter from centre to centre as near correct as we can, so as to be sure the cutters are large enough to make proper size.

Now, we will say we want a head to bore an 8in. standard hole; we count on making the cutters 1·5in. diameter. This would necessitate the holes being exactly 6·5in. apart, but we will suppose we get the holes about 6·494in. apart, but have no ready means of knowing what it is exactly. Yet we must know, in order to get a standard cutter. A safe plan for this is to first grind both the cutters on a grinding machine to one size; then screw them into the head, and measure across with the vernier caliper or measuring machine, and, whatever we find the measurement in excess of the standard we want, that much we must reduce the diameter of each cutter. The result, of course, will be, in case above-named, 1·506in., the diameter of the cutter. We now stamp the head an 8in. standard, and at each of the holes in the head we stamp 1·506in., the size of the cutter. When new cutters are wanted thereafter, the size is 1·506in. for that head until the head is worn out.

A variation of size could be made on the same head by having larger cutters to replace, but for special work it is not advisable to do so. For the work which I made these cutter-heads, I made two heads, a roughing and finishing head. They are fixed upon a short bar for use on a drill press, and are changed about as needed. If only one bar is used, the heads can be readily changed by the means shown in the drawing.

Four cutters can be put into one head as well as two, with the same accuracy and good results. They can be used for any size holes on boring and turning mills by fixing them in the manner described into a bar, and fastened into the tool-holder of a boring machine.

PHYSICAL DEVELOPMENT AS AFFECTED BY POSTURES.*

It is hardly necessary to state that many persons become deformed during their growth. Some of these deformities may be produced by accidents and by disease; but posture has considerable influence as an exciting cause, and even strong children may grow up crooked if kept for long periods of time in bad positions. The skeleton, although a framework, is unlike the framework of a house or ship, because the latter is a fixture in itself, whereas the former can be moved, one bone upon another, by the muscles. The human framework would allow the body to collapse were not the muscles ever ready to control its action and to maintain its varied postures. The erratic movements of a drunken man show well how much the upright form depends upon control over the muscles.

To understand how physical development may be influenced by postures, we must consider how the bones grow. At birth the ends of all the long bones remain in their original cartilaginous state, the shafts alone being ossified. These ends of bone are readily moulded by unequal pressure; growth in one direction being checked, while it proceeds unhindered in another. In early life ossific particles develop in these cartilage ends of bones, and gradually grow: but it is not till puberty or later that the bones become complete. For instance, in the thigh-bone the head is not united to the shaft until the eighteenth year of life, the lower end until the twentieth. In the leg-bones the heads are not united to the shafts until the twenty-fifth year of life, the lower ends until the twentieth. The spine is formed of twenty-six bones, placed one above another, but separated by elastic discs of permanent fibro-cartilage. Each of these bones is at first cartilage, and develops by the growth of several osseous points, which gradually unite, but not fully until about the thirtieth year of life. The ligaments which join the bones together in the skeleton are weak in childhood. The muscles also are less able to support the joints in early life than later. Thus, during youth the frame is fitted for free movement, for the activity so natural to the young, but not for sustaining long the weight of the body in any one position. In active movements, pressure of one bone upon another in any one direction is of short duration: and this activity is natural to the young. Young children lounge about, and play and crawl upon the floor, and when in health are seldom quiet, except in sleep.

If natural activity is checked—for instance, if a child is made to walk or sit when it would rather play upon the floor—irregularities of growth may be produced. Walking, though movement, is not natural activity, the body-weight being thrown too much upon the legs. The arches of the feet give way, and flat feet are produced; the ankle-joints get weak; the knees succumb to frequent pressure, and bend towards the centre of the body. Later in life the child may suffer from attempts at making it "sit up." This is probably the commonest cause of spinal curvatures. The child, when left alone, will rest itself in various positions, either by leaning back or to one side, or, best of all, when working at a desk, will rest its head upon its hand, with elbows on the desk, and thus relieve the back from undue strain. Teachers try to keep the pupil straight; but their plan defeats its object, and they produce the very evils they are attempting to avoid.

When sitting upright and without a back-rest, the spine is held erect by the dorsal muscles. These soon get tired, and then the spine subsides upon itself. The result is, that the spine is either bowed out backwards or subsides laterally. If the child is weak or careless, the spine will bulge out backwards, and a "round back" will be produced. The back, however, may be held apparently upright with a very small amount of muscular exertion by allowing the column to subside laterally. Under such circumstances the equilibrium of the body is maintained by a double curvature, and the spine assumes the form of an attenuated S. Whether the spine is bent backwards or sideways, it happens that at the concavity of the bends, where there is excess of pressure, the growth is much restricted; whereas, at the convexity, where the pressure is less than natural, development takes place quite freely. Growth thus occurs unequally, and in course of time each bone in the curves assumes a wedge-like form.

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* From *Popular Science News.*

SCIENTIFIC SOCIETIES.

LIVERPOOL ASTRONOMICAL SOCIETY.

The opening meeting of the session 1885-6 was held on October 13, Isaac Roberts, Esq., F.R.A.S., F.G.S., the president, in the chair. In his opening remarks the president said that the society during the last two years had been very successful. The number of members now exceeds 200, many of whom are non-resident in Liverpool. The society included many hard and careful workers in astronomy, and we may congratulate ourselves that it is now well known throughout the world. The chief astronomical event of the year is the appearance of a new star in the nucleus of the Nebula in Andromeda on the 3rd September. He examined the Nebula with his 7in. refractor by Cooke, and photographed it with his 20in. reflector by Grubb. The refractor showed the star-like nucleus very sharp. The spectroscope showed the well-known dull, continuous spectrum, without any bright lines. Seven photographs were taken on the same day. The photographs show clearly that the star and the nucleus are not coincident. The whole Nebula is about 3' of arc in diameter, is a nearly circular patch, with an undefined boundary, the star being at a little distance (about its own apparent diameter) to the south-west side of the nucleus, and other different photographs confirm this description. The drawings of this Nebula by Argelander, Bond, Espin, and Common differ widely from each other. Mr. Common's drawing of the Nebula, published in *Nature* on the 1st of this month, corresponds with Mr. Roberts' own photographs, where the Nebula appears as a slightly oval patch of light. That drawings made from eye observations should differ widely we have ample experience; but it is disappointing to find photographs differing. The different instruments employed, the sensitiveness of the plates, the time of exposure, and the state of the atmosphere may account for some of this; but we may assume that the Nebula itself has changed. If these photographs, varying as they do, are not misinterpreted, these changes are of a startling character, and the questions involved are of great importance to astronomers.

W. H. S. Q. Gage, Esq., F.R.A.S., also contributed a paper on the same subject, ably arguing that the new star is in the Nebula itself, and the following are the conclusions at which he arrives:—

(1) That it is highly probable, nay, almost certain, that the Nova is in the Nebula.

(2) If optical effect is of any value, that it is *far down* in the Nebula.

(3) That it is a second preceding the present nucleus, and is slightly south of it.

(4) That its colour is bright orange, though its variation is probable.

(5) As regards the Nebula itself, that its nucleus has brightened, and the whole object is brighter than formerly.

(6) That a great change has taken place in the Nebula, the exact nature of which is uncertain, but the so-called "star" differs in many essential respects from what generally goes by that name.

R. C. Johnson, Esq., F.R.A.S., remarked that the Nebula is singularly non-actinic, and urged the necessity that its shape and size be truly got at, for if it changes so much as has been supposed, many important questions are suggested respecting it.

Mr. Finlay gave an interesting account of the photographic charts of the sky that they are taking at the Cape of Good Hope. This idea has been taken up in Paris as well as by the Liverpool Astronomical Society. They used at the Cape a 6in. lens with 5ft. focal length, but had ordered a 9in. lens, which would soon be ready. The whole southern hemisphere will be divided into sixty squares, each one overlapping another adjoining it. Two plates are being taken of each picture, so as to avoid mistake. It is expected to take from three to four years, and will comprise 1,000 pictures. The length of exposure is an hour. So far the work has been very successful, the images being very good and round, and the doubles very clear in a magnifying-glass: but the work of measuring has not yet been begun. The electric light has been used for the microscopes.

A paper by J. Rand Capron, Esq., F.R.A.S., on "Celestial Photography," was read; one by Mr. Fleming, giving a short account of a lunar halo and paraselene, visible at Kirkwall, and other interesting and valuable papers were contributed.

WESTERN MICROSCOPICAL CLUB.

This club held its first meeting for the new session on Monday at the house of G. C. Karop, Esq., M.R.C.S., the genial secretary of the Quekett Club. The subject for illustration was "Diatoms." The host gave a short *résumé* of what was known of these widely-distributed organisms. He pointed out how, though once relegated to the animal kingdom, we now know from their method of growth and food that they are really low forms of vegetables. Their great value to the microscopist in the past was dwelt upon, seeing that in attempts to define their exceedingly minute markings they had brought about the continual improvement of the lenses and of much of the substage apparatus used. It was, however, to be regretted that till late so little real interest was taken in the living diatoms, and so little pains taken to make the microscope a biological instrument. Even now little is known of the multiplication of diatoms otherwise than by subdivision. That some other method must be used is clear, else they would become smaller and smaller till the race was extinct. The means by which they move from place to place, often pushing aside bodies larger than themselves, is utterly unknown. No extension of cilia or pseudopodia has ever been observed, nor has any motion of the valves been witnessed such as would lead one to infer that currents of water are ejected by which to produce motion. In the discussion that afterwards took place, Mr. C. Stewart explained the usual method of subdivision, illustrating this by microscopical slides. He stated that the concourse of evidence makes it now pretty certain that the mass of the markings are truly holes through the valve of the diatoms. By slides in which the upper and under surfaces of the valves were separated, Mr. Stewart showed what false impressions may be made upon the observer by the interference of the combined images.

Numerous diatom slides were exhibited by Messrs. Bartlett, Gwinnell, Karop, Stewart, R. T. and E. Swain, and Stokes. Specimens of the fossiliferous earth used to absorb nitro-glycerine in the manufacture of dynamite were shown by Mr. Gwinnell. These were seen to consist entirely of diatoms. Some live cattle ticks were exhibited by the hon. sec. The next meeting of the club will be on Monday, November 2nd, when Dr. J. L. Thudichum will introduce the subject of "Medico-legal and Chemical Microscopy."

Soldering Aluminium.—Dr. P. H. Vander Weyde, writing to an American paper, says:—The best solder for aluminium is an alloy of zinc, aluminium, and copper in the proportion of 80 zinc, 12 aluminium, 8 copper; or 50, 30, and 20, or intermediate proportions. The soldering iron should be provided with an aluminium top, with which the solder is rubbed on; some recommend pulverised kryolite as a flux. I found, however, that it does not aid much; it is a somewhat difficult operation, anyhow. Still, with some patience and practice one can succeed with this solder. The copper can be left out also: the solder is then, however, not so strong. I had to use such solder to connect the aluminium plates to the zincs in a Grove battery, when 25 years ago I had the idea to substitute aluminium plates for the more expensive platinum plates in the porous cells containing the nitric acid.

[illegible]

[illegible] Mr. [illegible] Hutchinson [illegible] own grammar. That [illegible] waste of time and memory [illegible] a statement which [illegible] In fact, [illegible] Mr. Hutchinson himself says, "The student [illegible] acquainted with Greek and Latin has an immense advantage in reading the [illegible] for the reason that such [illegible] technical language [illegible] to express in the most compendious possible form, what otherwise would demand a very considerable amount of circumlocution." Besides, very few people will be found to deny that the study of the Classics has a certain refining influence upon those who pursue it; and in these days it does not seem well wholly to despise and attempt to crush out all the little graces of life. It scarcely follows that because we could do without the study of the dead languages that hence we ought to ignore them. I could, of course, live upon oatmeal porridge, and bread and cheese and onions; but, to be quite candid, I should feel it rather hard if I were peremptorily told that, on that account, I was never to taste another Côtelette à la Bordelaise in my life. But I must repeat what, in effect, I began by saying: that the greater part of the address on which I have been commenting is admirably good, and worthy of all attention.

"A Constant Reader" (query 57795, p. 151) may read the reply to "An Amateur," in paragraph four above.

"J. H. C." (query 57819, p. 151) asks how to find an object concerning which he proceeds to say: "I know whereabouts it is!" "The sword handle in Perseus" (as 33 H. Persei is familiarly called) is between that constellation and Cassiopeia, and is quite visible to the naked eye. I strongly suspect that your correspondent has been trying to pick up this glorious cluster with far too high a power. He will find one of 80 on his instrument ample. With it he will see a superb mass or, rather, two masses in contiguity of stars of the most various sizes, aggregating in seeming nuclei, the nucleus of the principal cluster being much the more conspicuous of the two. An exquisite object in a small telescope, this in a large one becomes so marvellous that in my whole experience I never remember anyone looking at it for the first time without an uttered exclamation of wonder and delight.

A Fellow of the Royal Astronomical Society.

THE ANDROMEDA NEBULA.

[24903.] In reply to letter 24817, permit a few lines in conclusion upon this subject. The writer, when referring to me, need not have troubled himself "to protest against the assumption of knowledge where it does not exist," because no knowledge was claimed where mystery still reigns. He surmised that inference without foundation. My remarks were simply intended as inquiry and suggestion, arising from optical impressions only. *May* and *can not* were the tones of my communication; but in no way assertive. Had those bounds been exceeded, folly only would have been displayed. The tenour of Mr. Holmes's remarks certainly does not attribute a very high motive to a fellow contributor to your columns. A cultured criticism is legitimate, but a lowering imputation is unparliamentary.

If my [illegible] critic thinks the locus of the new star is on the other side of the Nebula, I must leave him to enjoy his own opinion; but would just inquire (as a tyro) if that hypothesis is correct, would the Nova, through hazy nebulous matter, appear with its decided and clear star-like outline? Would it not rather present the appearance more nearly akin to the old nucleus which remains fixed in the midst of 31 M.?

On the 9th September the colour of the new star, to my eye, resembled that of gas-light, neither red nor yellow, but whitish, slightly tinged with both; now, after the interval of a month's observation, it appears of an exceedingly delicate blue tint.

Southampton, Oct. [illegible] **S. S.**

THE NOVA IN ANDROMEDA.

[illegible] My observation of the Nova in Andromeda is decidedly to the same effect as that of Mr. [illegible], by whom my attention was first called to it, on Sep[illegible], on which night I saw it with [illegible] glass. I found it decidedly pinkish or pink-yellow. I think it was then considerably brighter than now. On Friday night last, Oct. [illegible], I saw it as I have many times during September, and found it white, or perhaps [illegible] a star [illegible] seconds preceding [illegible] star following the Nova [illegible] the appearance of a double [illegible] might be the [illegible] nucleus.

A star not far from the nucleus is drawn in the [illegible] plate in the [illegible] Herschel's Outlines. Is this in the position of the Nova?

On June 23rd I marked [illegible] Herculis [illegible] white [illegible]. On Sept. [illegible] I certainly saw the famous "apple green" and cherry red.

October 17th. **John Bone.**

IS IT A SUN OR AN EARTH?

[illegible]—The statements about this new star seem quite opposed to its being a sun. All agree that it never was in the very brightest centre of nebular condensation, and it has moved in reference to that centre—doubtless revolving round it. Now, coupling these with two more facts, that its splendour is quickly fading, and that it grows redder by failure of the blue rays emitted at first, I submit that it is not so probably the birth of a sun as of a planet; that its cooling crust may be expected soon to hide its light from us for ever. But it may indicate the nascent Andromedan system to be forming somewhat like our own, in which both the Book of Genesis and the astronomer Faye tell us that such minor bodies as our globe existed before there was yet any sun. If the object remain observable a year and a half, I expect a parallax to be found exceeding that of any star, as the Andromedan can hardly be doubted to be the nearest of nebulæ, and why not of extra-solar objects in general? Whenever it may reach the stage answering to the "fourth day" of our Genesis, and evolve a permanent star, perhaps that may be of first magnitude, rather than fading in a month from seventh to tenth. But we can hardly look for a reliable parallax unless four positions at intervals of half a year—say, August, 1885, February, 1886, August, 1886, and February, 1887—are obtained.

17th Oct. **E. L. Garbett.**

48 CASSIOPEIÆ—NOVA 1885—LARGE V. SMALL TELESCOPES.

[24906.]—Allow me to call the attention of those of our observers who possess large apertures to the double star 48 Cassiopeiæ (β 513), as I should much like to know the present distance of this pair. The latest measures with which I am acquainted are the subjoined by De and β.

De	265·1°	1·05″	1878·69	(1w)
β	264·4	1·01	1878·70	(3)
β	271·9	0·76	1881·67	(1)

As the mags. are 6·0—7·5, it should be an easy pair with a moderate aperture; but I think the distance has greatly diminished, as I have not seen it fairly divided at all this season. The principal star has a large proper motion of 0·107″ in 269·0°, which would look as though the decrease in distance was caused by p.m. only; but in that case it must have been a wide pair some years ago, and could scarcely have been overlooked by Σ, OΣ, and other observers. If, on the other hand, it is a binary pair, the rapid decrease (if such has occurred) may have been accelerated by the proper motion of the large star. I hope someone will measure it, and report the result.

In answer to Mr. Brooks's inquiry as to the colour of Nova 1885 (letter 24850), I found it, on September 4th, about 7·5 mag., and decidedly reddish yellow in colour (not unlike Arcturus). As it has lost light, it has apparently changed colour, and when last observed on the 7th inst., it was rated at about 10 mag., and bluish. Instruments 10¼in. Calver reflector and 3in. Wray achromatic.

With regard to Mr. Burnham's letter on p. 117, I think it is a matter of universal regret that an observer gifted with such phenomenal powers, and of such undoubted accuracy, should have apparently rushed to a conclusion without due consideration. On the matter of "Large v. Small Apertures" I will not touch; but I must say I cannot see the basis of the assertion that "Reflectors are immeasurably inferior to refractors in definition," when the writer thereof has had no actual experience of the former description of instrument. My own experience of refractors terminates with an 8in. Cooke, so that I am certainly not qualified to speak of an instrument like the Chicago 18½in. Regarding reflectors, however, there is no doubt they are peculiarly susceptible to atmospheric disturbance, which seems to increase out of all proportion with increasing aperture. Our climate, too, is one in which perfect definition is a rare thing indeed; but, judging from the performance of my [illegible] Calver mirror on some of the objects from Mr. Burnham's own catalogue, I am quite prepared to assert that, "given the necessary atmospheric conditions, reflectors are quite the equal of refractors in definition, and for planetary work are superior, owing to their more perfect achromatism." In answer to that part of the article which deals with the discovery of new double stars, I would ask how many double stars have ever been discovered in England at all? Yet at least three observers have worked, or are working, with the renowned Clark achromatics. Possibly the small star of Perry [illegible] is too wide to be reckoned a close pair; the distance is somewhere about 0·9, I believe. Yet this was discovered by the late Mr. Bird with one of the unfortunate silver-on-glass mirrors. There is also another thing—viz., that the silver-on-glass reflector (of any size) is comparatively a modern invention; and the field of double-star work has been so threshed out by Σ, OΣ, De, and by Mr. Burnham himself, that the difficulty of discovering an *absolutely new* pair is enormously increased. I have no reason to be dissatisfied with my mirror, as the star discs in good air are beautifully sharp and small: I have seen δ 63 well on two occasions this season, and it will divide down to 0·5″ when the definition is steady in a way which would be difficult to surpass by an achromatic, whether made by Alvan Clark, Cooke, or anyone else.

Kenneth J. Tarrant.

Letchford House, Pinner, 16th Oct.

THE "RAPID MOTION" OF THE STAR IN THE ANDROMEDA NEBULA.

[24907.]—I am afraid that Mr. Perry's explanation (letter 24848, p. 120) will not avail him much. He now states that he was aware that Dr. Copeland's measure was expressed in time, and that his reference to it as 1·6 was a mere misprint. But if this were so, why did he draw the conclusion in his first communication to the *Times* that the star was in rapid motion? For, although his own measure is given (presumably by another misprint) as if it were seconds of time, he must have been aware that it was really expressed in seconds of arc. Undoubtedly I have had enough to do with printing to know that it is not always possible to get things printed correctly; but a writer generally notices mistakes such as these before anyone else does. Mr. Perry is, I think, in error in saying that his second letter was not inserted in the *Times*: it duly appeared on the 22nd of September, but it failed to explain anything, and, by not withdrawing the strange assertion of the star's rapid motion, implicitly repeated it. It stated that he did not understand Mr. Lynn's remarks; but had there really been a misprint in his own first letter, surely Mr. Lynn's doubt respecting the accuracy of Mr. Perry's observation would have been intelligible enough. What did Mr. Perry mean when he said the star was in motion? Mr. Perry's bitter words respecting myself hardly require notice; as nearly a month had elapsed since he made his remarkable assertion in the columns of the *Times* without ever withdrawing it, the charge of "haste," indecent or otherwise, was rather wide of the mark. I sent Mr. Perry some two years ago a list of his own double-star observations compared with those of other observers at about the same epochs, and in reply he admitted that his distances were faulty, owing, he thought, to some looseness of his micrometer screws; possibly, he has as yet omitted to tighten them. I assumed that his micrometer was more faulty than Engelmann's, because the Leipzic observer is a man of world-wide reputation, and has probably made one hundred measures where Mr. Perry has made one. I may tell Mr. Perry that the calculated angle and distance of μ^1 Herculis for 1885·5 are 285·6° : 0·80″. Mr. Gledhill's distance in 1874 is a mere estimation, and it is evident from the angles noted that the star was not really seen double at Rugby or Halifax from 1871 to 1874. I referred, however, to Mr. Perry's distance measures generally, when compared with those of other observers.

H. Sadler.

μ CORONÆ—57 AQUILÆ—ASTRONOMICAL NOMENCLATURE AND ABBREVIATIONS—ERRATA—THE NOVA IN THE ANDROMEDA NEBULA—"100 TO THE INCH," &c.

[24908.]—On the 14th of August I observed μ Coronæ, and found its magnitude 5·2, equal to o Boötis. Afterwards I looked over my previous observations of this star for the purpose of comparison, and was surprised to see that they differed inter se by the best part of a magnitude, as I had no knowledge that the star was supposed to be variable. On turning up Mr. Gore's "Catalogue of Suspected Variable Stars" I found it entered as No. 472. It is entered there on the authority of Mr. Franks, who, in 1878, found it only 6 magnitude, while Heis had given it as 5 magnitude. On April 7, 1884, Mr. Gore found μ Coronæ brighter than o Boötis; and on March 21, 1885, 5·3. It will thus be seen that my own observation of variability in this star has been quite independent, and that it has become apparent in the course of observations. There is one thing, however, that I have noticed since, which I do not quite understand. In Bazley's "Stars in their Courses," the magnitude assigned to μ Coronæ from Argelander and Heis is certainly "5," but the magnitude from the same authorities assigned to ϕ Böotis is also "5." Now, Mr. Franks informs me that when he observed μ Coronæ in 1878, it was "$=\phi$ Böotis," so that, if Bazley be right, and ϕ Böotis be not variable too, I do not see how μ could have been "6 magnitude" in 1878. Perhaps, however, there may be a misprint in Bazley. I will forward the details of my own observations again, but may say just now that they seem to indicate a range of variability from 4 – 5 to 5 – 6, using Argelander's notation. My observations of ϕ Böotis do not, I think, show any fluctuations in its light.

In "Celestial Objects," Webb draws attention to the possible variability of the colours of the components of 57 Aquilæ. From Smythe he takes "blue, 1834," and from Struve "very white, 1835," and then gives observations by himself and others showing that the stars *differ* in colour. He adds, "This pair should be watched, as two of the first observers have attested the similarity of colours." I have obtained only two observations of this pair. They are as follows:—"1885, June 30. A, pale yellow; B, pale blue, I should say. They certainly do not seem identical in hue. A half-magnitude, or so, of difference in brightness." "July 1. A, pale yellow: B, light blue. Difference in tint quite plain." In connection with the statement that the difference in brightness was about half a magnitude, it may be noted that there is, according to Struve, *one* magnitude between the stars (5·2, 6·2). I would like to know of any comparative observations. Perhaps Mr. Franks or Mr. Sadler can say something more upon the matter. The pair is an exceedingly pretty one.

Writing of double stars, may I ask Mr. Sadler what is the present distance of μ Draconis?

In writing paragraph 1 above I overlooked the fact that I afterwards noticed that μ Coronæ is included, also upon the authority of Mr. Franks, in Messrs. Espin, Gage, and Read's Catalogue. It is 118 there.

In letter 24796 (p. 79), Mr. Gore remarks:—"By '61 Andromedæ' (letter 24699), I presume Mr. Dowsett means P II 61 Andromedæ."

It has often appeared to me strange that many of those who write upon astronomical matters should neglect to pay attention to the way in which they make use of astronomical nomenclature and abbreviations. The science of astronomy is singularly well off in the matter of its nomenclature and abbreviations, which are, for the most part, simple, precise, and serviceable. Why, then, should anyone neglect to avail himself of the advantages which strict adhesion to them brings, and confuse what he has written by employing the abbreviations, say, in an incorrect fashion? It is no uncommon thing in these columns to see Struvian numbers quoted without the distinguishing "Σ," without which they are meaningless and useless. Again, what is the use of confusing Piazzi's horal numbers with Flamsteed's numbers? "61 Andromedæ" must, of course, be Flamsteed's 61 And.; but it was not this star to which reference was intended, but to Piazzi's "P II 61." And this inaccuracy involves another element of confusion: while Flamsteed's numbers refer to the *constellation* in which the star is situated, Piazzi's have nothing to do with it, but relate to the *hour of R.A.* within which the place of the star is included. Therefore, "61 And." is not even a correct contraction of the abbreviation which ought to have been employed. Again, I remember at least one instance—and I am pretty sure that instances are tolerably frequent of this form of the evil of which I complain—of a number which should, in order that it might have had *any meaning at all*, have had "H." prefixed to it, but which was without this essential prefix; and which, to make matters more confusing still, was mixed up with a lot of Struvian numbers *minus their* characteristic prefix. Now, to realise the confusion which this sort of carelessness is apt to produce, suppose these inaccuracies *indexed*. Anyone looking up observations of "P II 61," or of "H 640," might very likely not think that observations of which he was in search were concealed under the names of "61 Andromedæ" (for he would probably presume that this was *Flamsteed's* star) and of "640 Cygni" (for this would not, necessarily, indicate the star he was interested in). The publications of the L.A.S. are disfigured to some extent by the same sort of inaccuracy. It would not be asking too much, surely, of a botanist that he should name his plants, or of a mineralogist that he should name his specimens, with precision, and surely it is not asking too much of the astronomer to request him to name the objects he observes with similar exactitude. It ought to be remembered that each astronomical abbreviation has a definite and distinct signification, and that to interfere with any of them is only to disturb the harmony of the system, to involve one's meaning in obscurity, and to lead to confusion. Similar blunders are made in connection with astronomical *nomenclature*, but these are not specially in question here.

Speaking of blunders, I may draw attention to an erratum in "E. M." for Sept. 25. In third par. of Scientific News the words "white lines" occur, but should surely be "bright lines." In connection with what I have said, may I ask why some double-star observers do not give the *declinations* of the objects they describe? What use is the "R.A." without the "Declination"—the one co-ordinate without the other? I know that Mr. Burnham has said in "Ours" that it is only the "R.A." that is needed—that that is all that is necessary for finding the object in a catalogue of double stars, when the correct name is given. But it certainly is not sufficient for finding it in the sky, and that is the main object, one would think, of "R.A." and "Declination."

The Nova in M 31 is still diminishing, and when I saw it the other night was less than 10 magnitude. With two exceptions its decrease of light seems to have been very gradual. On the occasions referred to, I thought that a sudden decrease of light had taken place, larger in amount than the decrease from night to night immediately preceding. A good deal has been written concerning the question as to whether the Nova is associated with M 31 or is distinct from it; but it seems to me, to say the least, curious that it should have been considered by anyone that the latter view was ever as probable as the former. In M 31 we have a "nebula" which is obviously in truth a star-cluster, but the light of which as obviously comes to us through some absorbing medium. In the same field we have another "nebula"—M 32—which is also obviously a star-cluster, and shining through the same or similar absorbing media. This association is singular enough; but would it not be in the highest degree strange that a new star appearing in the same region and which possessed a spectrum exhibiting the *same peculiarity* were not associated in any way with either. Again, we have had spectroscopic observations of two "new stars"; but neither one of these exhibited an "absorption" spectrum. They exhibited a bright-line spectrum, superposed upon a stellar spectrum. Is the case of the present star, we have a bright-line spectrum superposed upon an absorption spectrum. Is the difference of spectrum not strongly suggestive of difference of position and association? As to the other conclusion, that the star is within the cluster, necessitating the belief that the cluster has not that immense distance which it had been supposed to have, I do not see that that is any objection, for the individual stars of the cluster may, for ought we know, be too small and too densely aggregated to be separately visible, even although the cluster be so much nearer to us. It is absurd to suppose that we are compelled to assume that "star dust consists of suns and bodies of *average* stellar dimensions"—as "S. S." seems to think we are—and then to build theories concerning the huge size the Nova would require to be, in order to be separately visible, were it a member of a cluster composed of such bodies, so remote from us as "to defy individuality."

There is nothing whatever known compelling us to believe all stars to be of an average size, nothing at all to keep us from believing that there are stars almost minute in proportion to others. All the evidence, on the contrary, goes to establish that there are among the stars as many orders of size as there are of magnitude. What does "S. S." mean by his words, "Stars of larger and measurable magnitude"; and "a star of the 7th magnitude would apparently occupy a space equivalent to myriads of that occupied by the components termed star-dust"? As to his reference to Mr. Proctor, I would recommend "S. S.," if he has not already done so, to study that great astronomer's "Universe of Stars" and "Essays on Astronomy" before sneering at his theories

In connection with this matter, I would like to know whether any correspondent can furnish a complete list of the nebulæ known to exhibit a spectrum similar to that of M 31? Several such are noticed in Webb. Are there any more? Also, I would like to know whether any recent observations have been made of T Scorpii and of M 80, and what sort of spectrum M 80 exhibits? It does not seem to have been sufficiently noticed that the apparition of T Scorpii constitutes the only known case possibly similar to the present. Is there any peculiarity in the spectrum of M 15 Pegasi? Information on these points would much oblige.

In the sixth paragraph of his letter upon p. 120 (Oct. 9), Mr. E. Holmes asks to be allowed "a few words of comment" upon my letter on p. 103; but though he has used the space, he appears to have refrained from making the comment. He speaks of my calling him "to the front so plainly." I do not think I did so, at any rate in regard to the matters with which he deals in his letter. If I did call him to the front at all, it was in regard to what could or could not be done with 2in. of aperture—and that point he has ignored. As to Mr. Holmes's reference to Mr. Franks—that he "evidently was deeply annoyed that so humble an individual as myself should presume to differ from him"—and his accompanying wish that I may not be angry with him either, I feel convinced that Mr. Holmes misjudges Mr. Franks as completely as he misjudges me, and by inference misjudges most of us. Mr. Franks is, I am sure, about the last man to *take offence* because anyone "differed" from him. It is a great pity that so many people *do* take offence because others "differ" from them—and such a proceeding, not very defensible in any case, is absolutely indefensible in matters pertaining to science. I cannot but think that the whole of this controversy about the use of high powers bears some resemblance to the controversy concerning the two sides of the shield; or, at least, that a serious misunderstanding as to its meaning has existed in the minds of some of the disputants. I did not apprehend Mr. Franks as objecting to the use of high powers *per se*, but mainly as reiterating a declaration he has made before, to the effect that their use is, in many cases, most injudicious, and that it is always advisable to use the lowest power which will show the object well. But a point which has been overlooked, comes in here. What is "seeing an object well"? Different people seem to have very different opinions on this point; just as they have upon what constitutes useful astronomical observations. If our numerous double-star "splitters" and faint *comites* detectors would consider within themselves who, or what is benefited by their prolonged endeavours to see what is beyond their reach, and their complaints—now querulous, now indignant—because they cannot see it, they might perhaps cease from spending time and energy to no purpose. And similarly with "seeing objects well," most seem to forget the advisability of keeping some sort of proportion between the *light* and the *size* of the image. They seem to think that it does not matter whether the image is rendered excessively faint and the atmospheric disturbance enormously exaggerated, so long as the image is made as big as possible. And as to stellar observations, some users of telescopes never seem to appreciate the advantages of a large field, nor to recognise the additional beauty a fine double-star gains if it can be seen surrounded by other stars. An isolated star is never, to my eye, so beautiful as one grouped with others. Herein, in their fundamental difference of conception as to what good "seeing" is, lies a large part of the difference of opinion concerning low and high powers; and as to the controversy between Messrs. Franks and Sadler, surely it was obvious that they were talking about different things. Mr. Franks used one method of counting, Mr. Sadler another, and consequently they disagreed. It is surely apparent that Mr. Franks considered the *number of objects observed*; Mr. Sadler, the number of *observations made upon them*. At least, this is what the controversy appeared, to an onlooker, to come to. But as regards the question of restriction of aperture, it is curious that Mr. Holmes should pronounce an opinion, and straightway adduce evidence which seems to go to show that the opinion is ill-founded. But in respect to this matter, I must protest against Mr. Holmes's manner of "setting me down." I pass over his implied sneer, of course, as both unworthy and irrelevant. I never "traversed" Mr. Burnham's opinion, as Mr. Holmes seems to say I did. I stated the opinion, and stated that others had traversed it. I must take exception, too, to Mr. Holmes's method of "setting down," by an appeal to authority. He makes the very common blunder, apparently, of assuming that respect for authority necessarily involves deference thereto.

Glasgow. **S. Maitland Baird Gemmill.**

PERSEUS—ERRATUM.

[24909.]—In reply to query 57819, I presume "J. S. C." refers to the clusters H. VI. 33, 34, in the "sword-hand" of Perseus. He may find them readily enough by taking an imaginary line from δ (delta) Cassiopeiæ to γ (Gamma) Persei, when the object will be seen as a dull misty patch (to the naked eye), nearly midway between these bright stars. In the telescope, with a low power, two brilliant and compressed clusters will be seen separated by about 3 min. of R.A., the preceding of which (H. VI. 33) is the larger. The component stars range from about 7th to 14th magnitudes. There are several small ruddy stars in and between these clusters.

In letter 24885 I notice an erratum. Page 140, line 43 from top, for "Chicago reflector" read "Chicago refractor."

W. S. Franks.

DOUBLE STARS.

[24910.]—50^1 preceding γ Cygni 20' south is a neat new pair P.A. 120°. Mr. Sadler informs me the star 3' south of β Lyra is not new, and is the one mentioned in Webb. In this case there is another and neater double following in field which I did not measure, thinking it the one referred to by Webb.

Σ 2666 has *comes* at 202° 17″ or 18″, and another 157° 22″, and also a pair in field 2′ distant P.A. from 2666 20°. This pair is 210° 20″.

Σ 485 Camelus has four *comites*, two of which are new. One of the new ones is about 123° 16″, the other about 340° 32″, forms a pair with a previously known *comes*.

Σ 806 Cassiopeiæ has a triple in field, discovered, Mr. Sadler says, by Dembowski. This star is really sextuple. Dembowski's stars are the larger ones.

Edwin Holmes.

DOUBLE STARS.

[24911.]—Can Mr. Sadler oblige me with any recent measures of the following double stars? Places for 1880·0:—

1. Σ 888. R.A. 3h. 20m., N. 50° 1′. The last measure I can find is one by Mädler, 208·9° : 2·82″ : 1845·64.

2. φ Ursæ Majoris. R.A. 9h. 44m., N. 54° 37′. Last measure by O Σ, 1875·47.

3. O Σ 235. R.A. 11h. 23·8m., N. 61° 45′. Last measure by O Σ, 1871·53.

4. O Σ 387. R.A. 19h. 44·3m., N. 35° 0′. Last measure by Dembowski, 1877·67.

Oct 5th. **J. E. Gore.**

THE TELESCOPE.

[24912.]—Many must have wondered how Mr. Burnham can assert so positively what he does about reflecting telescopes whilst he admits he has no knowledge or experience of them. But that Mr. Burnham can arrive at opinions on such matters with scanty materials is plain from his comments on Clark's object glasses, compared with all the rest of the world. He tells you his "experience has been acquired by the use of half a dozen Clark telescopes," and from these he pronounces judgment on all telescopes and makers. He goes on to say he "don't want to speak *disparagingly* of the work of other makers, or to make *unfavourable* comparisons" (the italics are mine). The inference is plain enough—as plain as if he had compared them. He can tell of what he *has* seen, but how *can* he tell what can be done with those he has *not* seen? We here are of opinion that telescopes to be compared should be side by side. I fear he is as partial in his opinion of Clark's o.g. as he is unsafe in his opinion of reflectors.

I have seen specimens of Clark's, and (though I may be prejudiced, as I fear Mr. B. is) if I were ordering an o.g. I should certainly not go out of the British Isles for it. As to reflectors all being bad, I think his talented countryman, Mr. Brashear, will some day cure him of his prejudice. Mr. Burnham tells us that, because a reflector gives a steadier image when the aperture is reduced during unsteady air, it is a sure proof of the faulty character of the mirror.

If, on a night when the air is very unsteady, you turn a large star out of focus (in a reflector) considerably, you can see that the air in the tube is all on the whirl, circulating round the tube, and the light of the star is seen to be bulging out and swaying to and fro; as this is most intense immediately near the surface of the tube, a small stop will make a great difference, and on again looking at the expanded image it is seen to be much less, and definition of the star when focussed is much improved; a larger stop will still reduce it. Now, as this very same star could be well and satisfactorily seen on a previous night with full aperture, it seems a reasonable conclusion that it is the air, which in the tube of a reflector is free; the tube being open admits currents and motion, and that, in consequence, the mirror is under a disadvantage the o.g. is not. Added to this the fact that the rays in the reflecting telescope first traverse in a parallel course the whole length of the tube and then return to the plane. Whether the mirror is a perfect or imperfect one the air motion is seen to be the same, and by the introduction of a stop reduced to the same extent. Of course, in good air the reflector asks no favours, and in bad air no refractor can do well.

There is yet another matter never noticed, but which considerably contributes to the difference between the two classes of instruments. The plane acts as a stop to the central rays, and alters the appearance or character of the image, so that a star is a bright *point* with less diffraction rings, rather than, as in the refractor, a *disc* with rings. When it is a *large* reflector there are seldom any rings. Now, when an 18in. or 20in. reflector, having a 3½in. or 4in. plane stopping out these axial and disc forming rays, it must be seen how it alters the character of a ray; it is only the stars that are altered by it because they are points. In all other objects it is not a point, but an object of sensible diameter. To get a planetary disc with a large reflector, an *eccentric* stop must be used. You then use a cone of rays *not interfered with* by the plane; but to get this planet-like disc to perfection, the adjustments are not quite true, because you take a part of the mirror just so large as to get the action of the edge of mirror, and as near to the centre as the plane admits, so that the plane and the eccentric aperture cannot be opposite each other; but, even without altering adjustments, the star is very planet like. Let the experiment be tried on a refractor by stopping out the centre, and the image is very decidedly altered, especially if the o.g. is a large one. A star is practically the same size whether it is observed with a 3in. or a 3ft. glass, or whether the power be 200 or 500; thus it is that in small reflectors the proportion cut out of the centre of the plane being less enables it to show a star so near like a refractor. There is a correction—though difficult to obtain—that modifies and helps the large reflector over the effect caused by the plane cutting out the central rays. Rev. J. J. M. Perry's 18in. is one in question, and Mr. Burnham has been good enough to say that his is the best star work ever done with a reflector. I think this is quite correct, as many of the doubles seen and measured by Mr. Perry are as close as those measured by Mr. Burnham with the 18½in. refractor. For large double stars I have always admitted the superiority of the refractor, and above I have pointed out the reason; but for work on smaller doubles I contend they are about equal—many consider the reflector best, Mr. Holmes for one. For general work, however, the case is quite different, and the reflector is the best.

As Mr. Burnham has said so much against our English instrument, the Newtonian reflector, it will be suitable and proper to mention some very recent as well as past experience of observers with them. In my little book of "Hints on Reflectors" I publish a good number of letters received from observers, being only a portion of many I have; and besides a general consent, I have in many cases been kindly requested to do so.

I will only mention a case or two of very recent date. It will be remembered that I lent a 9in. reflector to the Liverpool Astronomical Society; it was in the custody of the Rev. T. E. Espin, who expressed himself pleased with its performance. Since Mr. Espin left Liverpool he has purchased of me a 17¼in. equatoreal, with clock complete. He sent me a report on the 5th ult. The 9in. has since been in the hands of Mr. Gage, who is equally satisfied with it. His refractors are a remarkably fine 6½in. and a 4¼in.

I have Mr. Espin's free permission to extract his remarks, which are as follows: "I have," he says, "had several good nights with this splendid instrument, and the celestial views I have had with it baffle all description. It is quite easy to manage, and in less than five minutes I can run the house off, and have the telescope on the object I want to observe. You have entirely converted me from my prejudice against reflectors. I would not return to a refractor again on any account." Mr. Espin's is a 5½in. refractor.

I may tell Mr. Burnham that there are readers of this journal who remember contests of reflectors against refractors they were interested in when Alvan Clark also was in it, and the results I can mention with satisfaction. The Rev. Saxby had of me about two years ago a 6in. equatoreal. A letter from him yesterday brought inquiries about a 12½in. equatoreal, complete with clock.

Mr. Westlake also took to a 10in. reflector, then to 12½in. This latter I am remounting on a first-rate equatoreal stand, complete with clock. I mention these cases as pointing in the one direction—the fair proof of the general appreciation of the reflector, as in every case the refractor had been used.

Mr. Burnham may say that all this does not prove so much as the discovery of a difficult double star would prove; to me it proves *enough*—that they give satisfaction. Evidently everyone does not attach so much importance to the discovering of another double star. Hundreds have been discovered, and no doubt there are hundreds more undiscovered, many of which can only be seen under the most favourable circumstances. I fear few care to absorb their whole time and energy in the *discovery* of such difficult and eye-straining objects while there are such numbers already known. Does the only or best use of one's eyes, telescope, patience, &c., consist in working night after night in trying "just" to see or "glimpse" some unknown or known difficult object that no one else has seen, or can see, or that only a few can just "glimpse" once in a lifetime.

May not *some*, at least, have telescopes for general intellectual recreation? It is not the ambition of all to be original, or discoverers? Hence they save themselves the labour, and take to the pleasure of the telescope.

With a refractor, to be grunting on the flat of one's back continuously, "just" to "glimpse" the barely discernible, is not *all* pleasure. I could better do it in my younger days than now.

With regard to the question of large or small telescopes started by Mr. Denning, I cannot see how Mr. Burnham could jump to the conclusion that Mr. D. referred to "large reflectors against small refractors"—nothing of the kind appeared to be intended by him; but the opportunity for Mr. Burnham to have another turn at reflectors was too tempting to be resisted. I am, however, quite of Mr. Burnham's opinion on the greater powers of larger apertures. We all know of the earnestness of all Mr. Denning undertakes; but his opinions on this matter cannot be true except for star discs. A small one will always show it as well as the large one, and often better; but, when the large telescope gets a good night, the smaller, on all other objects and work, is left far behind. The opportunity for the large one does not so often occur; but when it does come, objects can be seen and work done never to be hoped for from the smaller—good night and still air cannot make up in the small one, for the greater light, penetration, and dividing power of the large one.

It is only right to observe that Mr. Denning only alludes to planetary detail, though I don't agree with him on this point, and I do not see sufficient reason even if this point had to be conceded to place the capabilities of the smaller instruments before the larger.

I think Mr. Green has sufficiently and clearly replied to Mr. Denning on this point, and the use of stops also. I have not long since finished a 50in. speculum, and let us hope it may some day help to decide such a question. Mirrors should be of a good long focus.

Chelmsford, Oct. 12. **G. Calver.**

MR. S. W. BURNHAM ON SMALL v. LARGE TELESCOPES—δ CYGNI.

[24913.]—I have read with very great interest Mr. S. W. Burnham's article in your issue of Oct. 9th (copied from the *Sidereal Messenger*) on "Small v. Large Telescopes." I have had no experience whatever with refracting telescopes; but for the last five and a half years I have worked with an 18¼in. silvered glass equatoreal by Calver, and for some time before that I was in possession of a 6½in. instrument by the same maker. I have no hesitation in giving the preference to the larger instrument. Whether upon planetary details or upon double stars, I can, with the larger telescope, see all that was visible with the smaller one, and see it better; in addition to which, details which were quite beyond the reach of the latter are plain enough in the former. Both mirrors are, I believe, as perfect as human skill can make them. Mr. Calver has made for himself a deservedly world-wide reputation for the figuring of mirrors, and anyone who possesses one of his later instruments may rest assured that he possesses a mirror which will do all that a mirror can do in the way of perfect definition. But from my experience I should say that aperture is a very important matter indeed. In the separation of double stars this is acknowledged. I do not see why it should not also be true in the delineation of planetary details. I can only, of course, speak for myself; but here also I am of opinion that the possession of a large aperture is an unquestionable advantage. I do not by this mean to say that one individual with a large telescope will necessarily see all or more than all that another man will see with a smaller one. Eyes differ enormously. But granting both instruments to be equally good, the *same individual under the same atmospheric conditions* will see more with the larger than with the smaller one, and will see everything better and clearer.

But what concerns me more immediately is the contribution which Mr. Burnham has made to the old controversy between refractors and reflectors. In the first place, everyone will acknowledge the very high, if not absolutely unrivalled, authority of Mr. Burnham as a double star observer. Beyond all question he is exceptionally gifted, and for this reason his experience can hardly be compared with that of ordinary men. Just as the present age has produced marvels of human strength and endurance, such as the late Captain Webb and Mr. Weston—men possessed of quite an abnormal heart—whose feats in swimming and walking would by most people have been pronounced absolutely impossible before they became accomplished facts, so in Mr. Burnham's case we have most exceptional and abnormal powers of vision which have enabled him to do such work with a 6in. telescope as has never before been approached in the history of astronomical observation, much less equalled. He therefore occupies a unique position. He stands on a pedestal absolutely his own; but when he expresses an opinion so very strongly in favour of refractors over reflectors for all kinds of work requiring sharp definition, while not venturing to contradict him (since I have never used a large refractor), I can only put forward the result of my experience with a large Calver reflector in that department of observational astronomy which most requires sharp definition, viz., the measurement of double stars. And here, I must say, I think the reflector, as a reflector, has been somewhat severely, if not unjustly, assailed. Mr. Burn has had no exper use performance of reflecting telescopes. I have had some little experience in an exceptionally bad climate; but when I get a really good night and such nights are, like angels' visits, few and far between—I think Mr. Burnham himself would acknowledge that the star images, could he see them as shown in my instrument, leave nothing to be desired in the way of sharp definition.

I ventured once to express the opinion in your columns that, were my telescope placed side by side with the Dearborn refractor, and tested by the same observer on the same objects and with the same eyepieces, the reflector would not suffer very much by the comparison. In support of my observation I gave the results of my work on some pretty difficult doubles; and in reply, Mr. Burnham, in your issue of Sept. 1, 1882, made the following remarks: "Whatever may be the performance of reflecting telescopes generally, there can be no doubt that he (Mr. Perry) has a most excellent instrument, and one capable of doing, in his hands, the very best work in this field. The class of stars observed, and the excellence of the measures, furnish satisfactory evidence on this point. Mr. Perry, however, will agree it has rarely happened that a large reflector has been so severely tested in any tangible way. We have had plenty of descriptions of how planets, nebulæ, &c., have looked, which, however satisfactory to the observer, could be no evidence to anyone else. Fortunately, with the micrometer no description is needed, and the correctness of the observation can be verified at any time." But Mr. Burnham asks for the discovery of a very close pair of not more than 0·3″ or 0·4″, if the stars are about equal, as the conclusive proof of the equality of the reflector as compared with the refractor for this class of work. I am under the impression that the duplicity of the companion to Rigel was independently discovered by Mr. Herbert Sadler with a Calver mirror. And, let me ask, have more stars of this description been discovered *in this climate* with refractors than with reflectors? From the *ease* with which, on a really good night, I can measure small and equal pairs of not more than 0·5″, I have little doubt I could discover them of that distance, or even less, if I came across them. But I have been under the impression, possibly a mistaken one, that on those very rare occasions when the atmospheric conditions permit work of this kind I was better employing my time in measuring known and difficult pairs than in searching for new ones. To say that I could not help making such discoveries if my telescope was equal to it is, I think, a little unfair to the telescope. I think I am quite within the mark when I say that of the nights I am observing not half a dozen in the course of a year are, on the average, of really first-class quality. Lying as we do right in the fair-way of the track of cyclones coming across the Atlantic, the atmosphere here is almost always in a state of perturbation, and other duties necessarily prevent my spending any large portion of my time in the observatory. Besides which I imagine undiscovered pairs of 0·3″ or 0·4″ are not very plentifully scattered over the blue vault of heaven. The chances, then, of discovering such pairs are very small indeed; but I submit that the telescope is not necessarily to blame.

With regard to the use of stops, my experience does not seem to coincide entirely with Mr. Burnham's. On a really first-class night I use the full aperture with great advantage in all kinds of work, and it is on such occasions that the real powers of the telescope are brought out to perfection, showing what the instrument is capable of under the best conditions; but when the air is unsteady I find definition generally improved by the judicious use of a stop. I think it very possible that this may be in consequence of the necessarily open tube of the reflector. Air currents may circulate round the inside of the tube, thus interfering with the definition of the outer portion of the mirror, and here, of course, if that is the case, and not that the edge of the mirror is defective, refractors have the advantage. Yet there remains the very important question of cost, and this is a consideration which will weigh heavily with most purchasers of telescopes. Given a certain and limited amount of money, can it best be expended in the purchase of a refractor or reflector? I should have little hesitation in advising the latter. I believe you could get more satisfactory work of every kind out of a Calver reflector than would be possible out of a refractor costing the same amount. The cost in every way is so much less. In the mirror the glass is not so expensive; there is one surface instead of four to figure and polish; the tube is much shorter; the size necessary for the observatory is much less, aperture for aperture, and to anyone who can follow plain directions the difficulty of silvering even a large mirror is not worth mentioning; and when we come to the performance, to judge from the work done by the two classes of telescopes *in this country*, I do not think there is so very much to [illegible] Mr. Burnham speaks highly, and de- [illegible] of the Clark refra[illegible]; but he has [illegible]nce of the Calver [illegible]. I think those of your readers who are fortunate enough to possess these latter instruments will agree with me that they also are deserving of the highest praise for all kinds of work.

I had a few minutes of superb definition yesterday afternoon, the first I had seen for some months, and I took the opportunity of measuring δ Cygni. I took three measures, and I have great confidence in them. Very shortly afterwards clouds put an end to work.

(1.) P = 318·0°. D = 1·35″. Ep. 1885·77.
(2.) P = 317·5°. D = 1·35″. " "
(3.) P = 318·5°. D = 1·41″. " "

The mean gives—
P = 318·0°. D = 1·37″. Ep. 1885·77.

I have also commenced to measure the test stars on p. 421 of Gledhill and Wilson's book, mentioned by Mr. H. Sadler.

Jevon J. Muschamp Perry.

St. Paul's Vicarage, Alnwick.

"CLAMP" v. "CRAMP."

[24914.]—In my letter, p. 141, I ought not to have said a "clamp, as that is what it is in German," but "Klampe, being a German word." Klampe does not mean a clamp, but a cleat; nor yet does Krampe mean a cramp, but a staple, wall-hook, or holdfast. A cramp in German is Zwinge, so I submit that it is a mistake to attempt to derive either of the above words from the German at all. I observe that in Holtzapffel's catalogue, 1844, p. 13, cramps are correctly described thus, "short or bent cramps of iron from 4in. to 30in. long, with square thread screws," and "long or straight . . . . with screws and shifting heads and pins." Clams are probably so-called from the likeness of some of them to the bivalve clam-shells, which are very various. **J. K. P.**

ELECTRO-MECHANICAL CLOCK.

[24915.]—It is useless to criticise the remarks of "An Old Correspondent" (p. 140) until he gives more details. Judging from the meagre information he gives (there is abundance of assertion), I should say that he does not understand the point at issue. However, if your correspondent wound a clock, and kept it perpetually wound, by means of a single cell Leclanché battery "15 years ago," it must occur to him now that it is a great pity he did not see the opening such an invention affords for making money. There are plenty of electrical devices in connection with clocks. The question is, Are they useful, and, above all, inexpensive? I should like to know what it is that your "Old Correspondent" has actually done; at present, his letter is vaguely vague. **Quæstor.**

VOICE HARMONIUM AT THE INVENTIONS.

[24916.]—In letter 24873 Mr. S. E. Hunt says that "Colin Brown's voice harmonium at the Inventions, however, has enabled me to hear melody with these intervals (perfect fifths), and the result is, as I expected, worse than with even temperament." The "as I expected" in this sentence is sublimely rich—quite too-too, for Mr. H. must have expected the true musical scale to be worse than the equal tempered. He cannot mean this: but no matter, for Mr. Hunt proceeds to say that Mr. Brown's keyboard is easily managed, as you have simply to use "all white keys in the scale." In Vol. XXIII., p. 298, which gives a diagram of Mr. Brown's keyboard, I read: "In every case the 1st, 2nd, 4th, and 5th of the key are white digitals, the 3rd, 6th, and 7th coloured." Something wrong here, it strikes me; but surely Mr. Hunt has not joined the gentleman who is still looking for those other major scales, which he is quite sure exist, but which he is unable to find. I hope I shall not be misunderstood this time; but, really, Mr. A. J. Ellis knows as much about music as any man breathing, and I would like Mr. Hunt to point out where Mr. Ellis said (and in what connection) that "the musical scale is not one, but diverse." Surely it is the duty of anyone who quotes a writer to endeavour, at least, to understand what that writer meant. Mr. Hunt knows, I presume, that Mr. Ellis was speaking of the "musical scale" as found amongst all the nations of the earth, not of the musical scale as recognised by the civilised, or, perhaps, I should say cultured, races, as we Westerns understand culture. **N. E. Child.**

SOME NOTES ON PODURÆ.

[24917.]—The other day, while testing a $\frac{1}{10}$ immersion of Beck's on some scales of the Podura Plumbea, I neglected to remove the small perforated "cap" that is generally used for centring the condenser. There was a full flood of parallel light from the plane prism then on, and I then racked the condenser full up, and bringing the $\frac{1}{10}$ carefully down on the slide was much surprised at the result. The spines, or "notes" of exclamation they are generally called, came out with great distinctness, and the "notes" showed dark at the edges, with a clear band of light running down the centre of each spine. I have not been able to do this before, and would like to know if any other "Micro." has ever tried this dodge. It, however, clearly demonstrates the usefulness of having diaphragms *over* and close to than *under* the achro-condenser, particularly for the higher powers.

Edgbaston, Birmingham. **E. H. W.**

CONCERNING BALL OR ROLLER BEARINGS.

[24918.]—Your "anti-roller" correspondent has been so well answered by several in "Ours," that I need no more space than will suffice to call his attention to the well-known fact that a hard knife-edge, resting upon an equally hard true plane surface, moves with the least friction, and is therefore used in balances; of course, it would be entirely useless in a case where a great weight had to be borne, as the weight would tend to cause the edge to cut the bearing like a knife. Would our friend call a "knife-edge" useless for a balance because, forsooth, it is not useable in railway rolling stock?

As a matter of fact, however, roller bearings *are* used in the United States to a considerable extent for light carriages, heavy trucks, and freight cars on railways, and are found to work admirably; they reduce the indicated draught (by dynamometer) to 10 to 20 per cent. of that with the best parallel bearings in common use. I have seen a 10-ton flywheel, on rollers, driven steadily, at a high velocity, by one strand of *white sewing cotton*; of course, not transmitting power!

So our "anti" friend will see that it all depends on what sort of machine it is that one speaks of, and on how much weight the bearings are to carry.

Roi ne puis, Souza je suis.

THE SOARING BIRD.

[24919.]—This subject appears to be somewhat of a puzzle, but more mystifying still are the attempts of those who would give an explanation of the supposed facts. "Norman" (24856) calls to his aid intermittent gusts of wind. One of these meets the bird in its flight; the bird trims his wings to the gale and rises in the air. Good; and in the meanwhile the bird has acquired the horizontal speed of the gust, and when this ceases the bird goes on merrily with this acquired speed. Lucky bird to be able to turn obstacles to so good an account!

I hope I am not misinterpreting "Norman," but he presumes, I suppose, that the bird is brought to a standstill as regards terrestrial space, but that as regards the air the bird has the same relative velocity that the gust which is composed of this air in motion has to the bird. But if the gust instead of ceasing were to go on, the bird would be swept back; its cessation merely allows the bird to remain where it is.

The bird would, I believe, have done quite as well had he declined to soar; by trimming his wings for a rise, he exposed a wider surface to the gust which swept him back (relatively) more than it would have done had he continued his onward course, and his rise in the air merely gave him the vantage ground sufficient, perhaps, to compensate for this loss.

It is my belief, previously expressed in your columns in the last grand tournament on this question, that the only difficulty, but, perhaps, an insurmountable one, is in ascertaining the condition of the air in which these "soaring birds" appear to float. We occasionally see a flock of rooks gyrating in graceful circles high in the air, upheld no doubt by the ascending currents of a cyclone, of which there must be many among the variable airs of our atmosphere, and rooks, who have much time on their hands and many opportunities for the amusement, evidently enjoy the glorious sensation of circling in mid air. I have little doubt myself that soaring birds are supported by currents of air they meet with in their various peregrinations, and exercise no mysterious or unknown functions in riding on these friendly gales.

M. A.

AN AUTOMATIC CUT-OFF GOVERNOR.

[24920.]—One of the most serious difficulties in the way of making self-regulating engines of small size is that of making a satisfactorily operative governor in miniature. This difficulty may be entirely overcome by the adoption of the governor construction shown in Fig. 1. It may be contained in the fly-wheel, driving pulley, or a special wheel made for the purpose.

It regulates by varying the travel and angular position of the eccentric that actuates the slide-valve, the changes in its movements being substantially the same as those produced by shifting the link of a locomotive between its mid-position and one of its extremes.

The construction is so simple and so plainly shown that no very complete description will be necessary, though I will willingly answer any queries in regard to it.

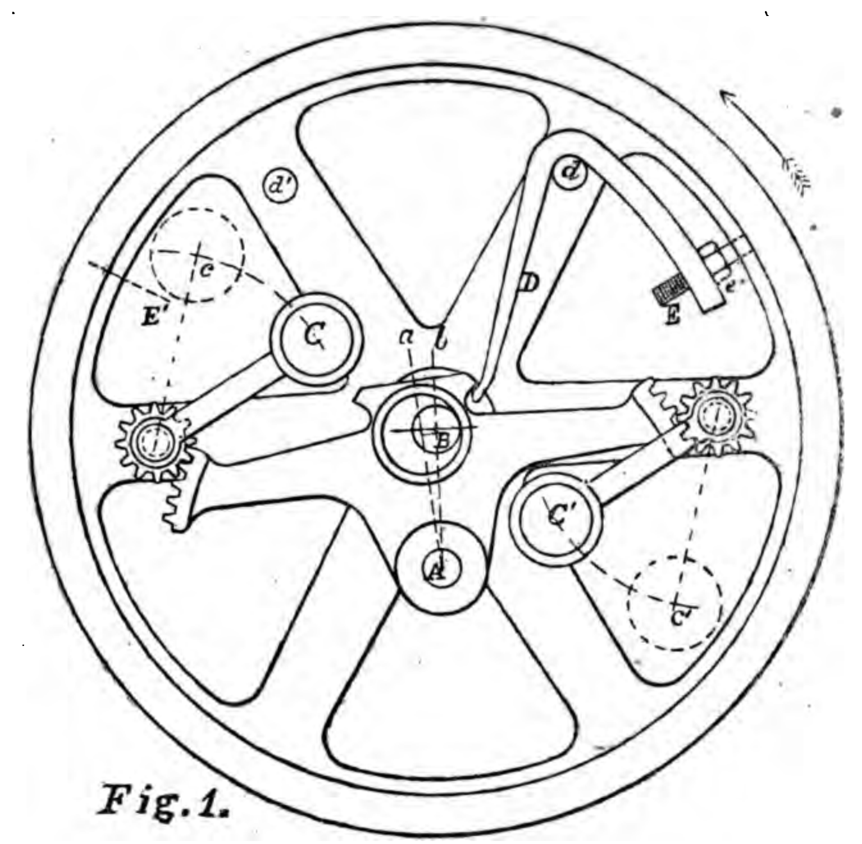


Fig. 1.

The eccentric, seen surrounding the shaft B, is simply an annular hub or rim projecting from a plate which is pivoted at A to the containing wheel, and carries two arms terminating in segments concentric with A. Two pinions fitted to work on studs in the wheel mesh into these segments. To these pinions are rigidly attached arms terminating in weights C C′, the outward movement of which to positions *c c′* shifts the centre of the eccentric from line *a* A to B *a*, in which position it imparts a movement to the valve coincident with the piston, but (with any form of slide-valve which admits steam by movement from the induction end) in an opposite direction, and of just sufficient extent to overcome the lap of the valve and show a slight trace of opening at each induction period.

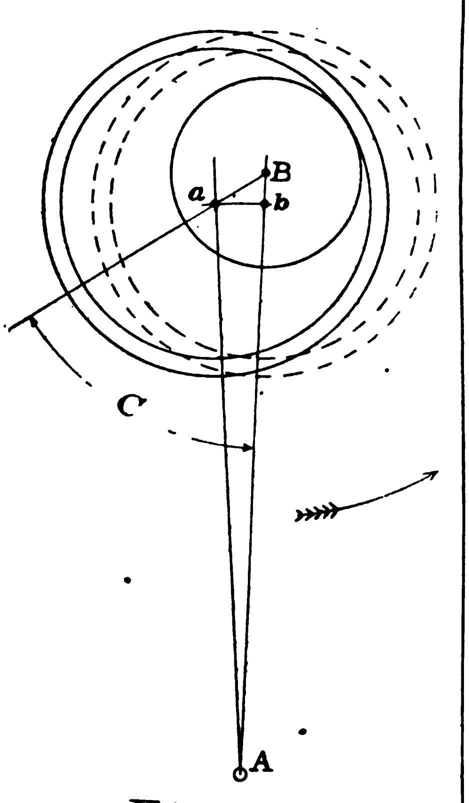


Fig. 2.

A spring D, the tension of which is adjusted by nut *e* on stud E, furnishes the centripetal force.

For close regulation this spring should have as much tension as possible without introducing instability of equilibrium, the proper speed being got by more or less weight at C C′.

The spring should be as strong as possible without danger of breaking under the tension to which it is subjected when the weights are expanded to positions *c c′*.

The wheel is secured to the shaft in such position that pivot A will be diametrically opposite the crank. It will then be correct for either direction of motion.

The parts are shown in proper position for rotation in the direction of the arrow. For the opposite direction such changes will be required as will conform to the appearance the drawing presents when viewed in a looking-glass. For this purpose a place for tension-stud E is provided at E′, and one at *d′* for stud *d*.

Fig. 2 shows more clearly the nature and extent of the adjustment movements. The eccentric moves from *a* to *b* as the levers move through their adjustment range. This movement shortens its semi-travel from *a* B to *b* B, and advances it through arc C. The lead is varied to the extent that arc *a b* differs from a straight line perpendicular to A B. It is greatest when the eccentric is at *a*, which is as it should be, since there is least compression at that point.

The lay-out is proportioned about as it should be for a cut-off adjustment from about five-eighths stroke to zero.

No dimensions have been given, but they may be deduced from the principles given, starting with a shaft in proper proportion to the desired cylinder bore, say about one-half.

Fig. 3 shows horizontal and transverse sections of a cylinder and valve suitable for use with the governor. The attention of amateurs is called to the way in which the steam ports and passages are formed by drilling and mortising. In this way another almost insuperable difficulty in the way of forming the ports and passages in miniature cylinders is overcome.

The valve, or valves rather, for there are two connected rigidly by a bar, are shown in their mid-position.

Salem, Ohio, U.S.A. **J. W. Thompson.**

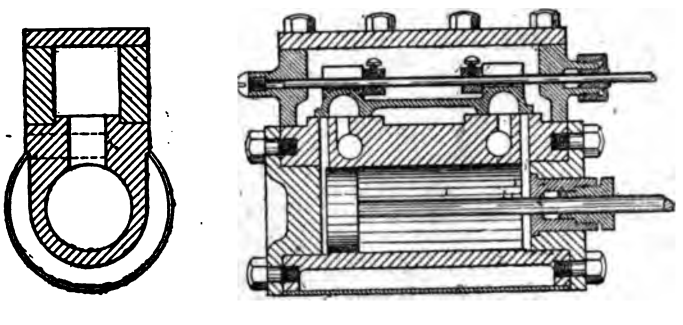


Fig. 3.

MODERN MAN-FLIGHT AND AERIAL NAVIGATION.

[24921.]—In following up "Silex Seadrift" (23439), in answer to "Norfolk" (24747), I confirm the impossibility, pointed out by the former, as to "Norfolk's" proposal, also endorse his latter remarks as to what is required, and to say a patent has been taken out for a blower, as he describes.

To this I beg to add that aërial navigation is a subject so eminently practical, that it involves as much mechanical and scientific knowledge as any branch of industry in the world, for the reason that every part of the proposed machine or aërial ship must be constructed as to size, shape, and weight by calculations based on the conditions which such ship or machine will have to contend with in raising itself from the ground, in navigating the air when raised, and in descending with safety as often as required.

Each of these will have to be carried out under the various states of rain, wind, or great heat, the effects of which upon an aërial ship have to be ascertained as near as possible by sundry data and experiments, and the ship built accordingly, so as to leave nothing to chance or speculation. Yet "Norfolk" opens his letter (24747) by saying:—"Showing principle of action without regard to precise measurement or form of machine." A rather loose master to guide the readers of "Ours" up to the sky.

In kindness, I beg to suggest to "Norfolk" or other readers desirous of doing anything practical for themselves, or wishing to guide others, that they must study very much and experiment. One paper in "Ours" of Oct. 24th, 1884, by the Editor, on Mr. Brearey's Aërial Machine, will also be of great help to them, because, properly applied, it contains the very basis of flight.

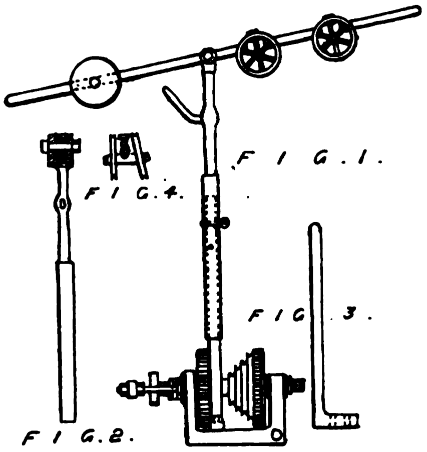
Flying machines have been made from time to time by scientific mechanics, and the correctness of the principles have been confirmed by the writer's experiments; but there is such a wide gulf between models—mere toys—and the large machine or aërial ship fitted for practical purposes of man that no man without large capital can attempt to make one of the latter.

One kind of aërial machine similar to that of MM. Krebs and Renard, of Paris, is the most easily made of any. This consists of a cigar-shaped balloon, both ends pointed, and the balloon driven by a screw or vanes. It must be made of a very light framework and covering, and I would suggest the propeller being fixed on one end of the balloon, the same as another inventor suggests, but care must be taken to balance the balloon. **Fugo.**

OVERHEADS.

[24922.]—I was very glad to see Mr. Wenham's letter, as I was getting tired of being the only correspondent on lathe matters, and had intended to write no more. Seeing, however, several correspondents asking for information on overheads, I send what little information I possess for their benefit.

Figs. 1, 2, 3, 4 show the kind of overhead I have made for my lathe. The foot of the standard, F 3, bolts upon the headstock, which is bad, but ca not well be helped in my case; I did not choo interfere with the [illegible] the cross-he change-wheels pre [illegible] standard. The be mandrel, and ob the standard to should have been bossed and be 3in. or 4in. diam. The upper part of the standard is made with a socket of gas pipe, which allows the upper part to swing round and also to be raised, if necessary, to accommodate the band. T. Hughes must have forgotten this point, as his sketch on page 106 shows no possibility of horizontal swing, a thing which is quite necessary. The ball, in my case, is 4⅝in. diam., and weighs about 13lb., it slides on a bar ¾in. diam., and 20in. from the centre to each end. This is about the simplest arrangement that can be adopted, and costs to buy about £3. It is very convenient, the bands being quickly changed, which is an important matter; I do not have to remove the long overhead band, but pull it up tight to the crank axle, and then wind the loose part round the bar at the top. The long band is rather apt to tremble or vibrate, but will not come off if the pulleys at Fig. 4 are sloped fairly straight to fly-wheel. The only serious disadvantage of this arrangement is that you cannot multiply your speed beyond that given by the largest speed-wheel and the smallest pulley on driller or eccentric cutter, say 20 to 1, which I find insufficient.



Figs. 5 and 6 I have copied from Holtzapffel's Vol. V., supposing that those of your readers who cannot afford to possess themselves of that admirable book would be glad to see the form most recommended by that firm. Fig. 5 shows how the lower part is attached to the left-hand lathe standard. Fig. 6 shows the upper part, which forms a kind of universal joint. The tension is adjusted by a spring, the band travels along the barrel in fluting, and the speed can be increased above that attained in the last example. The chief advantage claimed for this form by Mr. Holtzapffel over all other forms is that it has less friction, and the lathe scarcely slackens its speed when the foot is removed from the treadle to move the index in the division plate. A friend who has this arrangement on his lathe tells me he finds it is not necessary, as I supposed, that the barrel shaft should be perfectly horizontal.

FIG. 5.

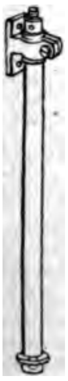
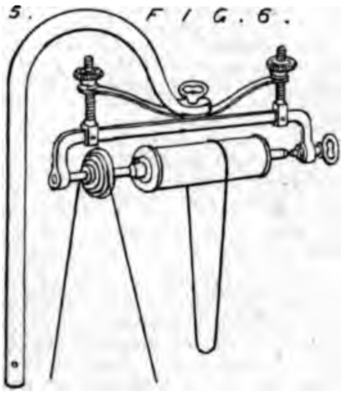


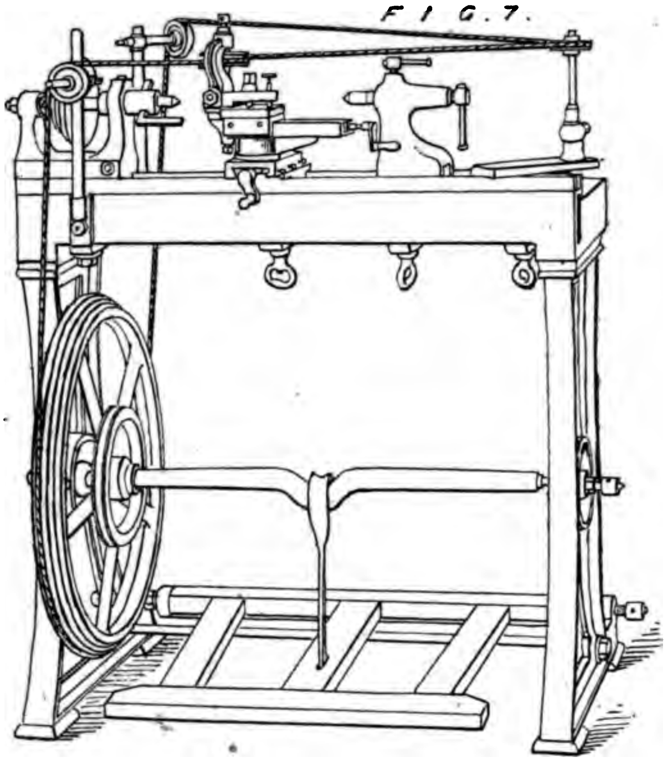
FIG. 6.



The photograph I sent, Fig. 7, shows Mr. Walz's method, which is not an overhead at all, and will, I think, be new to most of your readers.

I am sending this letter in answer to "A. F. H.'s" [illegible]l.; if he wishes for a "D. H. G." overhead, [illegible] will do screw-cutting in metal, he should [illegible] Vol. XXII., which is full of information [illegible]ject; it would take a whole number, "E.M." to [illegible] say- and he [illegible]

FIG. 7.

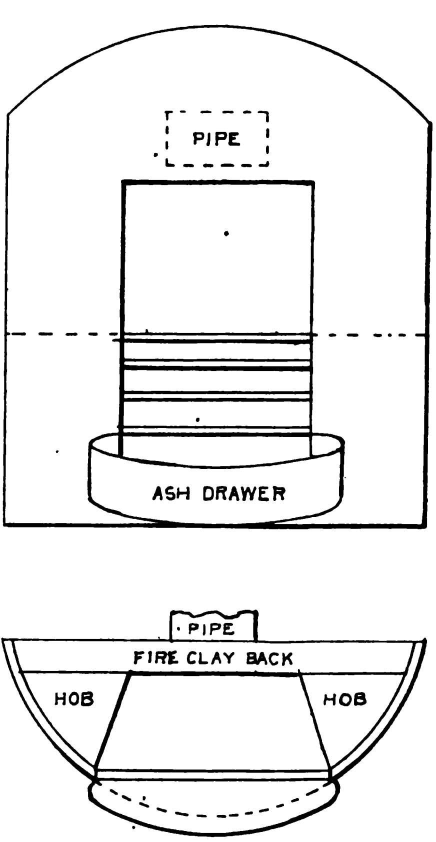


up the subject, and was very glad to see him re-appear in the "E. M."; he will tell us the points in favour of the two standard styles of overhead.

F. A. M.

FIREPLACES.

[24923.]—I WONDER why we in England continue to put up with the clumsy expedient of getting the sweep into our rooms every time a chimney has to be cleaned. In Germany, where close stoves are mostly used, the sweep goes up to the loft under the roof, finds there an iron door into the flue, lets down by a rope a weight with circular brush attached to the cellar, where he finds another door to take out the soot. Thus he need never enter the rooms at all.



Why could not we have, at least, iron doors in the *basement*, up through which the sweep could send his machine brush, so as to have no necessity for entering our rooms.

We could easily get the flues so built in new houses, and instead of a chimney fire-grate stuck in the wall, we could have a simple square or round aperture into which the pipe of a half-moon projecting grate could be inserted. Anyone could thus, in an unfurnished house, choose grates of his own style of ornamentation; and a simple register in the pipe, to close while the sweep was at work, would prevent all soot and dirt in the room. It only wants trying to be appreciated. I inclose a rough sketch.

J. C.

DOMESTIC HOT-AIR MOTOR.

[24924.]—WITH reference to the reply of Mr. Edmunds, I should like to say that I have seen the motor sold by the Britannia Co., and can easily imagine that the sale has not been large when the price is considered (£9), and also the fact that it has not been properly brought before the public as a *sewing machine* motor. It is simply exhibited driving a lathe, which is doing no work beyond revolving a rod of iron. I consider the great objection to this motor is its price, especially when it is considered what the same makers can do for the money in the way of lathes. It was this objection which prompted me to write and suggest that amateurs might be supplied with castings at a reasonable figure, so as to enable them to construct the engines themselves. I hope other amateurs will take the matter up, and so encourage someone to supply the necessary castings.

Motor.

SOLDERING.

[24925.]—INQUIRY is made in a recent number concerning a blowpipe long advertised in "Ours." I suppose Cohen's is meant. I have much pleasure in saying that I have used one of his "self-acting blowpipes" for some months, and am entirely pleased with it, as it is a perfect success in its way. It will easily melt 50 to 80 grains of silver in a few minutes, and it is extremely useful when a small but long continued and intense heat is required. For brazing it is invaluable.

Roi ne puis, Souza je suis.

Brooklyn, N.Y., U.S.A., Sept. 28.

COMPARISON OF TIDES AT LIVERPOOL AND FLEETWOOD FOR SEPTEMBER, 1885.

[24926.]—THE month of September has proved more boisterous than any preceding month of the present year. The equinoxial tides rushed in unwonted force from the Atlantic from the 8th to the 13th, augmented by cyclonic gales and a low barometer. The *diurnal inequality*, as was expected, operated to increase the night-tides, as compared with those which followed in the day-time, and the law which rules their production was as palpable as ever. The weather-charts from the 3rd to the 11th of the month sufficiently explain the extraordinary elevations of the ocean between those

COMPARISON OF TIDES AT LIVERPOOL AND FLEETWOOD IN SEPTEMBER, 1885.

Date.	Calculation.		Observation.		Error.	Barometer	Wind.	Remarks.
1885.	ft.	in.	ft.	in.	in.			
Sept. 1	24	7	24	5	− 2	30·0	E.S.E.	Fresh.
	22	10	23	4	+ 6	29·9	S.	Fresh.
2	23	2	23	6	+ 4	29·9	E.S.E.	Slight.
	22	0	22	4	+ 4	29·8	S.S.W.	Freshening.
3	21	9	23	4	+19	29·6	S.S.W.	Strong; cyclones impending.
	21	0	22	6	+18	29·5	S.W.	Strong to gale.
4	21	4	22	4	+12	29·5	S.W.	Strong to gale.
	21	11	23	2	+15	29·5	S.W.	Gale.
5	22	2	23	6	+16	29·4	W.S.W.	Strong.
	23	4	24	4	+12	29·5	S.W.	Strong.
6	24	0	25	2	+14	29·6	S.S.W.	Fresh.
	25	2	26	3	+13	29·5	S.W.	Strong.
7	26	0	26	9	+ 9	29·5	S.	Strong.
	27	2	27	5	+ 3	29·6	E.S.E.	Fresh.
8	27	4	27	10	+ 6	29·7	S.W. to W.	Renewed cyclone.
	28	6	29	11	+17	29·6	S.W.	Strong to gale.
9	28	3	29	8	+17	29·6	W.S.W.	Strong to gale.
	29	4	30	2	+10	29·6	W.N.W.	Very strong.
10	—		—		—	—	—	—
	28	10	29	6	+ 8	29·7	W.S.W.	Moderate.
11	29	5	29	10	+ 5	29·8	Calm.	
	28	6	28	11	+ 5	29·7	N. by W.	Strong.
12	28	5	28	10	+ 5	29·8	Calm.	
	27	2	29	2	+24	29·6	S.W.	Gale: cyclonic.
13	26	11	28	6	+19	29·9	W.S.W.	Very stormy.
	25	8	26	9	+13	30·1	W.S.W.	Very stormy. [sion.
14	25	0	25	9	+ 9	29·8	S.W.	Strong: cyclones in succes-
	23	9	25	7	+22	29·7	S.W.	Gale.
15	22	11	23	11	+12	29·7	S.W.	Very strong.
	22	3	23	11	+20	29·8	S.W.	Strong to gale.
16	21	0	22	0	+12	29·9	S.W.	Strong to gale.
	20	8	21	3	+ 7	29·9	S.W.	Strong to gale.
17	19	4	19	10	+ 6	30·0	S. to S.W.	Variable.
	19	6	20	1	+ 7	30·0	S. to S.W.	Variable.
18	18	10	19	1	+ 3	30·0	N.N.W.	Slight.
	19	10	20	0	+ 2	29·9	N.N.W.	Fresh.
19	19	5	20	10	+17	29·7	S.W.	Gale.
	21	0	21	0	+ 0	29·8	N.W.	Gale abated.
20	20	10	20	10	+ 0	30·0	W.S.W.	Fresh.
	22	4	23	2	+10	30·0	S.W.	Strong to gale.
21	22	3	22	1	− 2	30·1	N. to N.W.	Fresh.
	24	4	24	2	− 2	30·1	N.	Fresh.
22	23	9	24	1	+ 4	30·2	S.W.	Fresh to strong.
	25	9	25	7	− 2	30·1	N.N.W.	Strong.
23	25	0	25	6	+ 6	30·1	W.S.W.	Fresh.
	26	11	26	7	− 4	30·1	S.W.	Strong.
24	26	0	26	5	+ 5	30·1	N.W.	Strong.
	27	7	27	4	− 3	30·0	E.N.E.	Fresh.
25	27	0	26	1	−11	29·9	N. Strong.	Anti-cyclone commencing.
	—		—		—	—	—	—
26	28	3	27	4	−11	29·9	N.E.	Strong.
	27	2	26	4	−10	30·0	N.E.	Strong.
27	28	1	26	11	−14	30·0	N.E.	Strong.
	26	11	26	5	− 6	30·0	N.N.E.	Strong.
28	27	3	26	11	− 4	29·9	S.S.E.	Fresh to strong.
	26	0	26	2	+ 2	29·8	S.	Calm.
29	26	0	27	0	+12	29·7	S.S.W.	Strong.
	24	11	24	10	− 1	29·6	S.S.W.	Slight.
30	24	6	24	9	+ 3	29·4	S.W.	Fresh to strong.
	23	6	25	5	+23	29·3	S.W.	Gale.

dates. Four distinctly-marked depressions passed over these islands, the dominant system of which was *cyclonic*. These were continued during the following weeks, the winds being mainly of a *westerly* or *south-westerly* type. In all such cases the gradients were favourable for the elevation of the sea-level. Altogether, the stormy weather continued without intermission. But an anti-cyclone arrived over Great Britain about the 24th instant, and soon the condition of the sea-level was reversed. The tides seldom attained their predicted height in the Irish Sea, whilst on the east coast strong winds continued. A heavy cyclone on the 30th would have inflicted immense damage; but fortunately it occurred when the tides were low.

James Pearson, M.A., F.R.A.S.

Fleetwood, Oct. 12, 1885.

LARGE v. SMALL APERTURES—REFLECTORS v. REFRACTORS, AND MR. BURNHAM'S DICTUM THEREON.

[24927.]—WITHOUT in any way wishing to be drawn into the controversy which has arisen over reflectors and refractors, and large telescopes and small ones, still, Mr. Burnham's article, printed in "Ours" of October 9th, cannot well be passed over in silence. Greatly as we all respect Mr. Burnham and admire his splendid work amongst the double stars, yet we all must deplore the tone of his paper. When Mr. Burnham and Mr. Denning take up the cudgels one against the other, the blows given and received are somewhat widely distributed, and are apt to fall upon the heads of inoffensive spectators, and these blows are very liable to end abruptly any desire to take up astronomy as a pursuit, and this we must all admit is greatly to be deplored. If, therefore, I venture to take up my pen, it is neither to side with Mr. Burnham nor with Mr. Denning.

Firstly, I notice a very peculiar state of things. Mr. Denning condemns large refractors, but has never used one; Mr. Burnham condemns large reflectors, but has never used one. Now, I venture to think that both parties are in the wrong here. Mr. Burnham has always used a refractor, and Mr. Denning a reflector. The work of both is before the world: let the world then assign the prize, and the judgment will be that the work of both is of the greatest value, for both are leaders in their respective lines of research. One cannot help feeling that it is the *man* rather than the *instrument*, and wherever there is the patience to carry out research, there must be the success, whether the telescope be reflector or refractor, or of 5in. or of 30in.

But there may be a selective action in telescopes of such different principles. The reflector may deal better with one class of objects, the refractor with another. Much of the planetary work has been done with reflectors; double-star work, on the contrary, has been done with refractors; but that this has been so does not prove conclusively that reflectors are best for planetary work and refractors for stellar work. It cannot be doubted that had Mr. Burnham observed with a reflector he would still have been the authority on double stars, and Mr. Denning have made his reputation equally by the study of planetary detail with a refractor.

That Professor Hough may not be able to see a planetary marking with three times the aperture of Mr. Denning's telescope is no proof of its non-existence, so much depends on the peculiarity of vision. Years ago, I remember hearing doubt cast upon some of Mr. Burnham's discoveries by a gentleman possessed of a telescope two or three times the size of the one Mr. Burnham was then using; this, too, by no unskilled observer, and with a first-class instrument. Personally, if Mr. Burnham was to discover a double star with a 6in. o.g., Alvan Clark, I would not undertake to see it with a telescope of the same maker with twice or three times the aperture, because so much depends upon the training of the sight and acuteness of the vision. Nor, in the same way, would I promise to see a planetary marking detected by Mr. Denning, and for the same reason. There is another point, too, which must not be forgotten. Detail may be lost in too much light. Although I might be able to detect new striæ or spots on Jupiter with my 17¼in. reflector, yet some *one* detail which I used to see in the 9in. may be invisible, or at least not so easily seen, on account of the eye being affected by too much light. To realise how much the eye is affected by these things, look at the moon through a 6in. with a power of 50, and then through a 17in. with the same power. You will be blinded with the light of the 17in., while you can see with comfort through the 6in. But put a light neutral-tinted piece of glass between the eyepiece of the 17in., and the eye and the 17in. will show a great deal more than the 6in. Again, aperture and colour are intimately related: a small aperture will deepen the colour, and so make an object to be seen more easily, as it is a well-known fact that colour is lost in excess of light.

Mr. Burnham claims that all measurements and discoveries of close double stars have been made with the refractor; therefore, it is the best. But Mr. Burnham's conclusion is hardly logical, for it begs the question that large reflectors have been used in this work and have failed. Now, as far as I am aware, no large modern reflector has been used for the purpose, with one exception, and that is my friend Mr. Perry's. Mr. Perry has measured some of Mr. Burnham's discoveries, and has added some not over-easy objects to the catalogue of close double stars. We here have an 18¼in. reflector with great disadvantages in respect of climate, pitted against an 18½in. refractor with what appears to be a very fair climate. The pages of the "E. M." and of the *Journal* of the L. A. S. cannot lead us to Mr. Burnham's conclusion that the reflector is so very inferior to the refractor. Again, Sir John Herschel did not search particularly for close double stars, nor would it be fair to quote his telescope against a modern refractor. He himself, however, if I remember rightly, did not deem his metallic speculum inferior to Struve's refractor. He made some remarks on the two; but, unfortunately, I am far away from back numbers of the R. A. S. Memoirs, which contain them, and can only speak from memory.

But what is the greatest test in the controversy of the reflector *versus* the refractor is the fact that when an observer takes to a reflector he is not driven back to a refractor, as he would be if the former was so inferior. A case in point is that of the late Prebendary Webb. He had a 5½in. of Alvan Clark, and yet he sold it and obtained the 9¼ "With" reflector. Only on one night, unfortunately, has he a record of the trial of the rival kinds of telescopes. This was as far back as 1864, when he tried an 8in. of With's against a 5·5in. Alvan Clark—the foci were respectively 72in. and 84in. Though the reflector was somewhat troubled with rings, yet it gave a "trifle smaller discs and wider separation." As regards light-grasping power on 15 M Pegasi, he says that "6in. of the 'With' do not appear fainter than A. C.; 8in., much more splendid and brilliant resolution." Such was, however, the effect upon him that at a later date the reflector took the place of the refractor. Of this, I know personally he never repented, and if Mr. Burnham could see his observations of close double stars which I have besides me as I write, and could have had a look through the 9¼ With, as I have had many, he would not form so bad an opinion of reflectors. The fine evenings at Hardwick were taken up chiefly with sweeping over the heavens for new pairs and ruby stars. I have not found in his observations any close new ones amongst the former; but Mr. Webb never especially looked for them; being convinced that in many of the wide pairs where there was a striking contrast or remarkable similarity, the juxtaposition was not accidental, but must imply some relation which in this early stage of our knowledge we cannot comprehend. He swept for them with low powers. Nor can we forget that of those stars which Struve rejected, some have been found to be triples or quadruples of the greatest interest. Take, for instance, 86 Virginis, which was rejected by Struve, but which was found to be a quadruple by Mr. Burnham, and of which he says ("Memoirs of the R. A. S.," Vol. XLVII., p. 191): "Altogether this group forms apparently one of the finest quadruple systems known." And again over Σ 2005 Rej., we read (p. 193): "The discovery of the close star makes it an interesting object." The reason, then, that in Mr. Webb's observations we have no record, or next to none, of close new pairs, was not that the instrument was incapable of showing them; but that Webb preferred leaving such class of obj gentlemen like Mr. Burnham able and well-trained vision search, and took upon him less valuable line of registering wide but apparently connected objects.

Others have followed Mr. Webb in the preference of the reflector to the refractor. Mr. Franks, although for some years he had been working with a beautiful 5in. refractor, yet when he obtains a larger instrument it is a reflector, and we have no reason to believe that this able and experienced observer is dissatisfied with it, but quite the contrary. And, if I may venture to add my testimony, I might say that I was quite prejudiced on the side of refractors, and rather turned up my nose at the 9in. reflector Mr. Calver put into the hands of the L. A. S. A very few nights, however, entirely changed my opinion, and now I have here a 17¼in. of Calver's, which leaves nothing to be desired; and though I have never used so big a refractor, yet I have looked through one over 12in. aperture from time to time, and I must say that I wouldn't exchange my reflector for an 18in. refractor. I have not the slightest doubt I shall never detect any close doubles like Mr. Burnham's; but I know perfectly well the fault is not in the instrument, but in the observer. Let us note down some of the disadvantages of the refractor:—

(1) The over-correction.
(2) Clumsiness from great focal length.
(3) Necessity of an elaborate dome and observatory.
(4) Uncomfortable position while observing.

Against these, the reflector can be charged with—

(1) Open tube.
(2) Difficulty of adjustment.
(3) Perishable nature of the film.

These are all that I can think of at the moment. The open tube is, however, no disadvantage. As to the difficulty of adjustment, I do not think that putting the specula of the 17¼in. in their places and adjusting them took me half an hour, although I had no previous experience. And, as to the film, it will last for years, if carefully preserved.

Lastly, Mr. Burnham totally misunderstands the plan of putting in stops. He declares this is the sign of an inferior instrument: but this is not the case at all. Stops are only used on bad nights. The larger the aperture, the greater is the effect of atmospherical disturbance. Diminishing the aperture diminishes the effect of atmospheric disturbance. This applies equally to reflector or refractor; and, doubtless, if Mr. Burnham would have placed a stop before his 18½in. when he records "poor seeing," although he could not have seen *more*, yet if the object under observation will bear the decreased aperture, he would certainly have seen it *better*. **T. E. Espin.**

High-street, Wolsingham, Darlington, Oct. 13.

DIPHTHERIA AND DOCTORS' RISKS.

[24928.]—ANOTHER doctor has distinguished himself by venturing to draw out the poisonous matter of diphtheria by direct suction. More fortunate than his predecessor, who became a martyr to his professional zeal and courage, Dr. Thompson, of Tyrone, not only saved his patient without himself receiving damage, but has had his courage suitably acknowledged by a medal of merit. It remains a question, however, whether such a risk is justifiable, even if no other means were available for attaining the result. But it appears to me that there is no reason for any risk whatever being run in carrying out the operation, and, as I believe I first suggested the operation of tracheotomy for diphtheria long ago to the Melbourne doctors, I will now suggest a simple means of carrying out the further process.

It would be easy to devise a small suction apparatus, even if such is not already made; but it can scarcely be expected that every practitioner would be provided with one. But glass or gas-tubing is generally obtainable anywhere. A piece of large tube, packed with sponge or cotton-wool, with a mouthpiece at one end and a small tube at the other for connection, both fitted in by corks, could be made in a few minutes, and enable suction to be used without any risk of drawing the poison. Or the connecting tube might be longer, and so bent as to pass nearly to the bottom of a small wide-mouthed bottle, fitted with a mouthpiece like a gas washing bottle or an inhaler, so that the water, which might contain carbolic acid or other disinfectant, would arrest the passage of any matter or germs to the operator.

Sigma.

THE HYDRAULIC RAM.

[24929.]—I HAVE been deeply interested in "W. A. S.'s" experiments and remarks on the hydraulic ram, for I have long been convinced that the accepted notions of the working of the same are entirely wrong. Will, however, "W. A. S." kindly favour "Ours" with an explanation of the real action that takes place in the ram. Let him [illegible] valve, also the delivery pipe, and he [illegible] one, that the ram still works as before; but what is wanted is an explanation of what then goes on. It is evident that there is a recoil in the column of water in the supply pipe in the form of a pulsation which manifests itself in the supply cistern as a wave, there oscillating synchronically with the beats of the ram. There is no doubt also that in the ordinary working of the machine a partial vacuum is formed in the pipe, otherwise the snift-valve would not suck air. Again, in trying to stop the working of the ram by laying hold of the rod of the outer valve and drawing it towards the face of the outlet, it feels as if the column of water in the supply pipe were in a state of oscillation requiring a definite time to bring it to rest. How can such an oscillation be set up in a column of water which is said to be inelastic? Would it be possible to determine the force with which the outer valve falls? If a vacuum is formed behind the outer valve immediately after it closes, then the valve will descend, not only by its own weight, but also by the atmospheric pressure upon its area. Any explanation that "W. A. S." can offer of the matter I am sure will be highly appreciated by your readers, and especially by— **J. N.**

[24930.]—I HAVE read with considerable interest the article by your correspondent "W. A. S." on the above subject, and although it does not answer all the points raised in my former letter, it contains much that is valuable and interesting.

The formula $\frac{q\,h}{Q\,H}$, while giving the efficiency of any existing ram, does not assist in obtaining the *best* efficiency, and it is a knowledge of the rules by which the greatest efficiency is to be obtained under varying conditions that is incomplete. For example, if I have a supply 1,000 gallons per hour, with a fall of 10ft., and I want to carry the water a distance of 175ft. to a height of, say, 30ft., how much water per hour shall I get, and what size pipes should I use? Or, supposing I doubled the length to which the water was to be carried (350ft.), how would that affect the matter?

Again, supposing I have an unlimited supply, and desire to deliver 40,000 gallons per day to a height of 125ft., along a pipe 300ft., the source of supply being 75ft. from ram and 40ft. above it, how much water must I use, and what must be the size of the pipes? In the case "W. A. S." quotes he had a fall of 24·7ft., length 96ft., lift 87ft., and length of delivery pipe 2,400ft. The pipes were 2·25in. for the injection, and 1·5in. for the delivery. By what rules were these dimensions arrived at?

To put the matter clearly, in what manner do the following affect the sizes of the pipes?

I. The vertical height of fall.
II. The horizontal length of drive-pipe.
III. The quantity of supply.
IV. The vertical height of delivery.
V. The horizontal length of delivery pipe.

And how do all these points, and the sizes of pipes included, bear upon the quantity delivered? The explanation regarding the valves given by "W. A. S." clears up one or two points, but I shall be glad if he will inform me whether I am correct in supposing that their weight is immaterial (the pressure of the atmosphere, and not their weight, actuating the outer valve), and that only sufficient metal need be used as will make them strong enough to stand the force of the water.

I trust that this correspondence will be carried on by others having experience of these useful machines.

London, October 13. **F. A. R.**

LECLANCHE FOR LAMPS.

[24931.]—A WEEK or two ago a contributor of "Ours" said it was useless to light a lamp with the above battery. I agree with him there, but he does not think for a moment how long the light may be required—for two minutes or two hours—as it entirely depends on the time as well as the work to be done in using the various kinds of batteries. I take it for granted that the querist wanted his light for some half hour or so; then it would be nonsense to use a Leclanché for lighting, but it can be used if the light was only wanted for about 10 to 12 minutes at a time; just the same as it would be useless to use a bichromate for a light which is wanted for about eight hours or so together. Why should not a Leclanché light a lamp as well as a Bunsen?—being 1·50 and 1·89 volts respectively.

What odds is it if the person has the money to lay out, as well as the space to keep them? I myself would sooner have 15 Leclanchés, which would light a 5 c.-p. lamp, than 4 Bunsens to do the same work, if I only wanted the light for about 10 minutes at a time, such as to illuminate a microscope or clock, it being not only free from fumes, which are so deleterious in the Bunsen, but can be kept in a room, and is much cheaper, besides lasting about 12 or 15 months before it requires recharging.

I should advise our reader to visit the Inventions Exhibition and see for himself. At Mr. Swan's stand he has a small incandescent lamp lighted by 5 quart Leclanchés, and it shows a clear white light at about 9 or 10 o'clock at night, although it has been alight on and off for about 9 hours during the day, by the numerous visitors who set it in action by pressing a small push provided for the purpose, and this goes on day after day; also shows what the Leclanché can do, though the battery may only light a two c.-p. lamp.

In finishing up my letter I must say that I am in no way connected with Mr. Swan or the Leclanché Battery Company whatever, and I think that some of our readers agree with me in the above letter as to the Leclanché for lighting lamps.

Private Individual.

Camberwell, Oct. 13.

FERROUS OXALATE v. PYRO-DEVELOPER.

[24932.]—I SEE on page 122 of last "E. M." we have Ferrous Oxalate v. Pyro-developer again to the fore. Like many others I commenced with ferrous oxalate, but soon gave it up for the more convevenient pyro-developer. I had, however, to depend then on wet plates for lantern slides, owing to the slightly coloured films caused by the pyro solution. When sodic sulphite in conjunction with pyro was advocated, I thought we should then have a perfect developer, and bought a pound (for which I paid 2s. 4d.) at a large London photographic store; this I used in all degrees of strength up to saturated solutions, but obtained films as stained as ever. I therefore discarded it, and used instead a spot or two of citric acid, which, in my hands, had a far better effect than the sulphite.

I should like to know if any other reader has had the same want of success with the sodic sulphite; if wrong, I should like to be put right, as I could never get with it a plate clear enough for a lantern slide. Pyro can always be made up fresh at a moment's notice; this is a great inducement to us amateurs at least, who have, perhaps, only a plate now and then to develop. **Barium.**

DEATH BY THE TRIGGER: A HINT TO INVENTORS.

[24933.]—THE lamentable and avertible deaths of three individuals in the country within one short week, as recorded by the Press, and arising from the discharge of firearms, is too appalling to be passed over in a mere newspaper paragraph. To read the evidence produced at coroners' inquests on such cases, one might almost say that the safety of human life was of less concern than that parties should be made up to go forth and destroy wholesale during the game season. Be that as it may, on such occasions we but too often hear of some treacherous bramble in the hedge which catches the half-cocked gun, or a slippery mudbank which flings down the sportsman and jerks his gun, thereby causing premature detonation. Surely some mechanical means could be devised by which the unintentional discharge could be made impossible? A contrivance, say, by which the cartridge could be only inserted when in the very act of the gun being pointed for aim.

I am no mechanician, but I can conceive of an automatic safety adjustment being within the range of an inventor's faculties. Deploring as I do the frequent occurrence of such shocking accidents (or carelessness, perhaps), in the sporting field, I venture to make this suggestion, in the hope that it may catch the eye of some practical mechanic who will turn his attention to the matter, for him to design and perfect it. His success would earn for him a well-deserved fortune.

Norwich, Oct. 10. **Catapult.**

COMPOUND LOCOMOTIVES.

[24934.]—I WAS greatly interested in letter 24868. Is it too much to ask the drivers of other lines to follow the example of "In Favour of an Old Racer," and give us details of coal, oil, &c., consumed by their engines? I would suggest the Great Northern and Midland as being especially interesting. We should then have an opportunity of seeing which engines do best in practice, and not only in theory. **G. D. Seaton.**

RAILWAY COUPLINGS.

[24935.]—ONE of the most useful matters which received attention at the recent Railway Congress was the very important subject of improved coupling appliances on railways, in order that the necessity for the servants going between the vehicles to couple or uncouple may be avoided. Last year alone 130 men were killed and 1,305 injured while engaged in shunting operations, and during the last seven years 1,081 have been killed and 9,256 injured from similar causes. The Amalgamated Society of Railway Servants has for years given the question very serious attention, and at the Congress held at Leicester last week a report was received from a committee stating that nothing short of a trial with the full-sized and actual working appliances can be relied on, and recommended for the careful consideration of the meeting the propriety of setting aside a sum of money to award in prizes to the owners of couplings that best fulfilled certain conditions, which should be decided upon after trials. The fact that the servants themselves are in earnest in the matter is clearly shown by the vote of £500 towards the object; the difficulty, however, which now has to be overcome is that of obtaining the use of a few waggons and a piece of line upon which the experiments can be conducted.

I am requested to direct the attention of your readers to this difficulty, in order that, if possible, some railway company may be induced to give the necessary facilities for a full and fair trial of coupling appliances which have for their object the saving of the lives of railway guards and shunters.

Clement E. Stretton,
Consulting Engineer to the A.S.Ry. Servants.

OVERWORK ON RAILWAYS.

[24936.]—In various letters upon railway accidents I have had occasion to refer in some instances to the excessive number of hours during which servants have been kept on duty; it is but little use adopting safety appliances if the men who have to work them are tired out and therefore unable to perform their duties properly. Mr. Sutherst recently directed attention to the matter in an important letter to the *Times*, and he also read a paper before the Railway Congress. It has been stated on behalf of the companies that his figures were incorrect: I have therefore made all necessary inquiries, and find not only that the details he gives are perfectly true, but also that they are not exceptional instances but simply a fair average of cases which occur daily. It is monstrous that servants should have to work 15, 18, or 24 hours at a stretch. Simply looking at the subject from the passengers' point of view, it must be considered a scandal that such an amount of work as is implied by these hours should be exacted from any man upon whose vigilance depends the safety of the public. Railway directors and officials consider that "hours of duty" is a matter simply between master and man, and must be ruled by ordinary laws of supply and demand, and that the public and the Amalgamated Society have nothing to do with the subject. On the other hand, the Society very properly maintains, and I entirely concur, that the question is one of *public safety*, and that as it is dangerous to the public for servants to be kept on duty for excessive hours, the public should assist to obtain the abolition of such extremely long time.

Numerous accidents occur in consequence of men being tired out, and when inquests or Board of Trade inquiries are held it is sometimes the practice for the officials to instruct the servants not to tell the great number of hours during which they have been on duty. Another very important matter is the length of rest allowed between each stretch of work. It is a very great hardship that when a man has been out with a train perhaps 20 hours he should be sometimes called again for another journey after only some four or five hours' rest. Thirty-six hours' duty with only five hours' interval must be condemned as most dangerous, yet if the servants object to go out with a second train without proper rest they are dismissed for what the companies choose to call *insubordination*, or be subjected to reduction of wages, or to various forms of petty injustice.

Of course in cases of accident or emergency trains may be blocked for hours, and railway officials point to such instances as proof that long hours cannot be prevented; but it will at once be seen that such an excuse is of no value, as complaint is not made in *exceptional cases*, but against the *practice* of men being on duty 15, 18, or 24 hours under ordinary circumstances.

It will be urged that trains are not booked to be out for so long a time; but this is no reply to the fact that they *are* out such excessive hours, and when it is found month after month that goods or mineral trains are perhaps twice the time allowed, some steps should be taken to alter the working time-tables in accordance with the actual running time required. Railway servants consider 60 hours as a week's work, and they would prefer it to be divided as nearly as possible into six days of ten hours, rather than perform the 60 hours in three days. I have before me a very large amount of information upon the subject, from which it appears that the excessive hours have recently been on the increase rather than giving way to a better system: hence the necessity for some steps to be taken to check the dangerous practice. The question is a public one, and if accidents are to be reduced in number one of the first steps is to prevent excessive hours of duty on railways.

Leicester, Oct. 19. **Clement E. Stretton.**

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[57037.]—**Sewing Machine Work.**—I should recommend "J. W." to mark out his rows of stitching with a straight edge and blacklead pencil. This may take up a little time; but if he has a quantity to do, and wants them well done, it will repay him in the end. Or he may do the seven parallel rows in the middle, with the guide for quilting, the outer ones being marked out as shown. I should recommend the "new vertical feed machine" for the purpose, as from its construction and action it is just suited for this kind of work. If "J. W." resides in London, he could call at 24, Aldersgate-street and see the machine. I shall be pleased to give "J. W." any further information if he will kindly advertise his address in "Ours."—H. C. B.

[57037.]—**Sewing Machine Work.**—The seven rows of sewing could be done with a quilting guide, which is a bent wire fastened to the head of machine by thumbscrew, and coming down to within ⅛in. of the work. Crease or mark first line to begin; then fix the guide at the required distance, letting the last row of sewing run under guide. Do not mind the needle, but pay great attention to the guide, and keep the cloth straight. The side lines will have to be marked in some way before any sewing is done. I would try a strip of card cut to the required shape. Lay this on, and mark lightly with a fine-pointed pencil. The sewing will cover the mark if followed accurately. Almost any machine will do for this work, providing it has a quilting guide, and if not you can easily fix one.—J. I. S.

[57271.]—**Flageolet Tuning.**—Impossible for your flageolet to sharpen unless you have enlarged the bore and holes, which would most surely put it out of tune; it would flatten in pitch if not cleaned, owing to the accumulation of dried saliva. Perhaps in the hurry of writing you have mistaken the terms and written *sharpen* for *flatten*.—GWENT.

[57324.]—**Wire on F.M.'s.**—I do not care to reiterate my statements as to the correct proportion of wire on F.M.'s and armature. I make dynamos which work well and sell well. I am quite content that others should cavil over points which I have proved to my own satisfaction. I am much obliged to "Electrical Engineer" for his reference to Silvanus Thompson's "Dynamo Electric Machinery." As a matter of fact, I have had it some years, and can see that "Electrical Engineer" has never read it: otherwise he would have recognised the formula I gave for winding a shunt machine as being copied *verbatim* from that book.—S. BOTTONE.

[57357.]—**Tinfoil.**—Not "at sea," but misled by a querist who apparently does not understand the difference between *tin* foil and that known as composition, or lead foil. It seems strange that the querist did make it "do," but wanted it right at once. However, he knows the proper way of doing it now.—S. R.

[57385.]—**Piston Rings.**—I have not seen this query, but only a reply to it, from which I gather that a ring is wanted to fit an oval cylinder. I believe there are such rings, and will do my best to find out about them. Some are advertised in *Engineering*. They have springs of round steel wound up and down within the rings, forming a horizontal spiral.—BOWLING.

[57388.]—**Telescopic.**—This querist wants to know what lenses he should obtain to try and perform an impossibility, and the only reply he can look for is "none whatever."—J. C. L.

[57417.]—**Calcium.**—If "S. R." will consult my patent for calcium and its alloys, No. 16,652, '84, he will see how it can be utilised to resemble silver and gold at a trifling expense.—F. W. GERHARD.

[57453.]—**Lathe Overhead.**—I must refer "Somerset Lad" to my former reply. It would be quite impossible to describe "D. H. G.'s" overhead shortly. A detailed description is to be found in the numbers of "E. M." I gave; and I may direct "Somerset Lad's" attention to an advertisement in the very number of the "E. M." in which his query appears, offering any back volume or number for sale.—R. W. F.

[57453.]—**Lathe Overhead.**—I shall be happy to lend "A. F. H." the volume of the ENGLISH MECHANIC containing "J. L.'s" series of articles or "D. H. G.'s" overhead, if he will undertake to let me have it again when he has done with it, and does not mind paying the cost of carriage. It is a heavy volume, weighing between 4lb. and 5lb., and by parcel post it will cost 9d. each way.—G. C. C., Church House, Uckfield.

[57457.]—**Japanning.**—If this querist will procure the number for Sept. 16, 1881, he will find on p. 36 an article on japanning and japans which may be useful to him.—ESSAR.

[57460.]—**Preparing Hard Woods.**—The best way to "season" any wood is to cut it up into planks and stack them so that air can reach them on all parts. To prevent "shakes" as much as possible glue strips of canvas on the ends.—NUN. DOR.

[57462.]—**Papier Mache.**—The pulp is made in the usual manner, and is compressed into the required shapes. Sometimes it is treated with acids. There is no book on the subject that I ever heard of, and I doubt whether there is one, for I don't see how the publisher could expect a sale sufficient to pay him.—ALTON.

[57464.]—**Storage Battery.**—Will this querist explain? What shape are the plates that a plaster mould will not do? That is, I presume it will not, as he asks so simple a question.—S. P. T.

[57466.]—**Bright Silver Plating.**—Gore's directions are quite correct, and a little more practice will probably put the querist right. If he refers to the indices, he will find many references to this subject.—JEHU.

[57475.]—**Family Clothes-Washing Machine.**—If "Turk" had asked for a description of any well-known machine he would probably have obtained an answer. There is no such thing as an "efficient washing machine"; nearly all of them will "wash" things that are not really dirty, but there is not one that will wash a dirty shirt or a soiled collar properly. No doubt there will be contradictions to that statement; but I shall reply—Show me the machine, and I will buy it, if "Turk's" query is answered..—NUN. DOR.

[57479.]—**Clay Pipe Making.**—Tobacco pipes are made of a special kind of clay, to which they have given a distinctive name. The best comes, I believe, from Purbeck; but there is the usual washing process to go through, and no necessity for making the clay "tougher."—NUN. DOR.

[57480.]—**Kilns.**—These kilns are illustrated and described in nearly all the Cyclopædias. Surely an illustration of one would be of little interest and not much use to the readers of this paper.—NUN. DOR.

[57488.]—**Grinding O.G.**—If this querist will refer to his back numbers, he will find the calculations already set out for an o.g. of the size he mentions. If not, the rules for calculating.—W. H. C.

[57489.]—**Clock Cords.**—Dress them with linseed oil and hang up to dry. Two or three dressings will be required.—NUN. DOR.

[57502.]—**Quick Match.**—A "reliable" quick match might be made of cotton strands steeped in sulphuric and nitric acids, like the lightning-paper recently mentioned. That is something more than quick, and little less than instantaneous. I think you can buy it ready prepared of those who have fire-alarm apparatus for sale. The cotton is used to keep the electric contacts open; but the moment it catches fire it is consumed in a flash, and all the contacts it held apart are closed.—NUN. DOR.

[57526.]—**Heat in Dynamo.**—A blast of air driven between armature and pole pieces has proved a costly failure, in the hands both of Siemens Brothers and—S. BOTTONE.

[57528.]—**Slipping of Belts.**—I mentioned this query to an old millwright, and he says he has known the dodge for nearly forty years. I thought the holes would allow the belt to get partly in them, so to speak; but he says they allow the air to escape, which is sucked round between wheel and belt, thus allowing the two to touch and giving more friction.—BOWLING.

[57580.]—**Dentistry.**—It is a pity that "Dental Reform" will not answer a definite question. A "small percentage" may mean a great deal—more than some think; but "Dental Reform" was asked whether it meant more than ten per cent. of "L. D. S.'s" and more than one per cent. of those who do the actual work. I see he fights shy of defining the difference between "dentist" and "surgeon dentist"; but as the discussion is really "unpalatable," in a sense very different to that meant by our friend, I have no wish to press him. My reply (p. 570, Vol. XLI.) has served its purpose admirably—a fact which "Dental Reform" does not seem to have grasped; but if he had seen my face when I read the third and fourth lines of his reply on p. 145, he might perhaps have been astonished, or possibly astounded, that such wit and such sarcasm should have produced an effect exactly the opposite to that intended.—A. MALLARD.

[57594.]—**Gunboat.**—The dimensions of *Northampton* are:—Lengt [illegible] ween pe [illegible] 280ft.; extreme breadt [illegible] water (loaded), 24ft. 2in [illegible] smaller guns, consists of eight 12-ton guns—four on each side—and four 18-ton guns—two forward and two aft—and the ports for these guns are cut away, to enable the guns to fire in a fore-and-aft direction. Querist is sadly mistaken if he considers the *Northampton* a gunboat; she is an ironclad of the most approved type. I will be glad to forward any further details wished for or sketch.—JAMES M'CASH GOVAN.

[57596.]—**Orguinette.**—If "A. B. C." refers to No. 477, p. 225, or to No. 947, p. 249, he will find good working drawings for American-organ bellows, which have been worked to, and found successful. He should make his as large as his case will admit.—J. C.

[57599.]—**Gauge of Railway.**—Allow me to correct a slight error in J. W. Dear's reply to this query. I have always understood that the broad gauge was 7ft. 0¾in., and I see that Molesworth's Pocketbook gives the same. The difference is very slight. It would be interesting to know how this fraction crept in, and I shall be glad if anyone can enlighten me.—BOWLING.

[57637.]—**Belting.**—In reply to this I give rule from Molesworth's "Pocket Book." "Ignorant" will thus see that it depends partly on the speed at which his belt travels as to the width. "Approximate rule for leather belting $\frac{3}{16}$in. thick:

Let V = Velocity of belt in feet per minute.
H.P. = Horse-power (actual) transmitted by belt.
W = Width of single belting in inches.
Then $W = \frac{1100\ H.P.}{V}$

Can give more elaborate rule from same source if this does not suit.—BOWLING.

[57646.]—**Steam - engine Formulæ.**—I am much obliged to "Milverton" for his kind reply to my question, which is now very clear to me. If it would not trespass too much upon his good nature there is one other question which I am unable to solve, which is to find how U is obtained in Table 6, page 571, which, for the same pressure (33·7) is 295,410 foot-pounds of 1lb. of steam admitted into the cylinder at the temperature T°, which is in this case 257°, and expanded without liquefaction until its temperature falls to 32° Fahr.—UNGENANNT.

[57659.]—**Celestial Photography.**—In my reply to this query, 30ft. should be 36: I suppose my correction reached headquarters too late. Slightly separating the o.g. lenses is said to correct an achromatic for celestial photography.—ARTHUR MEE.

[57689 and 57769.]—**Dynamo.**—TO MR. BOTTONE.—If these two queries refer to the same machine, I can only say that the resistance of the fields is disproportionately large. About 4lb. of No. 16 on the field magnets would be ample against 1lb. of No. 20 on the armature. You get, as you see, plenty of E.M.F.; but, owing to the enormous resistance, but very little current. Take 10lb. or 12lb. off the fields, and report results.—S. BOTTONE.

[57693.]—**Photographic.**—To "J. X. C."—Stockton-on-Tees, with 60,000 inhabitants, has no thorough dealer in photographic requisites, though there are two of the chemists who keep a little prepared paper and a few of the chemicals required. Then there is South Stockton (or Thornaby), on the other side of the river, and Middlesbro' (60,000), four miles off, and the Hartlepools, twelve miles away. Of this group of towns Stockton is the market centre, and as there is a numerous and increasing body of amateurs in the district, I think a photographic and scientific apparatus dealer would do well.—HIRAM.

[57698.]—**Deposit in Boilers.**—Stop using the soda at once, and when the boilers are scurfed next time lay on a coating of hot tar, or if it would be preferable, a mixture of one part by weight of blacklead to six parts of tallow, hot. The soda is sure to hasten corrosion of the iron, and no doubt the corrosion increases the more the soda is applied. The water must contain much lime salts to produce such a thick incrustation. I should be very pleased to learn how you succeed.—TEMERAIRE.

[57700.]—**Astronomical.**—There are not many astronomical positions in the United Kingdom, either in public or private, and I believe none are vacant just at present. The owners of private observatories, I have noticed, usually advertise in *Nature* when they require an assistant, and vacancies in the observatories of Greenwich, Edinburgh, and Dublin are also advertised in the same periodical. The qualifications required vary exceedingly. An assistant at a private observatory should be thoroughly accustomed to the use and care of an equatoreal, and be a quick and accurate computer; high math[illegible] [illegible]quirements, though always useful, a[illegible] [illegible]ential. At Gree[illegible]ich Obser[illegible] [illegible]des of assist[illegible] [illegible]e one [illegible] petition, [illegible]amination being almost entirely mathematical, and as severe, or perhaps more so, than the mathematical papers set in the examinations for the India Civil Service. The latter would, however, be a good guide as to its character. The salary is £200 a year, rising by £10 a year to £300, with the possibility of promotion to the rank of senior assistant, for which the salary runs from £320 to £450. The limits of age are from 18 to 25. Use of telescopes is not essential; the requisite skill will come with practice. The lower grade of assistants are supernumeraries only; that is, they are dismissible at a moment's notice, and have no claim for pension, &c.; they are appointed by the Astronomer Royal himself, after a test examination in arithmetic, spelling, elementary algebra, and the use of logarithms. The usual entrance age is about 16, the salary £30 or £40, rising as the Astronomer Royal thinks fit, to £60, or, in cases of extraordinary efficiency, to £72. It is sometimes possible to earn a few extra shillings by overtime work. By a recent rule computers must leave when they reach the age of 23. "Constant Reader" can judge which kind of position would suit him best, and probably his best course would be to write to the Astronomer Royal, state his qualifications, and ask him to acquaint him should he hear of any vacancy. He had also better keep an eye on the advertisement columns of *Nature*, and in the mean time, to betake himself to some more remunerative employment, and, who knows, he may have made a sufficient fortune to start an observatory of his own, with assistant complete, before a likely opening occurs for him in someone else's observatory.—ASTER SEBRIGHT.

[57708.]—**Hot-Air Engine.**—TO MR. SUTCLIFFE.—The dimensions are as follows: Iron flywheel, rather heavy and 9in. diameter; displacing cylinder for heating and cooling the air, 6in. by 2in.; piston plunger, filled with charcoal, &c., about 4in. by 1⅝in.; this works inside the displacing cylinder by a crank ¾in. or a little over. The driving cylinder is 1in. diameter and 2in. stroke, you can alter the crank for this piston to suit the length through which the piston is moved by working the plunger separately by hand. In the original model of Stirling the plunger crank had a slot for the connecting rod to adjust it. Stirling's patent is 1827, No. 5456, but engines are usually made on the plan of his first model with a single cylinder, as in Simon's engine of 1860, or Laboreau's patent of 1864, which last is the one described in "Deschanel's Physics." He has since patented one in 1874, which has been adopted by several engineers as being the most suitable for small motors. A water tank is required to run one or two gallons per hour, according to the size of engine, and hot-air engines in consequence are most adapted for pumping, and not very suitable for driving any kind of machinery; one made to drive a sewing machine would be more curious than useful in my estimation, unless it was set up as a permanent fixture like a steam-engine. I would be glad to send drawing, but do not think that you could get a better plan for an amateur engineer than those referred to. The best method of making the air heated is by brazing a cylinder of sheet iron or copper, as cast iron offers certain engineering difficulties. The model described was made of thin sheet copper, and would work with the flames of two common dip candles under the displacing cylinder, and start in two minutes.—J. SUTCLIFFE.

[57709.]—**Repousse Work.**—"Dick" will find answers relating to this in Vol. XXXVI., p. 119, Vol. XL., p. 187 and p. 207. In one of these it says that Mons. A. François, Devonshire-place, Birmingham, gives lessons in this art, and from him; no doubt, "Dick" could get information. I quite agree with him that something ought to be forthcoming in these columns, and would certainly be very much more interesting than certain discussions lately. The art is both comparatively simple and profitable to those who know how to work it skilfully.—A. R.

[57712.]—**Vacuum Brake.**—"Ruhtra Nosam" will see if what he wants to know about can be done. To let him see, I will quote a few examples of the great brake competition at Newark in 1875. Experiment D:—All means of stopping except sand—Nos. of experiments, 18 and 20. Descriptions of brakes—No. 18, Smith's vacuum; No. 20, Westinghouse automatic. Time in seconds occupied in traversing successive distances of 800ft.—No. 18: 11½, 11½, 11½, 11, 11, 11; No. 20: 11, 11, 11, 11, 10½, 10½. Speed in miles per hour—No. 18, 49·5; No. 20, 52·0. Distance run in feet after application of brake—No. 18, 1,448ft.; No. 20, 918ft. Time in seconds in bringing train to rest—No. 18, 29; No. 20, 19. Reduced distance for 50 miles an hour—No. 18, 1,477; No. 20, 844. Another example. Experiment E:—All available stopping power and sand—Nos. of experiments, 28, 29, 31. Description of brakes—No. 28: Smith's vacuum; No. 29, Smith's vacuum; No. 31, Westinghouse automatic. Time in seconds occupied in traversing successive distances of 800ft.—No. 28: 13¼, 13, —, —, 12, 12¼, 12¾; No. 29, 12¼, 12½, 12¼, 12¾, 12¼, 12; No. 31: 10½, 10¾, 11¼, 10½, 10, 10½. Speeds in miles per hour, 28: 45·0; 29, 45·; 31, 52·. Distance run in feet after application of brake—No. 28, 860; No. 29, 920; No. 31, 840. Time in seconds in bringing train to rest—No. 28, 20; No. 29, 22; No. 31, 18. Reduced distance for 50 miles an hour—No. 28, 1,118; No. 29, 1,131; No. 31, 776. Therefore, from these tables that I have given you, I do not think the train would. I should also like to give you how many coaches these trains had on, but as it is not put down, I cannot do it. Also, the automatic vacuum might act better than a plain one.—AIR PUMP.

[57717.]—**Blotches on Face.**—Try a small quantity of saltpetre (about the size of a pea) (dissolved in your tea, or in a little water, and taken every morning for a week or two. After suffering from them for several years, it removed them when other remedies had failed.—GAY BEE.

[57717.]—**Blotches on Face.**—I should recommend "Facies" to abstain from all sauces, condiments, &c., and especially pepper, as by adopting this method I completely cured myself. I should also advise him to use Pears' soap for shaving, as it is a well-known fact that inferior soap will often produce eruptions on the face and skin generally.—LEVER.

[57718.]—**Annuities.**—I am much obliged to "Milverton" for his kind answer. The matter, however, is one of simple interest; and the formula seems to apply to the following case: An annuity of £19 11s. 8d. for six years was granted on payment of £100. A schedule showing the amount of principal in the several yearly payments was given thus:—

Principal.			Interest.			Annuity.		
£	s.	d.	£	s.	d.	£	s.	d.
14	11	8	5	0	0	19	11	8
15	8	4	4	3	4	19	11	8
16	5	0	3	6	8	19	11	8
17	1	8	2	10	0	19	11	8
17	18	4	1	13	4	19	11	8
18	15	0	0	16	8	19	11	8
100	0	0	17	10	0	117	10	0

At compound interest the general equation is arrived at by assuming that the amount of P. in *n* years should be equal to the amount of the annuity in the same time. On what principle is the foregoing based? Will "Milverton" be so good as to state? Those stated in "Todhunter" (Alg. Arts. 589, 590) do not seem to apply. I suppose I was out of order in asking the name of the best book on the subject.—W. C.

[57721.]—**Brakes.**—The Smith's brake is a very good one on the rails; but it has these defects—1st, that it is liable to failure; 2nd, that it does not stop instantaneously, I can fully testify myself, as it gives you three very unpleasant jerks. Also, to prove it I can give you an example: The 9.10 a.m. train express from Surbiton to Clapham Junction (I say express because it runs to there without stopping, but really goes to Waterloo) is nearly always checked by signal outside Clapham. The vacuum brake is applied to check the speed, and, as happens, it is found wanting afterwards. It runs nearly the whole length of the plaaform, and then pulls up very badly with the jerks that I complain of. Again, I was coming down in the 5.20 p.m. from Waterloo. When we got outside Surbiton we were checked by signal; the brake was applied, and the speed checked, the train being brought to a standstill. A minute afterwards this brake was again wanted, and the train ran the whole length of the platform before it pulled up. This brake also, if the train parted, would not go on so quick as the Westinghouse. You ask also if it fulfils the conditions of the Board of Trade. It does do that. You also ask if it is of a durable nature. If it has iron cylinders to apply the brake, then it is. But it has this disadvantage—viz., that then it must have voluminous reservoirs also. Mr. Harrison, C.E., says it is 10cwt. heavier than the Westinghouse. If fitted with collapsible sacks made of indiarubber, then it has this disadvantage—viz., the sacks, being made of perishable matter, tear very quickly. I do not think it is at all a good one myself. Some of the drivers who use it tell me that there is no doubt that the Westinghouse is the best, and all of them say that is is a very good brake. Others say that it is the best out, which I do not believe. But I do not believe in asking drivers much their opinions about brakes, as each one "cracks up" the brake he uses.—AIR-PUMP.

[57724.]—**Soapstone or Steatite** is a rather expensive article, vafying in price from £20 to £30 per ton. It is used to a great extent for making burners, being an incorrodible substance unaffected by heat, water, or acid; in fact, it is practically indestructible. It is found in Germany.—LEVER.

[57734.]—**Lathe Flywheels.**—My experience teaches that—1st, the nature and diameter of materials oftenest turned by the operator ought to decide what weight is handiest for a foot lathe. 2nd, that the flywheel itself should not, as is commonly the case, have any counterweight upon its rim, or indeed upon any part of it which revolves at a quick speed, as this undoubtedly causes jumping. 3rd, I consider that balancing either the crank or treadle is not only unnecessary, but inconvenient, as one is constantly requiring to jam the flywheel in various places, by means of the left knee, whilst measuring and marking; therefore it is desirable that the treadle should be as light as possible. 4. I cannot conceive how anyone can imagine that a chain with an immense number of links can be compared for a moment, as a connector between crank and treadle of a lathe, to a simple rod having a piece of lignum-vitæ for the crank to rub against.—A., Liverpool.

[57735.]—**Ammonic Molybdate Solution.**—Ammonic molybdate solution is prepared by dissolving 10 grams of powdered ammonium molybdate in 40 cubic centimètres of dilute ammonia (specific gravity ·96), and adding 120cc. of strong nitric acid, and 40cc. of water; heat to 40° centigrade for eight hours, and draw the clear liquid off. An analysis of steel of medium quality gave ·096 per cent. of phosphorus. T. Barron will, therefore, surmise that for two or three grams of steel a few cubic centimètres of the solution prepared as above will be sufficient.—Ernest Hanwell, Hull.

[57738.]—**Belting and Shafting.**—In my reply on p. 149, for " = *t* " read " – *t*."—Glatton.

[57738.]—**Belting and Shafting.**—The plan advanced by "Amateur Engine-Fitter" would be utterly useless. The following one answers exceedingly well:—A is the driving-shaft with pulley B, the belt from which is "hung to" the arrangement for altering the speed. This consists of two coned pulleys, C and D, set up as per sketch, and "hung" together by a belt E, the belt being kept in its place or moved at will by two forks, F and G, in any convenient manner; the power transmitted is again taken out by "hanging" a belt to pulley H. I have this arrangement working at the present time, and it has never given the least trouble: the greater the distance between the near faces of the two cones the more satisfactory the result. Do not have the cones too steep; any variation of speed can be obtained by moving the belt from the large to the small end. Another arrangement from which good results can be obtained where the power to be transmitted is not heavy, is as Fig. 2, where A is the driving shaft, having a plate B, whose face is turned up perfectly true, fixed upon the end of it in such a manner that an indiarubber-faced pulley D sliding upon a feather or long key on shaft E, and pressed tightly against face E, will be made to revolve, the number of its revolutions as compared to those of shaft A varying according as it is moved nearer or further from the centre. The arrangement for sliding D is merely a matter of detail, and must fit as per circumstances suggest. Power is taken out by belt from pulley F.—Colonel.

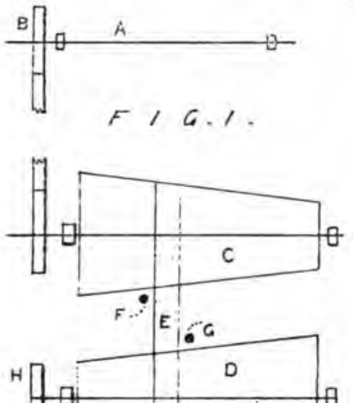


FIG. 1.

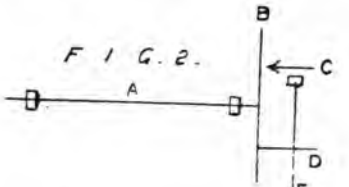


FIG. 2.

[57738.]—**Belting and Shafting.**—I am greatly obliged to the correspondents of "Ours" who have so kindly answered my queries. "A. F. H." does not know how difficult it is to obtain practical information on such matters when you live in a remote rural district in Ireland, or he would not express any surprise at my questions; and, being an amateur only, I have no training. I have no doubt the double cones are much the best way to obtain the varied speeds, but am at a loss to know where I can get such fitting; and may I ask if in using double cones there is any difficulty in throwing the machine out of gear entirely? I should fell much obliged to J. Brown, Belfast, for further information on the system he suggests, and advertise my address.—Amateur Engine-Fitter.

[57739.]—**Speed of Drills.**—For drilling in cast iron, the speed of circumference of tool should be from 80in. to 120in. per minute. For wrought iron from 140in. to 160in. per minute.—Bowling.

[57751.]—**Rain Gauge.**—By the expression "an inch of rain has fallen" is meant that as much rain has fallen on any horizontal area as would, if not drained off, cover that area with a layer of water of the uniform depth of one inch. The funnel being circular, its area is found by multiplying the square of its diameter by ·7854. An inch of rain on a square foot equals 144 cub. inches, and 1·728 cub. in. of water weighs 1oz., hence $144 \div 1{\cdot}728 = 83{\cdot}3$ the number of ounces equivalent to an inch of rain on a square foot; an inch on a square yard equals 9 times as much, or 750oz.; while on an acre it equals 100·9935 tons. Again, six fluid ounces having fallen on a funnel 4·697in. diameter, shows a fall of rain of ·6 of an inch; thus—$6 \times 1{\cdot}728 \div 4{\cdot}697^2 \times {\cdot}7854 = {\cdot}6$.—Jno. P. Bidlake.

[57753.]—**Photos of Diagrams, &c.**—Your camera body does not extend sufficiently. You require either a copying camera or an extending body fitted to your camera. Then you will be able to copy up to size required.—Gwent.

[57754.]—**Gas Supplies.**—I should recommend "R. M. P." to purchase the "Domestic Uses of Coal Gas," by William Sugg, which I think will give him all the information he requires to know. The price is 3s. 6d.—Lever.

[57754.]—**Gas Supplies.**—I thank the two correspondents who have noticed, but not answered, my query. It was not confined to simply reading a meter, &c., but general information on gas matters. Thus, as I write, my gas is making a singing noise—is that gas passing through the burner unconsumed, or what? Again, the other evening, down went all lights for a few minutes, then revived, and alternated this way for a quarter of an hour; then they burned on all right. What was the cause of this? Hence, my query for the title of any treatise that would explain such things and enable me to judge whether my pipes were correct sizes, and, in general, whether I was getting a fair return in light for gas consumed as recorded by the meter.—R. M. P.

[57755.]—**The Wimshurst Influence Machine.**—Let "Old Smings" wait till you are able to publish the "Outline of the Theory" recently sent by me to these pages. He will, I think, follow, and, I hope, add to it.—James Wimshurst.

[57756.]—**The Wimshurst Influence Machine.**—To "C. P. C."—It is not easy to comprehend how you have fixed your neutralising rods and brushes. Why not follow the system always recommended—viz., one neutralising rod to each disc, it to have a brush at each end, and its middle in metallic contact with the spindle? The brushes at each end must touch the two sectors at the same moment; the two rods should then be placed at about right-angles to one another; and looking through the plates, the four brushes will show to be about 90° from one another.—James Wimshurst.

[57767.]—**Adhering Photographs to Glass.**—The best liquid to use seems to be arrowroot. Absence of bubbles can only be insured by taking particular care when sticking the photo on. The best plan is to cover the photo with arrowroot and stick down one end, then smooth it gradually down till the whole photo is on the glass, taking care not to let any air-bubbles get in as you proceed. If you want the photo transparent, you must either oil it when dry with linseed oil, or wax it by heating the glass and rubbing white wax over the back of the photo.—R. A. R. Bennett.

[57771.]—**Commonplace Book.**—Some information on the commonplace book, or index rerum, appeared in an early volume of "our" encyclopædia, the English Mechanic. A plan that is strongly recommended may be explained as follows: Get an exercise book, the bulkier the better, divide it into 25 parts, one for each letter of the alphabet; of course, giving the fewest pages to the least used letters, such as Q and X. Now subdivide each division into five for the vowels, and letter the whole book Aa, Ae, Ai, and so on to the end. Entries can thus be nicely classified, the first letter of the title and first vowel following the initials being used. Thus Magnetism falls under Ma, English under Ei, Anecdotes under Ae. I hope I have made myself clear. Of course, to facilitate reference, you can enter everything under two heads; thus, Mill on Liberty (under Mi), and Liberty, Mill on (under Li), the second reference simply containing a note to guide the seeker to the first. If your notes and extracts are of a very miscellaneous character, it may be best to devote separate books to science, literature, and so on. I have a friend who has by him in commonplace books the notes and questions of a third of a century, and he is still adding.—Arthur Mee.

[57772.]—**Motor for Boat.**—To Mr. Bottone.—My Vol. XLI. is lent out, and it is just possible that I may have quoted a wrong page, as I quoted from memory. However, if "E. M." will kindly turn to page 387 of Vol. XXXIX., he will find figured as 1, 2, and 3 the same motor. A band from the pulley connects the motor with the shaft of the propeller. A single pint bichromate will run this well for an hour.—S. Bottone.

[57773.]—**The Wimshurst Influence Machine.**—To "H. F."—Probably you fit the projecting part of the boss too tightly into the hole in the glass; or perhaps you warm the machine. If so, the cracks may come from unequal expansion. I use soft wood for the bosses, leave space all round the hole, and never warm the machine, and with the many hundred glasses which I have used have never had one of them break.—James Wimshurst.

[57776.]—**Japan.**—Mix ivory-black or lamp-black with shellac varnish. Lay on evenly and thinly, always working in the same direction. When first coat is quite dry, go over it again, and then finish with a coat of seed-lac varnish. I should think white lead instead of lamp-black would do for white japan.—Bowling.

[57777.]—**Electric Bell.**—To Mr. Bottone.—A fine-wound bell, say with No. 36, would do for this. But do you want to use the current for anything else in the meanwhile? Because, of course, this alters the case. I do not otherwise understand the meaning of your desiring to employ a 100 volt dynamo to do such a comparatively trifling work. If the resistance is 36, as you say, and the internal resistance of the dynamo only four to five ohms, then you would have a current of three ampères, which is large for this purpose. Of course, if the current is doing other work, you must put the bell on a shunt circuit, and will require quite another resistance.—S. Bottone.

[57780.]—**The Dialyte Telescope.**—I am too busy in the summer months to do much more than read the "E. M.," which I always do carefully, and take notes of things which interest me; but I shall be happy to assist "Finem Respice" in any way I can. I think it is scarcely possible to obtain o.g.'s suitable for dialyte correctors of larger diameter than 2¼in. ready made, but I am making a special inquiry on that point. I feel disappointed that sufficient 5s. contributors could not be found to raise a fund to have this question tested in a scientific and practical manner, and equally so that Mr. Herbert Ingall, with his fine quality 10in. dialyte, has made no response to the appeal I have before made to him more than once in these columns for any further information he could give to us, more especially respecting his present instrument.—J. C. L.

[57781.]—**Tracing Paper.**—The usual method is to pin the tracing paper down to the desk with drawing pins, over the drawing to be traced, and the colour is put on dry, in the form of crayons of the best quality; and for blue, use blue lead.—A, Liverpool.

[57781.]—**Tracing Paper.**—The paper is generally pinned down over the drawing, and when all is inked in, the drawing and tracing are both taken off, the latter being pinned on again upside down, and then coloured in the same manner as drawing. Wrinkles always appear, especially if colour is put on very wet, and can never be got rid of altogether.—Bowling.

[57781.]—**Tracing Paper.**—I fasten the tracing-paper with the same pins that the drawing is fastened down, slightly stretching it. The colour is applied at the back of the tracing, so that the Indian ink shall not run into the colour. Probably "G. B." has the paper too thin, and has had so much colour in his brush that it wrinkles. It should be slightly stretched and fastened down till dry when being coloured. Tracings are me
to be exact copies of the drawings they are
from, so should be coloured the
best made by washing ou
moderately wet (clean

blotting-paper to remove the wet; then, while the paper is still damp, rub with soft indiarubber. If the paper is greasy, ox-gall, or a preparation obtainable at any drawing-material shop, should be put in the Indian ink. "G. B." should avoid tracing on cloth if he can, as it is always very greasy.—BOW PEN.

[57781.]—**Tracing Paper.**—To take a tracing off a drawing you have simply to cut your tracing paper or cloth off the roll the size required, and pin it down over the drawing with ordinary drawing pins top and bottom: the more pins you put at the bottom the better (if a large drawing), as the paper will not then roll up at the bottom edge by leaning over it. Do not put any pins in the sides of the paper, or your T-square will not work flat to the paper. It is best to cut the tracing paper rather larger than you require the finished tracing to be, as the margin will be convenient to try your pens and colour on. A tracing should always be made with Indian-ink: if tracing on cloth, a little ox-gall should be added to make the ink run from the pen more freely, or if you have no ox-gall at hand, sprinkle a little French chalk on the cloth and rub off with an ordinary duster; neither the ox-gall nor French chalk will be required for a paper tracing, but cloth has a greasy surface. Put in all small curves first, then the larger ones, then join up the curves with the straight lines, then put in the centre lines in red and the dimension lines in blue and the figures in black; now take the tracing off the board and turn it face downwards, and colour the sections on the back; do not attempt to put any colour on the front of the tracing, or the ink will run and spoil your work. Tracing cloth may be coloured (at the back) to any extent, as it will not shrink, but most kinds of tracing paper should be coloured as little as possible, although there are some kinds of paper manufactured that will not shrink on the application of moisture. No doubt your stationer could supply you with such a paper, ask him for some samples and try them with colour before you buy any. Any further information with pleasure.—T. R. SAXTON.

[57782.]—**Laundry.**—It is all "elbow grease," produced in the first place by good washing. Either hot or cold starch, well rubbed into the goods, and then polished by good ironing and rubbing with pressure and a certain skill produced by practice. The glazes, &c., sold are useless without the above: and if the above are properly done, no glaze is required. At the collar factory where I am employed we have tried all sorts of starch, glaze, and irons, and can produce the gloss with any or all of them. We are now using gas irons and cold starch: but I think the boiled starch is the best.—J. I. S.

[57782.]—**Laundry.**—In answer to "Alpha," I find that the smoothness of the iron has a great deal to do with good laundry work. Irons, as a rule, are just ground up a little on a stone, and sent out. They ought to be planed flat and polished. I have filed mine flat and polished them; and now my laundress has very little trouble in turning out creditable work.—MECHANIC.

[57783.]—**Dynamo.**—TO MR. BOTTONE.—This arrangement is known as "a separately excited dynamo." It is much used when a very steady electro-motive force, unaffected by the external resistance, is a desideratum. You will find the subject fully treated in Silvanus Thompson's "Dynamo Electric Machinery."—S. BOTTONE.

[57784.]—**Strength of Materials.**—Under this heading "Young Designer" asks about five perfectly distinct questions, an answer to any one of which would need nearly a column. I advise the querist to study the subjects about which he inquires in Twisden's book on "Practical Mechanics," and if he meets with any special difficulties I shall be glad to help him.—WM. JOHN GREY, Analytical Chemist, Newcastle-on-Tyne.

[57784.]—**Strength of Materials.**—The modulus must be the modulus of rupture S in the equation $\frac{1}{2} W \times \frac{1}{2} L = \frac{S I}{\frac{1}{2} D}$, where W is weight in centre of a beam of rectangular section, L the span, D the depth, S a constant for the material of the beam, calculated from experiments, and I the moment of inertia. The left side of the equation is the bending moment—that is, the force $\frac{1}{2}$ W × the distance at which it acts. The right side is the moment of resistance of the section of rupture. The moment of inertia in this subject, into which the compressive and tensile strengths enter, is the mathematical equivalent of the moment of inertia of a heavy body in motion round an axis. I, the moment of inertia, is the sum of all the area elements in the section of rupture × the squares of their respective distances from the neutral axis of the section. The summation is done by means of the integral calculus. Then the [illegible] × S and ÷ $\frac{1}{2}$ D (the neutral axis being taken a the middle of the depth of the rectangular [illegible] which is not the same as [illegible] actual [illegible] taken as the [illegible] whole of the area [illegible] neutral axis, and not as zero at the neutral axis, increasing to the actual breaking stress in the extreme area element), becomes the right side of the equation. This subject is well treated in Professor Cotterell's "Applied Mechanics" (Macmillan and Co.)—J. S. C.

[57787.]—**Induction.**—If the querist will accept my advice, he will commence operations by discarding the part he already possesses. There is no single point in which it is not bad. An 18in. core should be more than an inch in diameter; it should most certainly not be inclosed in an iron tube, split or not; it is mere folly to use a cotton-covered primary wire. Certainly either the disc or sectional construction is much superior to having the wire run from end to end, and the advantage grows with the length of the coil. The central disc in the coil referred to was of course only an ornament with an intent probably to make the buyer suppose there was a divided coil. The best hint to give to the querist is to try his hand first upon something less ambitious than an 18in. coil.—SIGMA.

[57788.]—**Electric Bell Action.**—TO S. BOTTONE OR "SIGMA."—A Leclanché cell or two for each bell if you are going to strike chords; but if you are only going to strike single notes, a couple of cells would do all the work. An ordinary sounder key, with front action only would do for the transmitter—one for each bell. Each bell must have its own wire to the key, but the return wires might be common unless chords are required. In this latter case a separate lead and return must be used for each bell. If this is not clear, I will send plan of arrangement. Please state if chords are required.—S. BOTTONE.

[57788.]—**Electric Bell Action.**—All that is necessary is to arrange a spring contact to each of the organ keys with a wire to its proper bell. A single return wire from the bells to the battery, and a wire from the battery to one side of all the key contacts will enable one battery to work all the bells. The battery should be of so many cells in series as will work one of the bells steadily for some minutes: probably two Leclanché's will do this. Then use as many of these pairs coupled together in multiple arc as will maintain current. I expect five large cells would suffice; that is, ten in all. The bells should be of the ordinary "trembling" form, and then each will ring as long as its key is pressed, and stop on its being released. See p. 585 of my "Electricity."—SIGMA.

[57789.]—**Propelling Ships by Compressed Air.**—If "K. M. G.," page 157, refers to my plans, as published some time ago in "Ours"—that is, driving air down a tube along with steam by means of a nozzle and funnel to the greatest depth of vessel, and by its action similar to a succession of wedges, in making its way up to the surface by means of a suitable inclined channel fitted into after end of hull, I am not aware that any engineer has expressed any unfavourable opinion. I have models which work well, and which lead me to expect that I could easily get a speed of, say, twelve miles an hour, when on a larger scale than models, without any undue consumption of steam or a very high pressure. In a model drawing, say, 8in. of water, the steam comes to the surface without being condensed, on account of the mixture of air contained in it. The only drawback that I am aware of is that it is not feasible to put an incline at bow end, in order to go astern, if necessary. When we reflect that out of every 100 h.p. indicated by the area, &c., of the cylinders, that only 35 reaches the screw, it seems incomprehensible to me that no one has the energy to try my plan, and thus to throw all the cumbrous machinery overboard.—A., Liverpool.

[57790.]—**Rusty Boiler.**—Water-pipes are sometimes coated by being lowered into a bath containing a mixture of gas-tar, Burgundy pitch, oil, and resin heated to 400° F., and left at that heat, and then drained. A similar coating to this might prevent rust in your boiler; but, unfortunately I don't know the exact proportions.—BOWLING.

[57791.]—**Silver Battery.**—I have had a little experience in constructing chloride of silver batteries, and was much troubled at first with the battery failing in a few hours. The last pair of cells I made, however, worked admirably for several months. I employed unfused chloride of silver, and made a paste of it with water, adding a little unslaked lime, and spread the mixture on silver foil, bringing a short length of silver wire from this pole. The foil and paste were rolled round a small plug of wood and fixed inside the zinc cylinder, being so fixed that the zinc could not be touched. The copper wire from the zinc must not be in the solution, but soldered to an ear left on the zinc when cut. The solution was a very weak one of sal-ammoniac. I have seen "killed" muriatic aicd commended, but never tried it.—BOBADIL.

[57792.]—**Dynamo.**—All your griefs depend on two causes: 1st, Wrong amounts of wire on F.M.'s and armature; 2nd, Wrong sizes of wire. It is no use heaping up wire on a dynamo in the hope of getting increased power, unless the sizes and amounts are correctly proportioned. If you put on about 2lb. of No. 18 on the armature, and 7lb. or 8lb. of No. 16 on the field magnets, you will be much nearer the mark. Couple up the ends of the field-magnet wires, with binders only, so that you can, if you please, halve the resistance by coupling them up in parallel.—S. BOTTONE.

[57793.]—**Workshop Light.**—If gas is not obtainable for lighting your workshop, and no doubt the electric light would be too expensive, there seems to be only one way out of the difficulty, and that is to use suspended paraffin lamps over benches which are placed in the middle of the shop, and wall lamps for side-benches. Why not try the safety paraffin lamps known as "hurricane lamps"? They are very cheap, and give a good light; will not blow out, and are quite safe.—T. R. SAXTON.

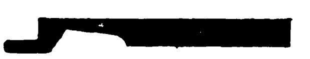
[57796.]—**Ferrous Oxalate Developer.**—I will shortly give details.—S. BOTTONE.

[57798.] — **Crystallisation (Practical).** — Soluble substances may be crystallised in many ways; perhaps, the best is to allow a very hot conc. sol. of the substance to cool, when you will obtain good crystals, or else to conc. the sol. by very slow evaporation until crystals separate out, and then leave to cool. It is impossible to tell you when the crystallisation will commence, as this depends on many things which you have not mentioned. Dry the crystals between blotting paper, or, if in large quantities, between cloths.—C. F. P.

[57799.]—**Dynamo.**—TO MR. BOTTONE.—I do not care much for this form of machine. The magnets are very small to get so much power out of. It will make you perspire to get six 10's well lighted from a lathe. Wind the F.M.'s with about 12lb. of No. 16, and the armature with about 1lb. of No. 20. Please report results.—S. BOTTONE.

[57801.]—**Cylinder Pivoting.**—Knock the cylinder through, out of its brass collet, from the top. Lay the cylinder in a slightly-hollowed stake, and tap it gently with a hammer at the part inclosing the plug; this will loosen the plug when all other ways fail. I am indebted to the *Horological Journal* for the pith of this hint.—L. T. P.

[57801.]—**Cylinder Pivoting.**—Let "One who Tries" place the cylinder over a hole the exact size to allow the plug to fall through when struck by a punch shaped thus—



A very slight blow is required if the hole is the right size; if it is not, you will smash your cylinder.—PARCLE.

[57803.]—**Amateur Photography.** — As far as I can judge from your query, it seems to me that you have let the toning process go on too long. They should not be left in till they turn slate colour, but dark purple. The bath must not be acid at all. You must test it with a piece of blue litmus paper, and go on putting in small quantities of carb. soda till it does not turn it red. It ought not to have been acid if you made it up the day before using, as you always should. Perhaps you may have got a trace of hypo in the bath, which is always fatal. I don't think this bath can be trusted to answer the following day, unless more gold is put in. It is generally recommended for amateurs, and sometimes works first-rate; sometimes nothing will induce it to work. The bath I generally use is 2grs. of chloride of gold, 40grs. of sodic phosphate, water 4oz. This answers admirably as a general rule; but even this is apt to go wrong. Most toning baths seem to me to be very unsatisfactory in this way. The chloride of lime bath, so strongly recommended by Capt. Abney, takes about three-quarters of an hour to tone one print, and it comes out brown at the end of it. I wish sombody would tell us of an infallible bath which could always be relied upon. Perhaps Mr. Bottone would do so? Take care to wash your prints thoroughly before toning.—R. A. R. BENNETT.

[57807.]—**Brush Dynamo.**—TO MR. BOTTONE.—In the Brush machine, series wound, the resistance of the field magnet wire in its entirety should be about quarter that of the entire length of the wire on the armature. By this means, when raising, the resistances are nearly equal.—S. BOTTONE.

[57809.]—**Resisting Acids.**—Is it not possible to make the centrifugal pumps of what is technically known as "fine white stoneware," similar to the composition of Wedgwood mortars and pestles? Pump rams are being made of this material, and, I believe are much more durable than brass.—POTTERY TECH.

[57810.]—**Dynamo.**—TO MR. BOTTONE.—This machine, if carefully constructed, will light the whole six twenties in parallel without any shunt.

Shunts are only wasters of power, to be used only when we wish to divert the power of a machine into another circuit, or to magnetise the magnets.—S. BOTTONE.

[57812.]—**Hat Stretcher.**—Warm the brim of the hat at a clear fire until soft, and then stretch it to the required shape, holding it in shape until cold.—998.

[57812.]—**Hat Stretcher.**—Do not buy anything at all. Bowlers, &c., are stiffened with shellac. Gently warm inside and outside of hat before a fire until quite soft and pliable; then carefully put it on your head, and take a short walk. The hat will stiffen again, and will be comfortable always.—J. I. S.

[57812.]—**Hat Stretcher.**—For stretching hats the hatters use a machine consisting of two wooden semi-circular frames, brought close together or further apart by a screw. Hard hats are made of felt and shellac, which latter softens by heat like sealing-wax. To stretch a hard hat the hatter stuffs the crown with paper to prevent that part from getting warm; places the hat over a ring of gas flames, which softens the shellac in the drum that fits round the head, then inserts the above mentioned semi-circles, and screws them out. To stretch a soft felt hat, the hatter does the same; but warms the hat by passing a hot iron round it. I wear soft felt hats, which shrink after wetting by rain, &c. In such case I stand in the hat four common wine bottles, and between these bottles I drive in pieces of wood to distend the hat; leaving it thus for the night is generally sufficient. If the hat of "Nous Avons" is a hard one, built of shellac and felt, it will be difficult to stretch it without the proper appliances above mentioned; but if he intends to try to do it without them, he had better not warm the hat before a fire, as it will probably get warm all over, and become as unmanageable as a wet rag. Instead of this, I should say warm the drum only of the hat by a warm flat iron, and put in a stretcher of some sort.—SIMONIDES.

[57816.]—**Carbolated Chloroform for Toothache.**—The compound used by dentists for the cure of toothache caused by an exposed nerve is made by Mr. Thomas Fletcher, of Warrington, and is a mixture of carbolic acid crystals, resin, and chloroform. It is troublesome to make, and would not pay to prepare in small quantities.—998.

[57819.]—**Perseus.**—Proctor remarks: "The stars γ and δ Cassiopeiæ point towards this cluster, which is rather further from δ than δ from γ, and a little south of the produced line from these stars. The cluster is well seen with the naked eye, even in nearly full moonlight." Hind says: "The stars are readily seen with the common night-glass, though the whole have a blurred aspect to the naked eye." Has the querist used too high a power? He might compare what he sees with the fine plate in Nicholl's "Architecture of the Heavens," or the miniature in Proctor's "Half-Hours."—ARTHUR MEE.

[57820.]—**Enlargements on Paper.**—Paraffin is the stuff you want, well melted in the cracks. If you can put your bath into the oven till very hot, and then soap the woodwork all over with paraffin, it will be quite watertight, and will not affect the developing solutions in the least. You need not even be at the trouble of making a wood bath, if you do not like, as the top of a large cardboard box, heated, and paraffin soaked into the cardboard, answers perfectly well, the paraffin being perfectly stiff when cold, and rendering the cardboard completely waterproof.—R. A. R. BENNETT.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

57212. Co-ordinate Geometry. p. 528.
57218. Electro-Magnetic Problem 528.
57223. Gas Engine. To "Invicta," 529.
57225. Copper Bend, 529.
57226. 5ft. Reflector, 529.
57228. Tinman's Piecework Prices, 520.
57241. Robinson's Patent Lubricating Bags, 529.
57243. Condenser, 529.
57245. Compound Tandem Engines, 529.
57253. Waterwheel. To "Invicta," 529.
57259. Making Patterns on Glass, 529.
57260. Flies, 529.
57264. Blue Paint, 529.
57266. Sea Voyage, 529.
57267. Live Spindle, 530.
57268. Dyeing Fishing Baits, 530.

57459. Intermedial Engine, p. 42.
57461. Universities, 42.
57469. Lime, 42.
57485. Gillet's Telephone, 43.
57505. Engine Query, 43.
57512. Hydraulics, 43.
57518. Swings, 43.

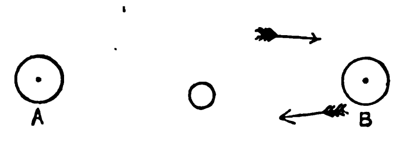
QUERIES.

[57822.]—**Legal.**—TO MR. WETHERFIELD.—A.'s estate adjoins B.'s, and is supplied with water by a stream running first through B.'s land. B. contemplates building, and, in order to secure a large supply of water, diverts the stream at the point where it enters A.'s land, so as to keep it in his own, making for it a fresh bed and a reservoir, the surplus water being returned to the original bed in A.'s land, some few hundred yards below point of diversion. A. also thinks of building, and, depending as he does on the stream for water, objects to the diversion, because the water as returned to original bed will be more or less polluted. Has B. power to divert without A.'s sanction? If not, what steps should A. take to have stream restored to original course?—W. J. GRIFFITHS.

[57823.]—**Dynamos.**—If some of our friends who have experience in making dynamos will help me I will be sincerely obliged. I want to make a dynamo that will light five 20 c.p. lamps. Mr. Jones has advertised in the MECHANIC castings with laminated armature, Simens H pattern. Is this kind of dynamo as good for this size as any other? and, if so, would there be any benefit by winding it as a compound shunt? If there would, should there be the same length of fine wire on the F.M. as of coarse? Through information given by S. R. Bottone and others, I was enabled to construct several coils and other electrical apparatus. I know a little about dynamos, thanks to the MECHANIC; but I see amateurs get into difficulties—I want to ask information at the beginning.—BRIAN BORU.

[57824.]—**Lamp.**—Will some kind reader explain the details of Schoth's medical lamp, and its workings, and oblige a brother reader?—INQUISITIVE.

[57825.]—**Belting.**—In the inclosed sketch, A and B are two wheels, 6in. dia., 6in. wide, and about 6ft. apart. A band passes over these. A drives the band; B is loose.



The bottom of the band must always be straight. C is a roller, adjustable for height, to take up the slack on top. All the pressure is on bottom of band, in the opposite direction to arrow. What would be the best thing for a band? Would two tricycle chains connected 6in. apart do, and have A geared? The pressure back on chain is 8cwt. or 10cwt. The wheels and band are to be continuously in water.—ONE IN DOUBT.

[57826.]—**The "Genesta."**—Can anyone give me the measurements of the "Genesta," with her sail area, and number of crew she carries? Has she ever beaten the "Marjorie," who seems to run away with all the prizes? How many cups has the "Genesta" won?—ONE IN DOUBT.

[57827.]—**Dissolving Alloy out of Gold Ring.**—Will some kind reader tell me how to dissolve out the alloy on the surface of a gold ring, so as to leave a coating of good gold? The ring is now a very brassy-looking colour, but I want it to resemble an 18-carat gold ring. Any information on the subject will greatly oblige—ONE IN A FIX.

[57828.]—**Sprained Elbow.**—About four months ago, I had the misfortune to fall down-stairs and sprain my elbow. It was very painful, but as it did not swell up I did not think much of it. I bathed it in cold water, and rested it as much as I could, but it never got better. Any small jerk or twist causes me considerable pain. If any of our readers can advise me how to cure it, I shall be greatly obliged.—FER.

[57829.]—**Boiler.**—Would any kind reader favour me with instructions how to braze the top of an iron boiler, and how much pressure will it hold. Size, 8in. by 5in.; thickness, 1-32in. I shall be very glad of an answer to these few lines.—G. W. R.

[57830.]—**Power of Engine.**—Will someone kindly tell me the power of a double-cylinder engine—each cylinder is 2in. bore and 4in. stroke? Will it drive a boat 15ft. long? or the largest boat you think it will drive?—A. W. NURSE.

[57831.]—**Induction Coil.**—Will one of our readers please help me out of the present difficulty? I wish to get three or four powers from the same bobbin. I have tried by putting three layers of primary, then some layers of secondary. I connect the secondary to the terminals, and obtain the current. I now put on some layers of secondary again. When I connect the second secondary I don't obtain any more current. Must I, therefore, put on more than one primary on the same bobbin? Please explain.—WELSHMAN.

[57832.]—**Railway Carriage Wheels.**—Will "Meteor," "Historian," or some one of our readers favour me with diameter and circumference of wheels upon which the newer-made carriages of the London, Tilbury, and Southend Railway are mounted? Also the number of revolutions they make per mile, or, what is perhaps better, the most exact rule in use among engineers for estimating circumference from diam., or proportion that diam. bears to circumference, as I detect a diversity of opinion between two journals supposed to be devoted to engineering science? and also diam. of axles at any point, say midway, between a pair of these wheels?—TILBURY.

[57833.]—**Steel Castings.**—Would any of "ours" oblige me with a few practical hints as to making steel castings on a small scale, both as regards moulding and melting the metal, as I am out of the way of any of the steel districts and occasionally require them? The name of a good book treating on this subject would also oblige. I may mention I have Spretson's "Casting and Founding."—IRON.

[57834.]—**Electric Light.**—Would some correspondent kindly give information as to the best mode of illuminating an artist's studio? Size of room, 12ft. by 12ft. State cost.—ARTIST.

[57835.]—**Working-load of Chains.**—Could some of your readers favour me with the correct rule to find the safe Working-load of chains, from 5-16in. to 2in. dia.? Most tables have the breaking or proof strength attached to them.—CHAIN.

[57836.]—**Stove.**—Will some reader kindly inform me how to make a hole about 5in. in diam. in the top of a small cast-iron box stove, and how to make the cover smoke-tight?—F. G. H.

[57837.]—**Wimshurst Influence Machine.**—On looking through back numbers of "E. M." I can find no instructions as to distance of points on the conductors from the glass. I should be obliged if someone would inform me within what distance they ought to be, and whether this is an important item in the efficiency of the machine? I should be glad to know also why one arm, with attached ball, of conductor is always smaller than the other? Has this anything to do with length of spark?—JOH.

[57838.]—**Induction Coil.**—Can any reader of "E. M." give me directions for construction of Rhumkorf coil with central division? I have made small one by directions in hand-book by Dyer with good results. Wish now to make more powerful one. What is the object of central division? Can I get the same power by having polished mahogany ends instead of ebonite? What dimensions should core be, and quantity of wire, primary and secondary, to produce 3in. spark? Also, how many square feet of tinfoil should condenser contain? Information would be esteemed.—INDUCTION NOVICE.

[57839.]—**Electrical Resistance of Fats and Oils.**—I should be greatly obliged if any of "ours" could tell me of any work dealing, either specially or incidentally, with the electrical resistances of fats, oils, gums, and resins? If none such exists, I should much value any information from those individuals who have that special knowledge, and will be so kind as to impart it.—R. R.

[57840.]—**Bichromate Battery.**—Having made a bichromate battery of three gallon size jars, carbons and zincs 10½in. long, 6in. wide, I should be glad if anyone will tell me what quantity of bichromate of potash and sulphuric acid I must put in each to charge them, and how long they will last before wanting recharging.—BOLTON.

[57841.]—**Burning Kerosene under Steam Boilers.**—Will any reader of the ENGLISH MECHANIC be so good as to inform "Steam Port" what description of burner is used for burning kerosene oil under steam boilers, and, if possible, give a sketch of it?—STEAM PORT.

[57842.]—**Gramme Dynamo.**—TO MR. BOTTONE.—I have made a Gramme dynamo from the sketch and dimensions given by you in the "E. M.," Aug. 28th, but am now in a fix as to winding the same. Could I trouble you for a sketch, showing how to commence wiring the F.M. and armature, and the direction to be wound in or each of the four poles? Also size of commutator, and number of sectors, and the way to connect armature to commutator? All other instruction you can give me on this little machine will greatly oblige—ONE IN A FIX.

[57843.]—**The Sodio Sulphite Developer.**—Would Mr. Bennett be so kind as to give the formula for this developer?—ETA MU.

[57844.]—**Dynamos.**—TO MR. BOTTONE.—Will you kindly explain the following to me? In a book on dynamos appears the following paragraph:—Another machine which is also much used is the Siemens machine, but it is so constructed that it can only give one light. This would also be the case with the Gramme machine, if another contrivance called the distributor were not employed with it. Also, will the armature, described in No. 1050, be better for the dynamo described in No. 1066? If so, will the same amount of wire be required, or more? What width should the cogs be?—ANXIOUS.

[57845.]—**Storage Cells.**—TO SELIMO BOTTONE.—I have made a storage battery, 3¾in. by 3¼in. by ⅞in., and divided into two cells by a wooden partition. Each [illegible] has two lead plates, 2¼in. long by 1in., and 1-16in. in thickness. Each pair of plates have a piece of felt between them, and bound together with a piece of tarred string, afterwards well smothered with a paste of red lead and sulphuric acid, and immersed in dilute sulphuric acid. After sending a current from a 15-cell Daniell backwards and forwards for about a month on and off I connected the storage to two half-pint bichromates for about a quarter of an hour, and on disconnecting I could only get a spark equal to about the same as one gets from a pint bichromate. Is there anything wrong with the battery, or does it want a little more forming before using it? I should have thought it would be strong enough to give an electrical pressure of four volts, or enough to light a [illegible] 2 c.p. lamp of low resistance. Would you kindly tell me what I can do to put my storage battery in working order?—VOLT LACKER.

[57846.]—**Chamber Organ.**—Will any gentleman interested in the subject kindly give me his advice? I am about to build a chamber organ, and I propose to have a stopped Diapason from C C, Dulciana tenor [illegible] or C, Gamba [illegible] tenor C, these two to borrow bass octave from stopped Diapason, and a flute 4ft. Would these be suitable? I also have an extra slide. Would a clarionet be suitable for this, all of them to run 5½ octaves [illegible] or coupling [illegible] MECHANIC.

[57847.]—**Black Oil for Harness.**—Will some [illegible] kindly give me a good recipe for black oil [illegible]—J. C. C.

[57848.]—**Dynamo.**—TO MR. BOTTONE.—Please accept my sincere thanks for your kind and able replies to my queries. The result of my last trial (Dynamo, [illegible]) was obtained, of course, while coupled-up in series. I have not yet tried coupling-up in parallel, but will at once, and report the result, which may, probably, be of use to some of "Ours." If I couple in parallel, will that produce the desired effect with a reduced speed? The speed I was running at was enormous, over [illegible]000 revolutions [illegible] min. Is this speed necessary to produce the best [illegible] Swan's 10 c.-p. lamps, [illegible] parallel? As I have be[illegible] MECHANIC for two we[illegible] (57689) is to my query [illegible]

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 21, and unacknowledged elsewhere :—

T. TAYLOR.—Burdess and Townsend.—Sir Thomas Bazley.—Selig, Sonnenthal, and Co.—J. Greig.—F. E. Knowles.—W. Nolan.—Embroidery Printer.—A County Chip.—A. E. B.—Gratia.—J. W. A.—J. Brown, Belfast.—Five-inch.—J. H. Schucht.—B. R.—A. F. Shakespear.—Gallus.—J. K. P.—T. Fletcher.—Norman.—Pottery Tech.—O. V.—Sand-Rat.—B. C. R.

A CONSTANT SUBSCRIBER. (Yes, and you have been twice answered in this column. If correspondents neglect to look here, we cannot help it if they do not find any notice of their communications.)—CHANDELIER. (Certainly it would be feasible. Any dealer in fittings of the kind will give you an estimate of the cost.)—T. P. (Thanks; but we cannot afford space for a number of diagrams explaining how to read the index of a gas-meter, especially when a full explanation can be obtained for a few pence.)—CYMRO SIR GAER. (You do not seem to be aware that we have given such information several times; but without some idea of what it is wanted for we cannot do more than refer you to the indices.)—G. E. (Get some indiarubber solution in bisulphide of carbon (sold at the leather shops), and smear some of it over a piece of thin fabric, which is to be pressed firmly over the torn portion as quickly as possible after it is spread.)—BACHELOR. (Most of the German universities; but "Ph.D." is not held in much respect nowadays.)—N. A. L. (See any of the indices. 2. Fix it any way you like; the wires need not be insulated.)—A. L. R. (It is rather too late to ask us to reopen the wire-gauge question; it is too old. We gave the standard wire-gauge on p. 511, No. 986, and no doubt in time it will become universal. You will find much information on the subject in back numbers.)—EXPLOSION. (You must apply to the chief engineers of the insurance companies. See p. 535, Vol. XXXVII.)—NON-CONDUCTOR. (Try Leroy's composition.)—CYCLIST. (Get a "Facile.")—VIOLA. (The question you sent on the 23rd ult. was answered on p. 111—as soon as possible.)—T. B. S. (Look up back numbers, and procure Chadwick's "Magic Lantern Manual," published by F. Warne and Co., Bedford-street, Covent-garden.)—W. PODMORE CLARK. (In *Engineering*, a month or two ago, there were several articles on automatic sprinklers. The principle is an arrangement of water-pipes around the ceilings of the rooms, or forming a network roof, with holes plugged with fusible alloy (D'Arcet's) or beeswax. When the heat melts the plugs the water falls on the burning mass below.)—PAR CLE. (Procure "The Lathe and Its Uses," or one of the handbooks. 2. Dimensions of L. and N. W. compounds in No. 1,052, p. 262.)—WILLIAM SCOTT. (There is a book on Boat-building published by L. U. Gill, 170, Strand, W.C.)—J. E. R. (See pp. 181, 203, Vol. XL., and the indices generally.)—H. B. (To counteract the effects of what is termed centrifugal force. 2. "If"—there is great virtue in an "if"—it should happen so, it would be the outer rail, but the flanges of the wheels press with the greater force against that rail.)—H. R. B. (Yes. You can obtain all particulars of the Civil Service Commissioners, Cannon-row, S.W.)—F. GRAHAME. (See previous answer. Too old, we think. 2. We should think it a suitable place to go to; but see the *Weekly Times and Echo* for the last few weeks. There is much useful information about emigration in it, and recently about the State you name. There are also several replies in back volumes, mostly written from the places themselves.)—J. A. LOCKWOOD. (Give a patent agent all the particulars you can, especially the likely date, and he will find the number for you. Patent agents necessarily have all the lists by them, and charge only a small fee for such work.)—C. T. B. (You had better consult a solicitor. He has apparently broken the provisions of the agreement; but in the circumstances it will be wise to take the advice of a solicitor with the actual words of the agreement before him.)—HENRY CAPEL. (Do you not see that the replies would be gratuitous advertisements? It is a good lamp.)—MAGIC FAN. (That would be suitable for the Wanted Column—not for the Queries.)—VOLTA. (You can make one of strips of zinc and copper connected together at the ends, and separated by folds of canvas or cloth, which is wetted with salt and water, vinegar, or water acidulated with oil of vitriol.)—AMATEUR. (Both queries have been answered in recent numbers. Procure one of the little handbooks of photography.)—AMATEUR PLATER. (The "quick" you mean is made by dissolving 1oz. of quicksilver in nitric acid diluted with three parts water, having the mercury in excess. When dissolved, add a gallon of distilled water, to which has been added 2oz. of sulphuric acid.)—A PARENT. (If bathing with one of the simple lotions made up by the druggist is not effective, consult a medical man; it would be better to consult him first of all, as the eyes are too valuable to be experimented upon.)—S. K. (Bisulphide of carbon and mineral naphtha are the cheapest solvents of indiarubber.)—M.M.I.Sc S. (Is it not given in his book "Electricity," &c.? "Some years ago" is rather too indefinite.)—JOHN MELLOR. (You will find many recipes of the kind in back numbers. See the indices of Vols. XLI. and XXXIX., for instance.)—A WEST COUNTRYMAN. Scarcely of sufficient interest. You will find directions for charging on p. 129, No. 994.)—DUFFER. (Use aniline scarlet. 2. Oil of cloves, or a drop of carbolic acid; the blue shade is common enough in inks made of logwood and green vitriol; but see back volumes for a variety of recipes.)—LUMEN. (We know nothing of the lamp or its maker, and certainly should not send ourselves till we had seen it.)—A LIFELONG SUFFERER. (The symptoms are so peculiar that it would be better to consult a medical man.)

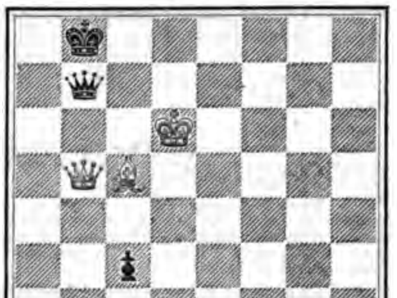
CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLXII.—BY B. HORWITZ.

From "Chess Studies and End Games."

Black.



White. [3 + 3

White to move and win.

SOLUTION TO 960.

White.	*Black.*
1. B-Kt 5	1. Anything
2. Q, R, B, or Kt mates	

(Nine variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 959, by Link, V. S. Pochin, and F. Rudman.

To 960, by Link, V. S. Pochin, F. O'N. H. (extremely neat), A. Bolus, J. A. Miles (good), Rev. W. Anderson (Old Romney), A. A. E. Lecluse, H. E. T. Glover.

To 961, by A. S. Olver, J. A. Miles, and A. Douthwaite.

A. A. E. LECLUSE.—We are obliged by your congratulations. The success of the Tourney is due to the fine problems sent by our contributors.

V. S. POCHIN.—We have supplied the omission. You are credited with your solution to 958.

WE shall publish the result of the Solution Tourney next week.

WE regret to announce the death of the veteran chess-player, Herr Horwitz. He will in future be known principally for his treatise on End Games, of which we have given a sample above. This work is of great value to the student, and is, in its way, as essential as an analysis of the openings.

MR. MACKENZIE, of world-wide celebrity, the winner of several Tourney Problems, is about to publish by subscription his long-looked-for work on Chess. It will contain: (1) the principles of the art of problem composition; (2) practical composition, illustrated by diagrams showing, step by step, the process of constructing some of the author's best problems; (3) a collection of 130 of his compositions, including 20 of his prize problems; (4) a dictionary of technical terms; also elementary instructions for beginners. A complete list of subscribers will be published. The subscription-price for a copy of the work is 8s. After publication the price will be 10s. 6d. We shall be happy to receive the names of any who would like to subscribe.

WE hope to be able to publish the Judge's report of the two-move problems next week.

THE following gentlemen have joined the third correspondence Game Tourney, in connection with the ENGLISH MECHANIC:—W. T. Pierce, F. A. Vincent, W. Nash, E. F. Gerahty, Rev. J. T. C. Chatto, G. W. Farrow, W. H. L. Monck, J. Clothier, H. Balson, R. Pilkington, C. J. Lambert, and H. F. Cheshire. With such a strong team we ought to have some very good games. We received other applications, but as the number was limited to 12 we were reluctantly obliged to decline them.

Holloway's Pills.—Indigestion, flatulence, and cramps.—These stomachic Pills are invaluable for all complaints of this character. They also correct the liver, and give tone to the whole alimentary canal. They purify the blood, correct all vitiated secretions, and elevate the tone of the nervous system when it is depressed.

USEFUL AND SCIENTIFIC NO

Crystalline Alloys.—Mr. Richard Pe
Denver, brought before the American Insti
Mining Engineers a paper "On Certain Inte
Crystalline Alloys." In treating the au
copper ores of this district, which contain b
a greyish white alloy was obtained, this
crystalline alloy of gold and bismuth. A
alloy of gold and copper was obtained. P
and bismuth were also alloyed, and in the
a black non-crystalline powder was formed.
instantly ignited a drop of alcohol and e
a mixture of hydrogen and air. The nature
alloys requires further study.

Signalling at Sea by Night.—Mr.
C. Grant, one of the Forth Bridge staff, i
ing out a new form of signal for use at sea
cate to other ships the direction of move
the helm, so as to avoid collision with shi
up. He does not propose to supersede
lights at present employed, but only to sup
them. The officer on watch is supplied
couple of signals small enough to be carr
breastcoat pocket of ordinary capacity. S
wish to indicate that his vessel is on the p
he takes a signal—with a round handle and
red—from his pocket and fires it by giv
slight tap. The result is a brilliant re
After this light has burned for about
seconds it explodes a small maroon, the r
which can be heard a mile off; and after
light continues to burn for another thirty
The process of firing the starboard tack s
of course, the same, the result being a gree
but in this case the handle is square, this
ence of form making it easy in the dark to
guish the right signal to be employed.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, OCTOBER 30, 1885.

HISTORICAL NOTES ON THE CASSEGRAIN.—VI.

BY DR. ROYSTON-PIGOTT, M.A. F.R.S.

(A Summary on Reflecting Telescopes.)

AFTER the beautifully-defining mirror (A) had been spoiled at Melbourne, many attempts were many to bring it into operation satisfactorily. It was, however, found absolutely necessary to displace it by mirror (B), which was more judiciously treated. Mr. Howard Grubb retained the central portion cut out for the Cassegrain eyepieces, polished with a proper figure, varnished it with shellac, and months afterwards removed the lac without leaving any mealiness or striation whatever.

It appears that Mr. Le Seuer sent in his resignation not very long afterwards. It cannot be supposed that any man could learn to repolish a 4ft. mirror within a year. From five to seven years' training is requisite, and even then special manual and intellectual endowment of a high order. Mr. Lassell, by dint of great enthusiasm and talent, with manipulative skill of a very high order, attained, after many years' practice, the art of repolishing in a very short time. It is notorious that the great 6ft. Parson's Town mirrors require frequent removal and repolishing. You may be lucky on a visit. One of the mirrors may have just been repolished to a superb figure, or you may see strange shapes of painful significance necessitating a speedy removal and refiguring. Lord Rosse's practice will be detailed further on, as regards this point. The fact of the one hundred-thousandth of an inch ground off too much, ruining the parabola, and often involving many months' maddening trials, is sufficient to demonstrate how hazardous it was to figure a 4ft. metal mirror in a cool climate which was intended for a hot one.

The second mirror (B)—already alluded to in these articles—having been unvarnished by the plentiful application of naphtha and, subsequently, whem mopped up, of soap and water, began to assume a tolerably bright appearance, though the polish never equalled its original brilliance as seen in Dublin. No signs of mealiness were distinguishable now, though considerable pitting of two patches some 2in. square, owing to the dropping of the soldering acid, were very unsightly and deep. The mirrors were exchanged about the end of August, 1869. Many attempts were made to use the instrument for adjustment and observation: but that dreadful enemy, the dust and grit of Australia, accumulated to such an extent as to lead to fear of considerable damage to the bearings and more delicate parts of the machinery. The instrument, during the building going on, was covered up with tarpaulins for some time.

During the diffusion of the Cape dust photography was almost impracticable, and, if abundant, even the specula could not be finely polished. When a star by night was observed, it was invariably blurred into a diffuse sort of nebula, while nebulæ proper were rendered invisible. The only good observing nights at the Cape were when the dew was falling, thus corroborating Sir W. Herschel's experience with the 40ft. reflector.

fore giving a final *résumé* of this history
make a few remarks on the prac-
the Cassegrain as an instru-
quatorially mounted.
of the black spot
L
by the

eyepiece when the instrument is directed to a bright sky or illuminated white paper, using a pocket lens a brilliant circle is seen, centred with a black spot. The first is a miniature image of the large mirror, the second a miniature of the aperture in the parabolic reflector. And their respective diameters can be found by dividing the apertures of each by the total magnifying power.

Examples of Emergent Pencils.

(*a*) Diameter of white spot in Grt. Cassegrain with the power 240........ $= \frac{48}{240} = \frac{1}{5}$in.

Diameter of central black spot .... $= \frac{8 \cdot 05}{240} = \frac{1}{30}$th

Eastbourne Cassegrain.

(*b*) Diameter of white pencil 18¼ mirror, with power 170 and 28in. convex........ $= \frac{18\frac{1}{4}}{170} = \frac{1}{5\frac{1}{2}}$

Diameter of black spot ...... $= \frac{3}{170} = \frac{1}{57}$

Here the black spot is only half the size of that in the Melbourne glass.

Lord Rosse's 6ft. Newtonian.

(*c*) Diameter of white emergent pencil with 2in. eyepiece giving power of 350 .... $= \frac{72}{350} = \frac{1}{5}$ nearly

Diameter of central black spot, the image of the "flat" 4in. diameter ... $= \frac{4}{350} = \frac{1}{90}$ nearly

In each of these cases the pupil of the eye under ordinary conditions can embrace the whole of the emergent pencil.

(*a*) The intrusion of the black spot of $\frac{1}{30}$th of an inch in the exact line of sight causes great annoyance unless it is kept perfectly central. The least shifting of the big mirror or little convex always throws it out of the centre. The best remedy for this is a plate of zinc or blackened brass, slightly larger than the eyepiece end, made with shifting slots, so that the fingers can instantly adjust the centricity. (Large-headed screws, with holes much larger than the thread, appear to answer the best.) You may get a wing or a darkened field. If the convex be too large, you will see a black border, like a black annulus, showing the amount of light cut off from the great mirror.

(*b*) I tried a 40in. convex to reduce the magnifying power of my Cassegrain down to 129; but the black annulus was quite distressing.

(*c*) The view in Lord Rosse's 6ft., with a bright emergent pencil of only $\frac{1}{5}$th of an inch, and the reduction of the intrusive black spot to a tiny speck $\frac{1}{90}$th of an inch in diameter, must have combined to render the field of view pleasant and beautiful in the extreme. The diameter of the full moon at the focus of the large mirror is 700 × sin. 32, or 700 ÷ 108, or nearly 6½in., which, with a 2in. single convex lens, gave a power of 350.*

In every case of a reflector, unless means are employed for regaining the *fiducial* axis of the telescope by instantaneous alteration of the adjustments, no reliable equatorial observations can be taken without the help of some fiducial zero, in the field, if possible.

Some of the particulars given in Dr. Robinson's report are of special interest. He differs somewhat from Steinheil as to the intensity of light after reflection at two mirrors, making it only 0·401, or less than half the incident intensity, and on this basis, he says an achromatic telescope to be equiluminous with the 4ft. Cassegrain, must have an object-glass of 34·4in. aperture. Newton's great objection to this telescope was the almost perpendicular incidence of the light upon the convex, which he thought would absorb too much light. But though this is true for glass, it is not so for metals; and a silver-glass convex returns a large percentage, 0·91. So does the large mirror when made of silvered glass, which gives eighty-two percentage of incident intensity, just double that of a Cassegrain made with two speculum mirrors. In other words, the nebula at Melbourne would show up exactly twice as bright with silver-on-glass reflectors. Moreover, the expansion of the glass would only be a fraction of the copper and tin mixture.

The Constants of the Great Melbourne Cassegrain.

	Inches.
Diameter of large speculum..............	48·0
" small convex..................	8·05
Focus F of large speculum	366·0
" *f* of small "	74·71*
Distance between the 1st and 2nd images	61·00
Distance between 2nd image and surface of convex	332·31
Lowest power M	240·
Focal length of field lens of eyepiece ...	16·10
Ditto of eye lens of Huyghenian not given	Min. of arc.
Field of view	14·32
Increase of magnifying power by the intervention of the convex of 61in. focus.	5·4177 times.
Equivalent focal length of the Cassegrain, 1,994in.	166ft. 2in.

Remark.—The final image of the moon presented at the eyepiece aperture of the large mirror a diameter (supposing diam. of moon to be 32 minutes):—

$$D = r \times \text{sin. } 32' = 1{,}994 \times \tfrac{1}{108} \text{ nearly.}$$
$$= 18\tfrac{1}{2}\text{in. nearly;}$$

or above half a yard. The light taken on a screen at this plane would be too feeble for photography, except, perhaps by long exposure. (In my Cassegrain the convex No. 4 of 28½in. gave an image of about $5\frac{5}{16}$ in.) The most difficult arrangement of the Melbourne constants was to keep the diam. of the emergent pencil down to two-tenths of an inch, and so to arrange the diameter and focus of the small mirror so as to lose none of the incident light. For this reason Dr. Robinson assigned the focus so as to magnify the first image about five and a half times. To keep the bright eye spot down to one-fifth of an inch, an eyepiece (negative) was constructed 9in. long, which, by calculation, I find to be about 8in. focal length.

It appears from the researches of M. Jamin the intensity of the light after two perpendicular reflections is about 0·646 × 0·646 = 0·4173 of the original brilliance.

Contrasting this with Dr. Steinheil's results, we have strong evidence, that if the Australian Government were to substitute wholly silver-on-glass mirrors in place of the copper and tin alloy, great advantages would follow.

1. The curvature is settled once for all, and merely silvering the surfaces would bring back all the original beauty of the definition.
2. The mirrors should be figured on the spot at a mean temperature.
3. The change of figure from variation of temperature would be in a great measure reduced for glass instead of speculum metal.
4. Some such artist as Mr. Grubb, Mr. With, or Mr. Calver should be offered £1,000 to go over with silver-on-glass mirrors finished for English climate, and to be refigured for a mean temperature of the Australian climate on the spot.

By this the £14,000 said to have been expended on this *great failure* would be satisfactorily utilised. All the reports coming in for years (and even recently) of its performance are in a high degree unsatisfactory. The tremendous difficulties involved in repolishing a tarnished mirror, already as perfect in figure as attainable, will be well illustrated by the experience gained at Parson's Town. There, the large 6ft. mirror has at least been repolished every second year. Every time the speculum is removed for this purpose the old figure, whether superb or bad, is utterly lost in the process of polishing, and after the process it is virtually a new instrument, and it is most difficult to test it. It has to be replaced in the tube, dragged a quarter of a mile by twenty-five men; then awaiting a favourable night, a star is selected; frequently there is failure; the whole process is then recommenced. The 3ft. mirror can be turned on its frame for testing progress; not so with the 6ft.

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* I am not sure these data are perfectly correct, as I cannot at this moment find them, and write only from memory about Rosse 6ft. reflector, which must be somewhere near 750in. focus.

* This number was misprinted in a former article 7171, as noticed by "A. S. L."

The present Lord Rosse's father had the ingenious practice of always testing a spare 3ft. mirror on the polishing frame before repolishing the 6ft. A watch dial erected on a tall pole over the machine performed this test operation. Thus the various details of the process were recalled to mind to assist in finishing off the 6ft. Sometimes after waiting a fortnight, the latter placed in the tube gave a satisfactory result. It is not wonderful, then, that even distinguished foreign visitors should sometimes be disappointed with the defining powers of the monster tube.

Dr. Robinson, of the Armagh Observatory, wrote a report to Lord Rosse, saying, "My experience of it differs widely from that of the foreign astronomer."

[ABRIDGED LETTER.]

"My dear Lord Rosse,

"In 1869 Mr. Proctor published a strange attack on large reflectors. He depreciated Lord Rosse's work, and declared it was quite deficient in definition, and only fit to condense light on the slit of a spectroscope—a distinguished foreign astronomer having declared on looking at Saturn with it, 'It might have been anything.'"

"Planetary Nebulæ and the spiral ones require very high defining power to bring out their details. These were wonderfully shown trials.

"(*a*) Feb. 11, 1845. Unfavourable night; Sirius good with 400. Out of focus, the ring of light was curdled, surface not quite true. Mar. 3. It was successfully polished except some damask marking from impurities in ammonia.

"(*b*) Mar. 4. Speculum dewed on uncovering. *Regulus.* Prodigious light; star disc, neat, small and round; γ Leonis very well defined with 360. After some hours, Fahrenheit 23°, *the stars flared.* ε Boötis very indifferent.

"(*c*) March 12. On first uncovering mirror stars very well defined, but they became blotty as the cold increased to 24·5°.

"(*d*) March 15. ξ *Ursæ Majoris* examined with a series of zone discs 6in. broad. All star images unexceptional, and of the same focal length except with outermost zone, when if it was thrown out of focus, irregularities show that the outer zone surface is not quite true. γ Virginis well seen with the whole aperture, as also the photosphere of 8 Canum.

"(*e*) Jan. 30, 1848. *i* Cancri fairly seen through a bad night.

"(*f*) Feb. 10. Speculum had been repolished. Air very unsteady, yet parts of nebula in Orion are distinctly resolved and *a 7th star in Trapezium* is well seen.

"(*g*) Feb. 11. Air unsteady, but the bottom of the ring-mountain Albategnius is covered with minute asperities with 360; but nothing of them can be seen in the three foot.

"(*h*) Feb. 20. The resolution of the flocky part of Orion's nebula cannot escape any eye, several of the stars being rather large; but what is most curious, besides the 7th star of the Trapezium seen on Feb. 10, there is an 8th, both quite conspicuous. Jupiter, a wonderful object, its antarctic and, still more, its arctic zones are brown, but far less so than the belts. The south belt is much darker than the other; both have a striated appearance, and are darkest in the centre, fading away towards the end of the planet.

"(*k*) March 11. High wind, good definition. ξ *Ursæ*, well shown with 400 to 720. Telescope unsteady, north wind. M 97 shows two internal spirals. At 4 a.m. the night changed, but ε Böotis was pretty good with 400.

"(*l*) March 12. The lunar mountain Aristillus has its cone covered with sharp radiating ridges from near the Crater's rim to its base.

"(*m*) The *thinner* speculum. Night very bad. Intense aurora. Saturn too low and too far past meridian. Only five satellites seen. Ansæ of Ring seen fairly, though the minor axis is only 0·80″. Four belts on the planet. I had little hopes of doing anything with γ Andromedæ on such a night; but with 360 the blue star was elongated and separated by glimpses. Mr. G. J. Stoney drew it elongated in the right direction, which he had not previously known.

"(*n*) Oct. 20. The instrument performs well on α Andromedæ and β Ceti. Both well defined. Saturn also. A satellite threaded on one of the Ansæ, γ^2 Andromedæ fully separated with all powers. With 1447 the interval was a full diameter of the blue star, and the three discs were very small.

"(*o*) Set for level on double star 38 Piscium. It showed only a monstrous flare, and I thought some accident had happened to the speculum; but I found it was owing to a shift of wind bringing the hot air across the telescope from the chimney of the calculating room. When that ceased the stars were like points.

"These facts are, I think, sufficient to satisfy any unprejudiced person that Mr. Proctor's disparagement of this telescope is groundless. The extracts prove that for (*b*), (*c*), (*h*), and especially (*n*), the definition was of a very high order; (*b*) and (*c*) show the effects of temperature. *a* and (*d*) show your father was not content with a speculum merely because it acted well, but carefully examined its figure and polish, and repolished it without remorse if he found any error. The public have little notion of the amount of labour which this implies, and most persons would have tolerated a slight defect rather than incur it. Even on indifferent nights I never saw anything like what is described by the foreign astronomer. It is possible that the small mirror may have been out of adjustment. This we always looked to.

"Several of the extracts (*m*) in particular prove that even on bad nights the telescope had an amount of definition scarcely to be expected from so large an aperture. If the foreigner's visit occurred during the winter, and the wind was anything north of east, the hot air from the chimney (of the observatory) would certainly have interfered with vision. But be this as it may, many years' experience assures me that this solitary instance must have been quite abnormal, and I think it reflects some discredit on our age that anyone should, on such slight warrant, have tried to blight the laurels of the dead.*

"(Signed) T. R. ROBINSON.

"To Lord Rosse."

To Mr. Stoney Lord Rosse entrusted the charge of the observatory from 1884. His Report, dated April 2, 1878, has a vivid interest. He says:

[ABRIDGMENT.]

"My Lord,

"About two out of three of the mirrors were good working mirrors—i.e., mirrors which possessed defects very much below those arising from the state of the atmosphere on an average working night.

"The tests usually applied were the performance upon the 8th, 8½, or 9th magnitude, under a power of 750. They are usually seen as balls of light, like small peas, violently boiling from atmospheric disturbance. If the night is good there will be moments now and then when this disturbance will abruptly seem to cease for a fraction of a second, and the star is seen for an instant as the telescope really presents it.

"Lord Rosse generally occupied a few days first of all in practising on the 3ft. mirrors, thus gaining valuable data for manipulating the 6ft. ones. These weighed about seven tons with the carriage. When tested, it sometimes turned out either the figure was unsatisfactory, or some inaccessible *pinch* had arisen. Some of the mirrors bore the most severe tests without betraying any defect. With the best of your father's mirrors the appearance (of a star) was like that of the light shining through a minute needle-hole in a card placed in front of a flame. But unless the adjustments were most carefully attended to, the effect of raising the telescope was utterly to so impair the image as utterly to defeat the object in view, testing. . . . . Referring to γ Andromedæ, Mr. Stoney says that the blue companion appeared like a single bright mass of blue light, boiling violently some seconds in diameter. On the best nights, this patch of bright blue light was sufficiently small as often to be oval, and on one night remained persistently oval. Then, for an instant, Lord Rosse's best mirrors. The companion would instantly become two very minute round specks of white light, with an interval between them about equal to the diameter of either of them. They then looked like two very small needle-holes in a card. The appearance would frequently recur, though it never lasted for more than a very short period on each occasion. It is, of course, the appearance which the instrument would have furnished uninterruptedly if the state of the air had permitted.

"(Signed) G. JOHNSTONE STONEY.

"The Earl of Rosse."*

These two letters are conclusive. Four mirrors were in use; and these were nearly always, one or the other, being repolished, i.e., more or less refigured. It was a great chance against any casual visitor that a given mirror should be at at its best estate. These facts are pregnant. If mirrors of metal alloy so readily tarnish, and require repolishing, i.e., refiguring, an infinite amount of labour is saved by silver-on-glass, because the glass surface, once truly figured, is figured once for all. The resilvering is a small matter, and the polishing a simple one. Again, then, precise agreement as to difficult testing on minute double stars demonstrates the possibility of even a 6ft. mirror being truly figured right up to the edge. Referring now to the Grubb 4ft. with mirror (B), the same star γ Andromedæ was employed at Dublin, and with precisely the same beautiful result, when transcendent definition was possible. At Dublin it was clearly divided with 350 and 450 (negative eyepieces). The different tints also of the components were also evident. One other remark. Even in Ireland the number of nights when a 3ft. mirror can be used with success is very small. It is said that the difficulties of definition in telescopes vary as the cubes of their aperture. A 6ft. telescope would, therefore, increase the difficulty *eight times.*

It appears wonderful, then, that a 6ft. mirror can be made to perform so admirably. A 4ft. glass should, therefore, be capable of fine definition were its figure adjusted to the ordinary remperature of the site. We have seen how a fall in the thermometer to 23 deg. Fahrenheit ruined the definition of the 6ft. on a very fine night. I wish, th fore, to lay great stress on the necessit advisability of substituting glass for sp metal at Melbourne; and, finally the mirrors as nearly perature of the site and

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* Scientific Trans. of the Royal Dublin Society, Vol. II. New Series.

* Appe

ASTRONOMICAL NOTES FOR NOVEMBER, 1885.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination South.	Sidereal Time.
	h. m. s. a.m.	h. m. s.	° ′ ″	h. m. s.
1	11 43 40·87 „	14 27 26	14 35 7	14 43 44·79
6	11 43 46·15 „	14 47 14	16 7 45	15 3 27·56
11	11 44 12·39 „	15 7 23	17 33 38	15 23 10·33
16	11 44 59·46 „	15 27 53	18 51 56	15 42 53·11
21	11 46 6·96 „	15 48 43	20 1 48	16 2 35·89
26	11 47 34·29 „	16 9 53	21 2 29	16 22 18·67

The method of finding the Sidereal Time at Local Mean Noon at any other Station will be found on p. 355 of Vol. XL.

Signs of solar activity in the shape of spots and faculæ are still visible.

The Moon

Is New on November 6th at 9h. 2·7m. p.m., and enters her First Quarter at 9h. 59·6m. on the night of the 14th. She will be Full at 9h. 39·2m. a.m. on the 22nd, and enter her Last Quarter at 1h. 57·1m. in the early morning of the 29th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	24·2	7 19·8 a.m.
6	29·2	11 29·5 „
11	4·6	3 34·9 p.m.
16	9·6	7 21·6 „
21	14·6	11 27·3 „
26	19·6	3 24·3 a.m.

The Moon will be in conjunction with Mars at 4 a.m. on the 1st; with Jupiter at 9 a.m. on the 3rd; with Mercury at 9 p.m. on the 7th; with Venus at 8 p.m. on the 10th; with Saturn at 11 p.m. on the 24th; once more with Mars at 9 a.m. on the 29th; and again with Jupiter at 11 p.m. on the 30th.

Mercury

Is an Evening Star during the whole of November, but is very badly placed for the observer on account of his great and rapidly-increasing South Declination. He attains his greatest elongation East of the Sun (21′ 14°) at midnight on the 30th. His angular diameter increases from 4·8″ on November 1st to 6·4″ by the 30th.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	15 5·7	18 24·8	0 21·9 p.m.
6	15 36·6	20 51·0	0 33·0 „
11	16 7·7	22 51·6	0 44·5 „
16	16 38·9	24 23·6	0 55·9 „
21	17 9·6	25 23·8	1 6·9 „
26	17 38·6	25 49·4	1 16·1 „

The path shown by the Ephemeris above commences in Libra, crosses Scorpio and the southern part of Ophiuchus, and terminates in Sagittarius. He will not approach very near to any conspicuous star. He will be between [illegible] and 3° North of Antares on the night of the [illegible]th.

Venus

Evening Star, too, but even in a worse [illegible] the observer than Mercury. Her [illegible] 17·6″ on November 1st, in- [illegible] 30th, and her gibbous [illegible] one.

Occultations of Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
17	B.A.C. 8365	6½	10 41 p.m.	Dark	140	166	11 44 p.m.	Bright	266	298
22	θ^1 Tauri	4½	6 29 „	Bright	73	33	7 17 „	*Dark	313	272
22	θ^2 Tauri	4½	6 38 „	Bright	46	6	7 9 „	*Dark	340	299
22	75 Tauri	6	6 49 „	Bright	173	133	7 8 „	*Dark	213	172
22	B.A.C. 1391	5	7 18 „	Bright	101	60	8 17 „	*Dark	285	246
22	Aldebaran	1	9 48 „	Bright	107	75	10 57 „	*Dark	278	257
23	117 Tauri	6	5 59 „	Bright	66	29	6 42 „	Dark	310	271
24	130 Tauri	6	2 52 a.m.	Bright	70	92	3 58 a.m.	Dark	290	323
24	26 Geminorum	5½	10 59 p.m.	Bright	92	54	12 6 p.m.	Dark	271	241
26	1 Cancri	6	5 40 a.m.	Bright	78	107	6 46 a.m.	Dark	255	292
28	48 Leonis	6	‡10 34 p.m.	Bright	109	73	§11 18 p.m.	Dark	224	186

* But seemingly bright. ‡ Star below the horizon. § Star rising.

Venus.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	17 30·2	25 50·0	2 46·1 p.m.
6	17 55·7	26 9·0	2 51·8 „
11	18 21·1	26 10·3	2 57·4 „
16	18 46·1	25 54·2	3 2·7 „
21	19 10·6	25 21·3	3 7·5 „
26	19 34·4	24 32·5	3 11·5 „

Thus Venus starts from a point on the southern confines of Ophiuchus and Sagittarius, and is travelling through the latter constellation during the entire month. The star to which she will approach nearest is the 5-4 mag. one, h^2 Sagittarii, a few minutes North of which she will be found on the evening of the 25th.

Mars

Is a Morning Star; but he rises a little before midnight at the beginning of November, and, of course, appears above the horizon sooner and sooner every night. The diameter of his very notably gibbous disc increases from 6·8″ on November 1st to 8·2″ on the 30th; so that even then he is but an inconspicuous object, and one of but small interest in the telescope.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	9 56·1	14 20·3	7 13·1 a.m.
6	10 6·3	13 30·5	7 3·7 „
11	10 16·3	12 40·8	6 54·0 „
16	10 25·9	11 51·8	6 43·9 „
21	10 35·2	11 3·7	6 33·5 „
26	10 44·2	10 16·8	6 22·8 „

Hence it will be seen that the path of Mars in November lies wholly in Leo, starting from a point to the North and West of Regulus, and trending in an easterly and slightly southerly direction in the constellation referred to.

Neptune

Is visible from dusk till dawn, and is as well placed as he can be for the observer whose possesses sufficient optical power. He comes into opposition to the Sun at 8 a.m. on the 16th.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 30·7	17 11·3	12 44·8 p.m.
6	3 30·1	17 9·3	12 24·6 „
11	3 29·5	17 7·2	12 4·4 „
16	3 29·0	17 5·2	11 44·2 „
21	3 28·4	17 3·1	11 23·9 „
26	3 27·8	17 1·1	11 3·8 „

This very short retrograde arc lies wholly in [illegible]ery barren region indeed in Taurus.

Jupiter

Will scarcely come into the view of the observer for whom these Notes are intended until next month.

Saturn,

Though still a Morning Star as regarded with reference to his time of Southing, is practically visible all night long, rising between 7 and 8 p.m. at the beginning of November, and between 5 and 6 at the end of it. As we remarked last month, his ring system is now almost as much open as it possibly can be; and he offers an all-repaying spectacle in a telescope of adequate power. The equatorial diameter of the ball of the planet increases quite imperceptibly from 17·6″ on November 1st to 18·3″ by the 30th.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	6 35·8	22 17·7	3 53·4 a.m.
6	6 35·2	22 18·2	3 33·2 „
11	6 34·5	22 18·9	3 12·8 „
16	6 33·6	22 19·8	2 52·2 „
21	6 32·5	22 20·8	2 31·4 „
26	6 31·2	22 22·0	2 10·5 „

So that Saturn continues to form a triangle with ε and ζ Geminorum.

Uranus

Is too near the Sun to be seen.

Shooting Stars

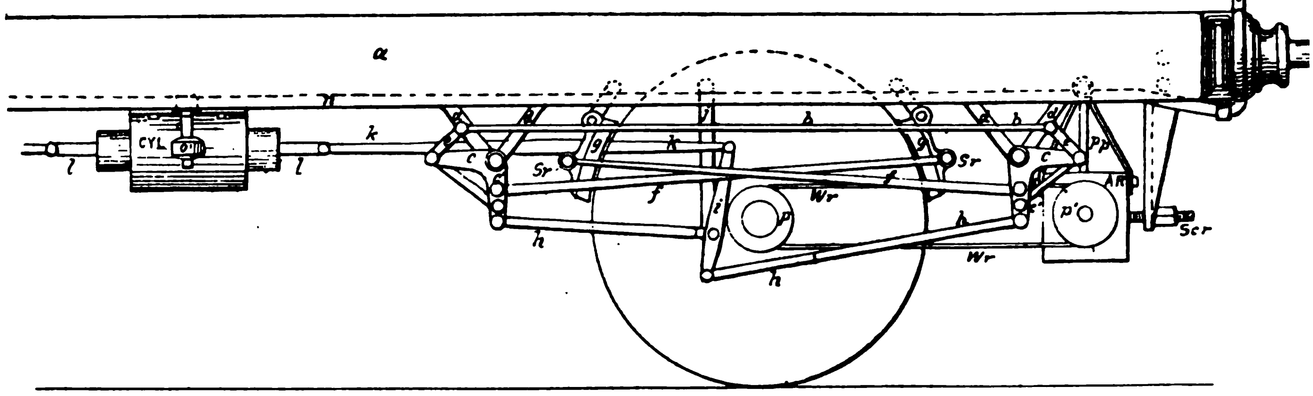
Should be watched for on the nights between the 12th and the 15th inclusive, and again on the 19th, the 28th, and the 30th. It may be necessary to reiterate here that it is useless for the observer to begin his vigil on the first-named nights until after midnight, when that part of the constellation Leo whence they seem to radiate appears above the horizon. The Moon will this year fortunately interfere but little with these observations. How Professor Adams showed the identity of the orbit of these "Leonids" with that of Tempel's small comet of 1866, has been told too often to need repetition here.

Greenwich Mean Time of Southing of Sixteen of the Principal Fixed Stars on the Night of November 1st, 1885.

Star.	Souths.
	h. m. s.
α Cygni...	5 52 49·75 p.m.
α Cephei	6 31 3·27 „
α Aquarii	7 14 59·07 „
ζ Pegasi	7 50 44·42 „
Fomalhaut	8 6 15·93 „
Markab...	8 13 59·17 „
γ Cephei	8 49 34·47 „
δ Sculptoris	8 57 46·05 „
α Andromedæ	9 17 14·09 „
α Cassiopeiæ	9 48 42·99 „
β Ceti	9 52 30·10 „
Polaris	10 32 41·10 „
α Arietis	11 15 9·92 „
α Ceti	12 10 34·96 „
α Persei	12 30 24·56 „
η Tauri...	12 54 42·07 „

The Method of finding the Greenwich Mean Time of Southing of either of the Stars in the

FIG. 1.



above list for any other Night in November, as also that of determining the Local Instant of its Transit at any other Station, will be found on p. 356 of Vol. XL. It must, however, be noted that the first of these rules is not rigidly accurate when applied to Polaris and other close circumpolar stars (nor even, in fact, to a star like γ Cephei), although it will probably be found quite sufficiently so in practice.

A NEW AUTOMATIC BRAKE.

A NEW automatic brake, which has been worked out with care and many experiments made at St. Margaret's Railway Works, Edinburgh, has been recently exhibited in model form in London, and will probably be on view at the Inventions Exhibition by the time these lines are read. We have previously mentioned the fact that the brake was being tried, and Messrs. Sloan and Hawks having, as they believe, perfected it, are now introducing it to the notice of all interested. To describe the brake briefly, it may be said that the weight of the carriage is utilised to force the brake-blocks on the wheels, and either compressed air, a vacuum, or water pressure can be utilised to keep them off. It will thus be understood at once that the system is automatic, and that the blocks are applied to the wheels when anything goes wrong to such an extent as to relieve the pressure in the train pipes. The system, however, presents many other points deserving of attention—not the least of which is that the brake-block pressure is always proportional to the pressure of the wheels on the rails, whatever may be the variations in the load. The retarding effect is thus, as it should be, proportional to the weight of the train, and by the arrangements adopted there is a uniform skidding point, depending entirely on the weight carried by each pair of wheels. In existing systems the brake-block pressure is approximately equal throughout the train, and each wheel is pressed with equal force whatever may be the load of the carriage. In the system now introduced actual skidding is avoided by means of an automatic regulator which is operated by the movement of the axle, and reduces the block pressure before the skidding point is reached. The advantage of the new automatic brake which will, perhaps, attract most attention, from the directors of railway companies, is the fact that existing gear can be utilised, as will be seen from Fig. 1 annexed, which represents the application of the new method to a pair of wheels fitted with Westinghouse gear and the extra parts. The bell crank *c c'* may be called central to the mechanism on each half of the carriage, because from it radiate connections to four main parts—viz., the frames, the bearing springs, the brake blocks, and the brake cylinder and valve. The reservoir beneath each coach is dispensed with; but the brake cylinder is retained with preferably a simpler valve, though the famous "triple" can be utilised if necessary. The bell crank is joined to the frame *a* by the stay or spring carrier *d d*, to the top plate of the spring *b* through the link *e*, to the brake block *s* by the pull rod *f* and its cross tie *s*, and to the brake cylinder, by the diagonal rod *h*, the vertical lever *i*, its hanger *j*, push-rod *k*, and the piston rod *l*. The parts *c c'* and *f* (the cranks and rods) are the new portions which have no counterpart in existing gear. It will be noticed from the way in which the bell cranks are linked to the bearing springs that the brake blocks are applied to the wheels by the weight of the carriage and its load, and are always kept there, unless, as is shown in the illustration, there is pressure in the cylinder, which, acting upon the pistons, and through the gear, forces the blocks off the wheels. The dual valve which connects the brake cylinder with the train pipe is an ingenious device, in which a rubber slab or disc forms the valve proper. With the pressures in equilibrium, the rubber disc, the edge of which is free to move to a certain extent, closes the eduction pipe or return pipe, as the case may be; but as soon as the pressure in the train pipe is reduced, the valve allows air to escape, and the blocks are pressed to the wheels with a force regulated by the difference in the pressure of the fluid on the two sides of the rubber disc. When water is used, as is contemplated, the released water is returned by a second pipe. The automatic regulator is also an ingenious device which effectually controls the disturbing forces. There are variations in amount and distribution of load, momentum, block friction, vertical motion, and the effects of gradients. The variations of load may be as much as 40 per cent., say, in a third-class coach. Momentum and block friction shift the pressures from the hind to the front wheels, while vertical force creates a pitching motion, and disturbs the balance of the friction on the two pairs of wheels. These disturbing forces are under control in the system introduced by Messrs. Sloan and Hawks, mainly by means of the automatic regulator shown in Figs. 2 and 3. This apparatus is put into operation the moment skidding commences, and by easing the pressure of the blocks at once allows the wheels to revolve. Fig. 2 is an elevation, Fig. 3 a section through the centre of the axle of the regulator. P is the flywheel, P^1 the pulley for driving by rope, chain, or band, unless friction or other gear is adopted; p is the axle, and p^1 a sleeve bolted to the flywheel; qq is a cross-piece which is actuated by the sleeve on the flywheel, and imparts motion through q^1 to the spindle s of the valve t; r is a coil spring in the end of axle p, w sists the retarding effect of the air on wheel; and r^1 is a plate-spring which the pressure on q^1 arising from the ret by braking, with a balance of force normal operation of the regulator skidding. The automatic regulat operates on the brakes throughout t and will preferably be placed under th or footplate. By opening the valve block-friction nearly balances adhesio skidding is imminent), the air or water is allowed to act and the blocks are The regulator acts at all speeds f highest to the lowest. By a mecha rangement, the brakes on any coach readily released without affecting the o

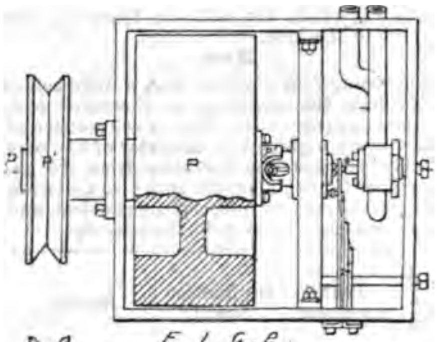


FIG. 2.

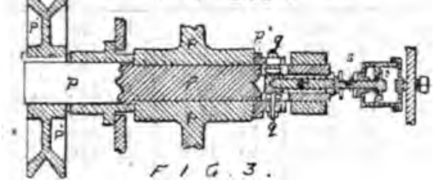


FIG. 3.

ON THE DURABILITY OF GEL NEGATIVES.

WET collodion negatives, ten and m old, are at the present time a printers as they were on the day made, large percentage of gelatine negatives, e those made when first bromo-gelatine appeared among us, go rapidly to destructi cause of this is, however, to be looked f the qualities of the plate or its mode of it, than treatment it is subjected to. condition to a durable gelatine negative i fixing. Two gelatine diapositives, one had been fixed for seven the other f minutes, were placed against a windo former has kept quite well, while the othe after the expiration of four weeks, to sh of yellow stains, especially on those part the film had been thickest—that is, wher much longer time to fix. These stains are in size, and turn darker from day to day. effects come to our notice almost daily whe ing for old negatives, and many of them h course of time become utterly useless. In o overcome these injurious effects I have adop new mode of fixing, which promises well. I pla negatives in a fixing soda solution, 1 : 8, in a ve position, and fix for seven minutes. A plate l flat in the fixing bath receives frequently a de of sulphide of silver, which settles firmly in body of the gelatine and gives the plate a granular appearance. Such deposits need be feared when the plate stands vertically being fixed. All precipitates will fall to the bo of the box, and are much easier kept from re ing suspended in the solution; besides, such b can be easily covered, which prevents a rapid copious formation of sulphide of silver.

A second condition is found in the mod developing. A regular and perfect develop and keeping an even intensity of the whole is easily accomplished when one is well acqu with the qualities of the plate used. compelled to intensify, mercury and ammonia been used. Plates of this description, and d back to the early time, have lost all strength are yellow. Placing them for a few days in sunlight, the image will disappear entirely. trying to remove the varnish the whole film b off in scales. A negative, the intensity of has been reduced, stands a much better than one having been strengthened, especially the reducing agents now so generally used and red prussiate).—CARL BETZ *in Archiv.*

MM. CAPELLO AND IVENS, the explorers, arrived [illegible] 'd last we received by a de[illegible] the graphical Societ infallibility save the Pope, and everyone who has done some original work must of necessity have made a certain percentage of blunders. I confess to my own share, and meet with those of others almost daily; but am content to agree with the illustrious Liebig that a man who never made mistakes never did any original work. Having said so much, let this spirit of carping hypercriticism die an ignominious death, and the columns of the English Mechanic be in future distinguished by a higher tone of courteous discussion than that of any other scientific periodical. **W. S. Franks.**

γ^2 ANDROMEDÆ.

[24038.]—Having been asked by several observers to state the present angle and distance of γ^2 Andromedæ (O Σ 38), I send a list of some of the latest determinations which I have noticed.

Hall	99·4°	0·32″	1880·04	(3^n).
β	107·9°	0·36″	1880·06	(1^n).
Eng.	93·1°	0·29″	1883·15	(7^n).
Perrotin	103·0°	0·40″	1883·88	(2^n).

The measures are as coincident as could be expected, considering the difficulty of the object. The present angle is probably about 96°; it has been decreasing at the rate of about 1° in every three years since its discovery, though, as Dunér remarks, the errors are enormous in some of the measures, and the distance probably does not exceed 0·35″, and is, I think, about 0·31″ or 0·32″. It would, therefore, require a telescope of 13½in. or 14in. aperture to satisfactorily divorce the components, though they can be seen elongated in a telescope of considerably smaller size. **H. Sadler.**

THE ANDROMEDA NEBULA.

[24939.]—"S. S." (letter 24903) inquires as a "final"—final what?—if the Nova is on the other side of the nebula, would it present "its decided and clear star-like outline"? I answer him, I do not know, and have formed no opinion on the position of the star, from want of evidence. I would only say further, that the old nucleus is not a star in the ordinary sense of that word.

I must protest that I made no lowering imputations, and attributed no motives of any kind to "S. S." His emphasis of the word "friendly" is quite uncalled for. I have no feeling in the matter but the desire for knowledge. His remarks about cultured criticism savour of personalities as a means of distracting attention from the main question.

I will endeavour to deal more fully in another letter with the question of Mr. Gemmill (letter 24908) as to what can or can not be done with a 2in. aperture.

His opinion that it is curious that on this question of aperture I should "pronounce an opinion," and "adduce evidence to show the opinion is ill-founded," only shows he forgot one may hold an opinion and yet see there is evidence against it. I may remark that a re-perusal of my letter of Oct. 9th fails to present anything but a consistent position on my part, as far as I can understand it.

Further, I did not "set" Mr. Gemmill "down"; I did not "sneer" at him; I did not assert that he "traversed" Mr. Burnham's opinion, nor did I "appeal to authority." It was Mr. Gemmill who introduced Mr. Burnham's name. Perhaps you will allow me to protest against Mr. Gemmill's epithets, and to assure him I have every respect for his abilities and opinions, and really regarded him as entitled to enter upon a discussion with Mr. Burnham on such a subject, from his experience and standing, which I certainly do not possess. Mr. Gemmill's opinions may be of some value; mine are confessedly of none.

Is not Mr. Garbett (letter 24905) wrong as to colour of Nova, 1885? I thought it began red, and has changed to blue, instead of, as he puts it, growing redder.

I should like to ask if it is not correct that nearly all the cases of discovery of spurious stars—stars which have no existence—such as the close *comites* of Polaris and Vega, central stars in Trapezium of Orion, &c., have been made with refracting telescopes.

Mr. Calver (letter 24912) will excuse me if I ask him to review his statement that a "star is practically the same size, whether it is viewed with a 3in. or 3ft. glass, or whether the power be 200 or 500." He will surely find this is wrong.

Will anyone enlighten us as to the want of colour-correction in the large so-called achromatics? Is or is not the outstanding colour very bad on a bright object with the Washington 26in. How does this affect the comparison? To me this is worse than anything about a reflector.

Edwin Holmes.

THE "RAPID MOTION" IN THE STAR IN THE ANDROMEDA NEBULA—μ^1 HERCULIS.

[24940.]—If Mr. H. Sadler (letter 24907) will be kind enough to take my words and figures as I wrote them, instead of endeavouring to read a meaning into them which they certainly do not contain, he would have no difficulty in understanding my meaning. The misprint in quoting Dr. Copeland's first measure of the Nova has already been explained by me. Mr. Sadler now assumes that my measures (expressed in seconds of arc) contained in my original letter to the *Times* were also misprinted. This was not the case; and if Mr. Sadler will convert Dr. Copeland's measure, expressed in seconds of *time*, into seconds of *arc*, and then compare it with my measures (expressed in seconds of *arc*), he will at once perceive the ground on which the suspicion of "rapid motion" in the Nova was founded. And I also must beg Mr. Sadler to give me credit for saying what I mean. I stated that I wrote a *second* letter to the *Times*, which did not appear. He now informs me that he thinks I am in error here, as this letter appeared in that journal on September 22nd. It is really wonderful that Mr. Sadler should know how many letters I wrote to the *Times* better than I do myself. The letter, which appeared on Septemper 22nd, happens to be not the *second*, but the *third* letter written by me to the *Times* on the subject; and now Mr. Sadler complains that I allowed nearly a month to elapse before withdrawing the suspicion of motion announced in my first letter. Allow me to assure Mr. Sadler that I did this in letter No. 2, as soon as I had time to settle the question by obtaining additional measures. This letter, as I have said, never appeared.

With regard to μ' Herculis my measures were:—

$$P = 284{\cdot}0^\circ \quad . \; D = 0{\cdot}4''. \quad \text{Ep. } 1885{\cdot}57.$$

Mr. Sadler now tells us that the calculated angle and distance of this difficult and rapid binary for 1185·5 are 285·6° and 0·8″. My angle is as close as possible to the calculated angle, and as to the distance it would be hair-splitting extraordinary to quarrel over it. The very slight loss of time which I detected (thanks to Mr. Sadler) in my micrometer about two years ago was duly rectified by me, and I have now no reason to suppose that it is untrustworthy.

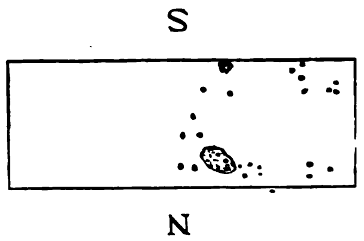
Jevon J. Muschamp Perry.

St. Paul's Vicarage, Alnwick.

SMALL v. LARGE TELESCOPES—NEBULÆ IN ANDROMEDA AND LYRA—48 CASSIOPEIÆ—RED STARS—DOUBLE STARS.

[24941.]—With nine-tenths, or, perhaps, it would be more correct to say ninety-nine hundredths, of Mr. Burnham's most admirable article, reprinted in your issue of the 9th October, I most heartily agree. What he says there about double stars needs no comment from me. In this branch of astronomy Mr. Burnham stands *facile princeps*, not only by reason of his discoveries, which far exceed in number and interest those of any living astronomer, but also by his scholarship; and there is little to add to what he has said on the questions raised in his paper, both now and on previous occasions. It would appear, however, from the letters of some of those who have written on the matter in your columns, since the article of Mr. Burnham appeared, that some misunderstanding exists as to the relative amount and value of the double-star work accomplished with refractors and reflectors. I can only repeat what I said in the Mechanic for January 9th of the present year, that out of nearly *six hundred* first-class pairs discovered during the present century, and visible in European latitudes, not *six* have been discovered, first of all, with a reflector, metallic or silvered-glass, and this in spite of the fact that scores of silvered-glass mirrors of considerable size, and large numbers of smaller ones, have been manufactured yearly for the last quarter of a century both in England and on the Continent. I do not think that I shall be accused of writing with any prejudice against reflectors, yet I may safely say that I have never yet seen measures of double stars made with reflectors of 10in. aperture or under, equatorially mounted, and driven by clockwork (so many of the reflecting telescopes manufactured of late years have been mounted), which can in any way compare in point of accuracy with the measures of Dawes, Herschel, South, Dembowski, and others, made with refractors of from 3¾in. to 5½in. aperture, often insufficiently mounted, and in no case driven by clockwork. Moreover, so far as I am aware, there are no measures of double stars extant, made with a reflector of any aperture, which can be compared with the measures of Dawes, Dembowski, Engelmann, or Schiaparelli, made with the aid of refractors of from 6½in. to 8½in. aperture. One of your correspondents asks whether more close pairs have been discovered *in this climate* with refractors than with reflectors. Dawes, who gave his attention chiefly, as Dembowski did, to the measurement of old pairs, found five first-class ones with refractors of from 6¼in. to 8¼in. aperture (three of them with 6¼in.), and he and Alvan Clark found seven or eight pairs at Hopefield of the kind of which 44 Cygni is a type, only one example o which (Herculis 206) has ever been found with reflector. Many close pairs have been discovere at Pulkova and Dorpat, where the seeing ca hardly be better than in England. As for plan tary definition, I have never yet seen drawings c Mercury, Venus, Mars, or Saturn made wit reflectors which have shown more detail than tho of these planets by Vogel, De Vico, Dawes, Schi parelli, Sentini, or Schmidt, all of whom use refractors, and, with the exception of Vogel, c 8½in. aperture, or less. May I be permitted to r mind Messrs. Franks and Vallance that M Burnham is an *amateur*, and not a profession astronomer, and that his work has been a labour c love throughout.

As Mr. Capron and Mr. Ward are writing abo the "Cycle" drawing of Messier 31, it may intere them if I send a copy of the original drawin from which the one on page 15 of the Bedford Cat logue was enlarged.



Dr. Royston-Pigott (letter 24880, page 138) i in error in supposing that Sir J. Herschel used flat with his 18¼in. speculum, as it was of th front-view construction; and the drawings mad with it are not inverted as ordinary astronomic drawings are; hence the star Dr. Pigott speaks o as preceding 57 M Lyræ is really the well-know little star *f.* it. If Dr. Pigott will refer to th English Mechanic for October 13th, 1882, h will find a rough copy of Lassell's beautiful dra ing with the 4ft. mirror. In my copy of this th star *f.* the nebula, the one figured by Herschel, i marked "2" instead of "1." If Dr. Pigott ca see any stars *nearer* the nebula than the "ring" o stars I refer to, they are new discoveries, as n others can be seen with Lord Rosse's telescopes o the 26in. at Washington. The stars 5 and 6 for a delicate little pair, which was seen with gre difficulty with the 3ft. at Parsonstown.

In reply to Mr. Tarrant (letter 24906, page 156) the following are the latest measures I have see of 48 Cassiopeiæ (β 513). Eng. 269·7° : 1·06″ (5^n) 1883·78. The two nights' observations in 188 give 266·6° : 0·955″ : 1884·23. Change is not ver marked. I presume that the proper motion Mr. Tarrant mentions is the one I sent him—viz. Mädler's. I am very busy at present; but when I have a little leisure I will make a fresh observation, using Auwers's Bradley, and recent observations of 48. I cannot say how many double stars have been discovered in England, because I do not know whether Mr. Tarrant reckons Herschel's, Smyth's, or South's wide pairs as double stars. Bird was uncertain as to the actual character of his pair near Procyon for some time; it was discovered independently by De, and by β with 6in. The distance is about 0·85″, and it is therefore a first-class pair.

In answer to Mr. Gemmill's query about Bessel's observations of red stars (letter 24840, page 108) I would say that, judging from the entries i Schj's catalogue copied into Birmingham, I shoul infer directly the opposite to what he does. I hav not time to go over the Königsberg observations but I can only count seven or eight instances i Birmingham of Bessel having called stars red but supposing, however, that there are ten suc instances, that would only be one in every 7,00 stars observed by Bessel, or proportionately thirt stars for the whole heavens, which does not see an excessive number. The telescope of Bessel circle was 4¼in. aperture, and bore a power of 1 and it was, therefore, comparable with Birmin ham's telescope. Either, as I have said, Bes preferred to observe the brighter star, No. 5, just before the triangle entered the field, Bes observed to his assistant, "Stop a minute, Arg lander, my pipe is out again," and hence the r star escaped observation. I do not know th Bessel was in any way colour-blind to red, thoug this was the case with Karl Von Littrow, the la director of the Imperial Observatory at Vien who could not see any difference in colour betwe Antares and Vega; whereby hangs a tale. my request Birm. 464 has been lately observed Dunsink, and Dr. Dreyer sends me the followi determination of its place for 1880·0:—18h. 4 49·13s—8° 2′ 38·9″. This agrees admirably with th determination of Lamont's I have given in lett 24539. When comparing observations of colour pairs, such as 57 Aquilæ, it should be remember that most of the determinations of magnitude an colour, by the older observers at any rate, we

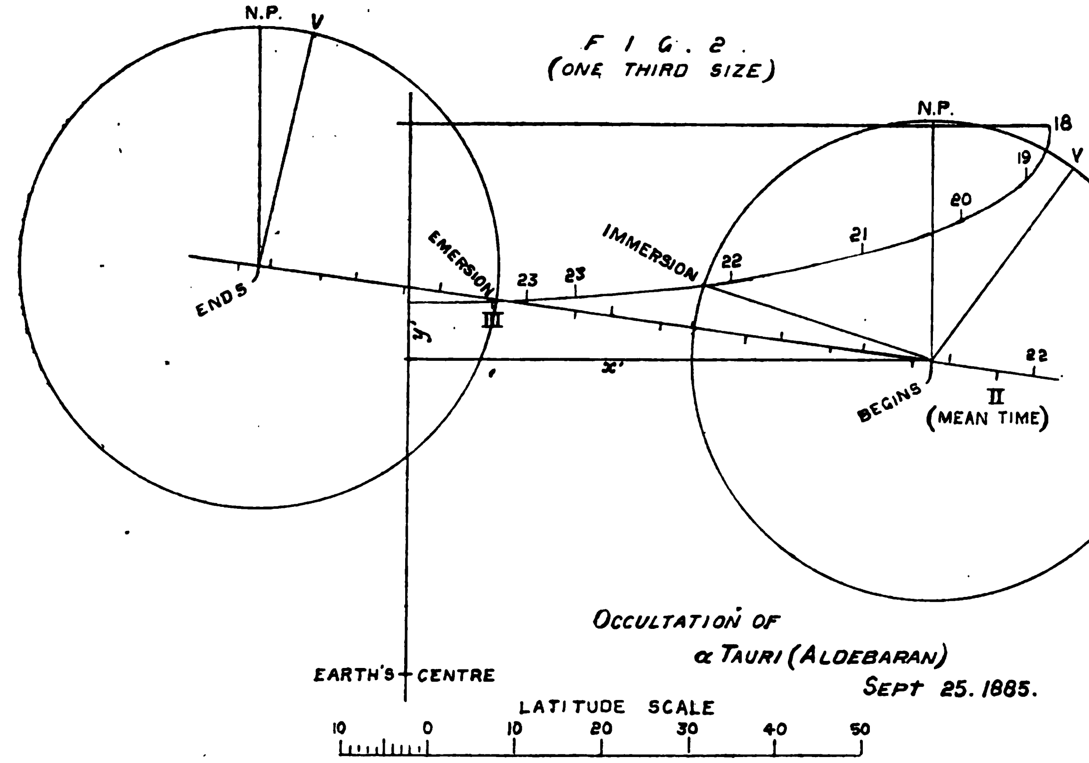


FIG. 2.
(ONE THIRD SIZE)

OCCULTATION OF α TAURI (ALDEBARAN) SEPT 25. 1885.

made with illuminated fields, and with micrometer eyepieces, which were not always achromatic. Sir W. Herschel gave the colours of 57 Aquilæ as white, white inclining to red, 1781, Oct. 29; South, both bluish, July and August, 1823; Struve, egregie albæ, 1822, 1831, 1833, 1835: Prof. Maria Mitchell, both yellow with greenish tinge, smaller greener, 1859, Oct.; Main, whitish, blue, 1861·73. both brilliant white, 1865·75, 1867·64, 1869·61; De, aūrea chiaro, azzurra chiaro (colori certissimi) 1868·68, bianche 1872·54, bianca gialla chiaro, bianca azzurra chiaro (colori certi) 1872·69. I have given some instances of the discrepancies in the colours recorded by different observers at the same time in the ENGLISH MECHANIC for Nov. 15, 1878. The present distance of μ Draconis is about 2·40."

The following are the latest measures of the pairs Mr. Gore inquires about (letter 24911, p. 160):—
Σ 388. De 208·9°: 3·00" (3n) 1865·05. Struve's angles, as he points out in the "Corrigenda" to the "Mensuræ," are 100° too small.

φ Ursæ. (OΣ 208) Eng. 139°, less than 0·2" (4n), 1882·19. 150°—183°? 1883.

The two stars have not been seen separated during the last twenty-five years. Casey gives a period of 115·4 years.

OΣ 235. Eng. 64·8°: 1·264 "(5n) 1884·54. Doberck gives a period of 94·4 years. The R.A. for 1880 is 11h. 25m. 31s.

OΣ 387. Eng. 5·5°: 0·400" (6n) 1883·13. Sch. 11·3°: 0·40" (3n) 1880·67.

β Centauri should be expunged from Mr. Gore's list of parallaxes on page 140, as Maclear's value is quite unreliable, and even Moesta's (0·213") is too large; the Cape heliometer observations giving only a negative result. The parallax of Lal 21258 is Krüger's, and that of 1830 Groombridge the mean of several different determinations; they are only *quoted* by Gyldén in his paper "Ueber die mittlere Parallaxe der Fixsterne erster Grösse."

In the little list I gave on page 197 of Vol. XLI. Œltyen is misprinted for Œltzen, δ Draconis for σ Draconis, and ε for e Eridani.

October 24. **H. Sadler.**

THE TELESCOPE.

[24942.]—I HAVE been much interested in perusing Mr. Calver's letter on the subject of "Reflectors, and their Comparison with Refractors." But his remarks in the fourth paragraph, that the effect of the plane mirror (cutting out the central rays) is to cause the diffraction *rings to be less*, I do not understand. I had always thought that the stopping out of the central rays caused the disc of a star to be smaller, certainly, but at the same time would *increase the rings* sursurrounding the star.

Dawes wrote, respecting the use of a central disc on the object-glass:—"The use of a central disc on the object-glass having been suggested to me by Sir John Herschel for the purpose of diminishing the images of the stars, I have frequently employed one from an inch to an inch and eight-tenths in diameter. . . ." The separating power of the telescope is increased; but the concentric rings accompanying bright stars are multiplied, and rendered more luminous, and are also thrown further from the disc. Hence, small stars may often be obscured or distorted by the ring passing through them."

The plane in reflectors must surely have the same effect. **Herbert Ingall.**

Champion Hill, S.E., Oct. 24.

A NEW METHOD FOR COMPUTING OCCULTATIONS OF STARS AND PLANETS.

[24943.]—I NOW desire to lay before your readers a new method which I have recently devised for computing, by a partially-graphic process, occultations of stars by the moon. The method, I may say, is founded on that of the Rev. James Pearson, M.A., F.R.A.S., which has already been described in these columns, and the chief merit I claim for my method over his is its extreme simplicity and the great rapidity with which accurate results can be obtained, the mathematical part being reduced to a minimum, thereby also reducing the time consumed and the liability to error. In fact, the computations can be made in *one-fourth* the time required by Pearson's method.

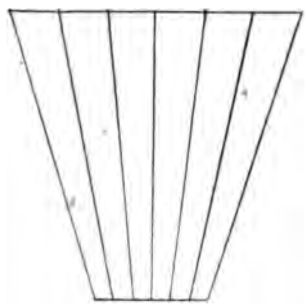
My method consists of two "elements," computed directly from the "Elements for the Prediction of Occultations" given in the American *Nautical Almanac*, and a diagram constructed from those elemetns.

I will first describe the process, and then illustrate it by a practical example.

First, the mathematical part:—

The first thing to be done is to construct a scale of equal parts to be used when making the diagrams, the number of inches equal to ten (10) divisions of the scale being found by multiplying the cosine of the geocentric latitude of the place of observation by the radius of the earth at the same place, and dividing unity by the amount so found. This scale is *invariable* for all calculations involving the latitude of the place for which it was constructed, and the quantities X, Y, x^1, y^1 and the moon's semi-diameter express the number of divisions of this scale to be taken in making the diagrams.

FIG. 1.



Then by Element I., we find the local mean, standard, or sidereal time of geocentric conjunction in right ascension of the moon and star, and the star's hour angle. These are easily computed in the usual way.

And by Element II., we find X = the distance of the centre of the ellipse, which forms the projection of the parallel of the star's declination, and Y = the distance of the moon's centre above or below the centre of the earth, as represented in the diagram. X is equal to the sine of the geocentric latitude multiplied by the radius of the earth multiplied by the cosine of the star's declination, multiplied by 100; and Y is equal to the quantity Y as found in the Almanac, multiplied by 100. Both the moon and the centre of the ellipse will be *above* the centre of the earth when the moon culminates south of the zenith in north latitudes, and north of the zenith in south latitudes; and *below* it when the moon culminates north of the zenith in north latitudes, and south in south latitudes. We also find x' and y' the moon's hourly motions in right ascension and declination respectively, which quantities are equal to the quantities x' and y' as found in the Almanac, multiplied by 100. And, lastly, the moon's semi-diameter is equal to 27·23 divisions of the scale, and is invariable for all latitudes and occultations. This completes the mathematical part, which, compared with Pearson's, is remarkably short and simple. It will be seen that one does not have to calculate a scale for each separate occultation, the scale in my method being alike for all, and variable only with a change of latitude; nor does one have to calculate the moon's horizontal parallax, semi-diameter, difference of declination of moon and star, or hourly motions. And for finding X a table may be easily prepared, whereby that quantity can be obtained by inspection or interpolation.

Second, the graphic part:—

The star's apparent semi-diurnal path will be represented in the diagram by a semi-ellipse, the semi-major axis of which is always 10in. long, and the semi-minor axis of a length equal in inches to the sine of the star's declination multipled by ten. (The semi-major axis of the ellipse may be of varying lengths, according to the latitude, while the scale remains invariable, as suggested to me by Mr. Wm. Bellamy, of this city; but this plan is open to the very serious objection that a new ellipse with different co-ordinates must be made for every change of latitude, which practically limits the observer to calculations for his own observatory.) This semi-ellipse is divided into hours and minutes, ranging from XVIII. hour at the right-hand end of the major axis to 0 hour at the minor axis (which represents the meridian of the place), thence to VI. hour at the left-hand end, whereby the exact place of the star is shown for any moment, and the semi-ellipse must be placed *above* the major axis when the star's declination is south, and *below* it when north. The moon's path is represented by a straight line, the direction of which is found by means of the two quantities x' and y', the direction of the former being parallel to the major axis of the ellipse, that of the latter perpendicular to it, the moon ascending or descending as indicated by its motion in declination. The moon's path is also divided on one side into hours and minutes to show the place of the moon's centre at any moment, one hour being exactly equal to the length of the hypothenuse of the right-angled triangle formed by the quantities x' and y', letting the time as indicated by the star's hour angle fall at that place on the moon's path where it intersects the meridian or minor axis of the ellipse. The places where the moon's path and major axis of the ellipse intersect the meridian must be as indicated in Element II.

The times of immersion and emersion may now be found as follows:—Take an extent equal in length to the moon's semi-diameter (27·23 divisions) and so arrange the extremities of this line that they shall indicate exactly the same hours and minutes both on the ellipse and the moon's path. Then, again, divide the moon's path (this time on the other side) into hours and minutes, as before; but letting the local mean standard or sidereal time of geocentric conjunction fall at the meridian instead of the star's hour angle. Circles may now be drawn to represent the moon at immersion and emersion, and the north points and vertices marked. The north point is in a direction perpendicular to the major axis of the ellipse; the vertex is found by drawing a line from the moon's centre parallel to a line joining the earth's centre and the star. The angles, which the lines joining the moon's centre and the star at immersion and emersion make with the north points and vertices, may now be easily measured.

To facilitate the drawing of the diagram, one should supply himself with: 1st, a system of concentric semi-ellipses drawn on thick card, the common semi-major axis being 10in. long, and the semi-minor axes of lengths equal in inches to the sine of the star's declination multiplied by ten. Thus, 2° = 0·349in., 4° = 0·698in., 6° = 1·045in., &c., up to 30° = 5·000in. The ordinates to these ellipses corresponding to the hours have abscissæ equal in inches to the sines of 15° multiplied by ten; 30° multiplied by ten; 45° multipled by ten, &c. Thus, hours XXIII. and I. = 2·588in.; hours XXII. and II. = 5·000in.; hours XXI. and III. = 7·071in.; hours XX. and IV. = 8·660in.; hours XIX. and V. = 9·659in., and hours XVIII. and VI. = 10in., all measured from the minor axis of the ellipse. These may be subdivided into intervals of ten minutes by drawing ordinates to abscissæ of lengths equal to the sines of 2½° multiplied by ten; 5° multiplied by ten, &c. The construction of this system of ellipses is not a matter of much difficulty, and once done it is good for all time. To use it, lay the paper on which it is desired that an ellipse be drawn on it, and the system of ellipses being seen through the diagram paper, the one required may be easily and accurately interpolated, as only a small portion of it (about two hours) is required in practice.

Second, two diagrams for subdividing any interval, one like Fig. 1, 10½in. across the top, and 8in. across the bottom; the other similar, 4in. across the top, and 1in. across the bottom; but divided into ten parts.

I will now illustrate my method by computing the circumstances of the occultation of α Tauri (Aldebaran) 1885, Sept. 29th, for Boston, latitude 42° 21′ 28″ N.; longitude 0h. 23m. 58s. E. from Washington. Let us, then, first find the number of inches equal to ten divisions of the scale, thus: Cosine geocentric latitude, ·74120 × radius ·9985 = ·7401, and 1·000 ÷ ·7401 = 1·351 the number sought. Or the same result may be much more easily obtained by logarithms, thus—

Log. cosine geographic lat. = 9·86861
*Log. correction = 0·00066

Subtract 9·86927
From 10·00000

Equals, as before, 1·351 = 0·13073

(* For a table of these corrections see English Mechanic, Vol. XLI., page 323.)

Then from the *Nautical Almanac* we take and compute—

ELEMENT I.

h. m. s.
Wash. M.T. of ☌ = 14 45 30
Difference of long. = 0 23 58

Local M.T. of ☌ = 15 9 28

Diff. of long. = 24 23 58
Wash. hour angle = 1 10 54

*Local hour angle = 23 13 4

(* Hour angles must always be considered positive—i.e., *past* the meridian.)

And for—

ELEMENT II.

we compute X thus: Sine geocentric latitude, ·6718 × radius, ·9985 × cosine star's declination, ·9599 × 100 = 64·35 divisions. Or, by logarithms—

Log. sine geographic lat. = 9·82851
„ correction = 0·00225

9·82626
„ cosine star's decl. = 9·98225
„ 100 = 2·00000

Equals, as before, 64·35 = 1·80851

From the almanac, mentally multiplied by 100—

Y = 45·11
x' = 58·61
y' = 7·50

and the moon's semi-diameter = 27·23

From these elements we may now construct the diagram represented in Fig. 2, at one-third the real size. Use a sheet of paper, say 15 × 18in., and commence by drawing the ellipse, letting the time on the ellipse corresponding to the star's hour angle fall at the centre of the paper; this will always insure space for the whole diagram. The minor and major axes may next be drawn, the former to be extended to the lower edge of the paper and the distance of the centre of the earth from the centre of the ellipse (x) measured on this line and marked. Then measure the distance of the moon's centre from the centre of the earth (y), and draw the co-ordinates x' and y' and the moon's path. Measure on a slip of paper the length of the hypothenuse of the angle formed by the co-ordinates x' and y', divide it into six parts, and one of those parts into ten, and then by the aid of this scale divide the moon's path into hours and minutes, letting the star's hour angle fall at the meridian. Find the times of immersion and emersion, and again divide the moon's path into hours and minutes; but this time letting the local mean time of conjunction fall at the meridian. Now find the north points and vertices, and measure the angles which they make with the points of immersion and emersion, and the calculation is complete, giving the following results:—

Immersion, at 2h. 8·6m., at 73° from the north point and 109° from the vertex.

Emersion, at 3h. 28·0m., at 259° from the north point and 275° from the vertex.

Duration of occultation, 1h. 19·4m.

Unfortunately, I did not see this occultation, as at the time I had not completed some alterations I had been making in my telescope.

Now, in order that your readers may practically test this method to their own satisfaction, I copy from the *Nautical Almanac* the following "Elements for the Prediction of Occultations," for Nov., 1885, from which the circumstances of the occultations may be computed for any place where visible.

The Stars.				At Conjunction in R.A.								Limiting parallels.	
Name.	Mag.	Dec. at Date.		Wash. M.T.			Wash. H.A.		Y.	x'.	y'.	N.	S.
		°	′	D.	H.	M.	H.	M.					
ε Leonis	5½	+ 6	42·8	1	13	22·1	– 6	46·0	0·9614	·5649	·1770	– 21	–
θ Virginis	4½	– 4	55·5	4	0	53·8	+ 2	46·4	0·1858	·5565	·1780	+ 45	–
81 „	5½	– 7	17·2	4	13	45·5	– 8	47·4	0·4064	·5567	·1706	+ 58	–
24 Scorpii	5	– 17	31·1	8	2	55·8	+ 1	33·5	0·5270	·5586	·0691	+ 56	–
ρ¹ Sagittarii	4	– 18	3·8	11	6	19·0	+ 2	29·1	0·4644	·5454	·0503	+ 49	–
ρ² „	5½	– 18	31·2	11	6	22·9	+ 2	32·8	0·9729	·5450	·0510	+ 72	+
Lalande 40522	6	– 14	55·6	13	6	19·7	+ 1	0·3	0·9936	·5337	·1131	+ 75	+
λ Capricorni	5½	– 11	53·6	14	6	38·6	+ 0	35·1	0·7194	·5302	·1386	+ 78	+
67 Aquarii	6	– 7	33·9	15	11	42·8	+ 4	47·2	0·3473	·5295	·1614	+ 54	–
B.A.C. 830	6	+ 10	15·4	20	6	45·4	– 3	50·4	1·1874	·5750	·1496	+ 90	+
70 Tauri	6½	+ 15	40·6	22	1	38·3	– 10	33·2	0·8720	·5998	·0874	+ 90	+
71 „	6	+ 15	21·4	22	1	56·0	– 10	16·2	1·2485	·5999	·0870	+ 90	+
θ¹ „	4	+ 15	42·4	22	2	49·1	– 9	25·2	0·9453	·6005	·0853	+ 90	+
θ² „	4	+ 15	36·9	22	2	51·4	– 9	23·0	1·0406	·6005	·0853	+ 90	+
α „	1	+ 16	16·7	22	5	44·7	– 6	36·4	0·6118	·6016	·0799	+ 80	+
B.A.C. 1728	6	+ 16	58·0	23	3	53·1	– 9	29·5	1·2012	·6087	·0354	+ 90	+
130 Tauri	6	+ 17	40·9	23	9	46·7	– 3	41·2	0·6598	·6095	·0228	+ 87	+
26 Gemini	5½	+ 17	45·0	24	7	5·2	– 7	14·2	0·5829	·6094	·0231	+ 77	+
1 Cancri	6	+ 16	5·2	25	12	24·0	– 3	5·2	0·6663	·6008	·0831	+ 87	+
ο Leonis	3½	+ 10	24·3	27	7	27·6	– 9	39·1	1·2945	·5791	·1487	+ 90	+
48 „	5½	+ 7	32·2	28	6	55·0	– 11	1·6	0·4589	·5675	·1701	+ 64	–
χ „	5	+ 8	28·7	29	7	0·6	– 14	45·4	0·3586	·5582	·1821	+ 57	–
Uranus	—	– 2	6·0	30	13	6·1	– 6	39·3	0·6112	·5500	·1827	+ 77	–

In conclusion, let me say that I feel sure this new method will commend itself to the use of amateurs and professionals alike; and I earnestly hope that your readers will compute from the foregoing list the occultations visible at their observatories, and report the results through these columns. I shall be glad to give any further information desired at any time. **Chas. L. Woodside.**

Boston, Mass., U.S., Sept. 29.

ON HYDRAULIC RAMS.

[24944.]—"J. N." (24929) notices a point which is well worthy of consideration, and one upon which I only touched incidentally in my letter (24862). Like him, I have tried the experiment of plugging the snift-hole and inner-valve; I have also attached a small model of an outer valve to an ordinary house tap. In all cases the valve h pulsated stably and forcibly. The recoil here (f that there is a recoil is certain) must be due to t elasticity of the metal walls of the ram, as Pr Unwin says (*Cycl. Britan.* Art. "Hydr mechanics"): "To compare the relative effe of this elasticity, and of the downward thrust the delivery column in producing recoil, we mu of course, settle what the height of the delive column is to be, for the force of the thrust depen on this; also, we must remember that the stress the metal walls will be greater when there is vent through the inner valve. The following e periment was tried with a small American r (Douglas's No. 3) which has no snift and no a chamber. A short length of the drive-pipe ne its upper end was made with glass tube, in whi a glass bead was hung by a silk thread, after ea stroke the bead was carried backward up the driv pipe by the recoil; its backward travel show the amount of the recoil. In place of a delive pipe a pressure gauge was screwed into the a ball, and the ram worked until it stood at 27lb. say, 50ft.; at this pressure the travel of the be was a full 2¼in. The air-ball was then remove the entrance to it plugged, and the ram again set work, when the travel of the bead was reduced 1⅝in., showing pretty clearly that the elasticity the walls, if it assists, is not the only agent in pr moting the recoil. I do not quite understa "J. N.'s" question: "How can such an oscillatio be set up in a column of water which is said to b inelastic"?

There is but one oscillation of the motive colum at each stroke, the first swing downward and forward by gravity, the second backward and up ward by the thrust of the delivery column an inertia, aided perhaps by the elasticity of the meta walls. There is nothing in this opposed to th incompressibility of water. I am sorry that I can not give "F. A. R." the definite information whic he is seeking as to proportion of parts. My own experience is too limited to allow me to speak o this subject. I will only remark that the velocit in the delivery pipe is so low that we need no trouble ourselves about friction if the pipes ar clean, and especially if they are coated with Angu Smith's preparation. In many cases, however, even when so coated, they soon become heavily rusted by the highly aërated water that has passed through the ram. It would be interesting to know how this affects the delivery. In reply to "F. A. R.'s" last question I have no hesitation i saying, Make the outer valve as light as you ca consistently with strength. A heavy valve is simply a clumsy expedient for assisting the drop, and i so much useless weight to be raised. With th Editor's permission I shall shortly have more to sa on this subject; meanwhile, let me once more repea that it is utterly impossible for the outer valve t fall by its unassisted weight. A recoil and con sequent removal of pressure from below the oute valve must take place somehow; then the valve fall by gravity aided by atmospheric pressure. The recoil is not caused or assisted by the air-chamber as is commonly asserted in books, but by the down ward thrust of the delivery column, and perhaps also by the elasticity of the walls of the ram.

W. A. S.

HOW TO MAKE AN INCUBATOR.

[24945.]—Get a tinsmith to make a cylindrical heater and circulating coil, as shown at Figs. 1

inserted in block. The lamp box must not be shut up tight; it is better to leave the front open. As shown in Fig. 1, the flue is removable. An opening in bottom of heater is left large enough to insert the flue or chimney. To this opening is soldered *inside* heater, a brass or iron flat ring with opening same size as hole in heater. Four or five holes must be drilled or punched through both to admit bolts being placed with the *heads inside* heater, putting a rubber gasket under each bolt head to prevent leakage. A tin or brass flange is soldered to base of chimney, and is of such a size that it will not allow the chimney to be pushed through the ring.

Between this flange and bottom of heater is a rubber gasket pierced with holes, to allow passage of bolts, as is also the flange. If the bolts are square-shanked, and the holes in inside ring are also square, they will come apart more easily—at least, they won't turn in the holes, as rusty bolts sometimes do. Put on the nuts and screw up tight. A little blacklead on both, or only one side of gasket, will facilitate removal. The top of flue, which should be about 1½in. diameter, is soldered inside a brass flange (see Fig. 3), threaded on its vertical part outside. The flange being larger than the hole in top of heater, prevents flue from going too far through. Slip a rubber gasket over flange before inserting up through bottom of heater, and when in position screw down the nut over vertical part of flange, and it should be watertight and removable at will. The upper flue *f* is then slipped in snug, and need not be soldered.

The tubes in flue are seven in number; one in the centre is conical, the upper opening being not over ¼in. in diameter, and bottom ⅜in.; the other six are placed in a circle round it, and are ⅜in. in diameter. The upper flues, on leaving smoke box, converge before entering brass flange. I think this is about as clear as I can make it without taking up too much of your valuable space.

Now, for instruction to work it. Put in through regulator, after removing brass plug *d*, as much hot water *at* 150° Fahr. as will come to top of regulator cone, tilting the incubator once or twice by raising the lamp-box end to allow the air contained in gridiron radiator to escape, and insure the circulation of the water. Let it (the regulator) stand open until the temperature in egg drawer rises to 98° Fahr. Place the lighted lamp, not fully turned up, in position, and allow it to remain five hours to heat the sawdust packing and woodwork, which, by the way, must be pretty well seasoned. Fill up the regulator tube and cone *level full* of water at the expiration of the five hours, and if the temperature of drawer does not exceed 100° Fahr., or fall below 99° Fahr., screw on the brass plug very tight, connect the two levers *g* and *h* by the rod *r*, and with the nut bring the weight of train of levers, rod, and small weight to bear on point of plug *d*, taking care not to turn down the lamp too much in doing so. See that tap *b* is tight, cover over the openings of tubes *w w* to water dishes, but leave ventilator tubes open. Put the thermometer in its tube, and run the incubator without eggs about 48 hours. Examine the thermometer hourly during the day, recording the temperature. If it keeps at a set temperature, put in 200 or 220 eggs from *selected fowls* if you desire a large out-turn of chicks. Fill up water dishes, of which there should be four, and attend to them daily, as insufficient moisture causes many eggs to fail to hatch. For the *first week* a temperature of 104° to 105° won't hurt the eggs, or for a short time 108° Fahr.: higher than that generally proves fatal. For the second or third week the heat must be *kept down to* 103 *or* 102, as anything causes the young chicks to become feverish and die in the shell. Turn the eggs daily, and when you take out the drawer put a piece of wood in opening to retain the heat in egg drawer chamber. At the end of the fourth or fifth day examine the eggs and remove the transparent ones, this will give more room to turn the rest. Open the drawer as seldom as possible, particularly on the last two days of incubation.

With good, strong, healthy parent fowls the eggs will hatch out as well as under a hen, and need no assistance if due regard is paid to heat, moisture, and ventilation.

When the young chicks come forth, open the egg drawer and close it very carefully or you will kill some of them.

Let them remain until quite dry, and do not open the egg drawer oftener than two or three times (if you desire success) on *the last day*. For *the first week* the young chicks require a temperature of at least 98° Fahr., or they will crowd over each other, or, rather, under each other, and the strongest chicks thus get smothered. For an artificial mother, get a galvanised iron tank 40in. square and about 6in. deep, place it in a box 6in. larger and deeper all around, first putting 5in. sawdust in bottom, so that the tank will come about 1in. below top, then fill all round with sawdust, cover it over with a board floor tongued and grooved to prevent the dry earth which must be strewed over it, from working below. A pipe to draw off cool water from bottom, and one to replace it with hot water at the top must be provided. Make a shallow box 40in. square inside and 6in. deep; but on two sides cut away one half the depth, nail on a bottom, and turn it upside down over tank box floor. This will leave an opening on each side 3in. high, which must be covered with a curtain slashed every inch. If two or three thicknesses of old blanket can be got, it will answer very well. Throw about 1¼in. deep of fine dry earth over the floor to absorb the moisture from their droppings before turning the box over the floor. To ventilate it an inch tin pipe is carried under the floor and over the tank, the ends both being left open and the pipe long enough to go across the tank and packing space to the outside of box communicating with the cool fresh air, which is soon warmed by heat from tank and ascends through ⅜in. vertical tubes, passing through floor and to nearly top of box. Six of these tubes will supply enough fresh air, and the vitiated air passes out under bottom of curtains. If you draw two or three bucketfuls of water from the tank every evening, and perhaps morning when the day is cold or wet, and replace it after heating it to boiling point, that will radiate sufficient heat to maintain a temperature of 98° Fahr. 24 hours. As the chicks get older reduce the heat after second week gradually, until the 6th, when they will no longer require artificial heat, but may be allowed to remain under brooder until eight weeks old, when they should begin to perch. If the brooder can be placed on a closely cut-grass patch and the young chicks fenced in and well protected from vermin, supplied with good pure water and a little fine gravel or broken granite, they will do as well without a mother as with one, but they make infinitely more noise, and will drive a nervous person into a lunatic asylum. If they get diarrhœa, remove from brooder and give one drop Browne's chlorodyne in one teaspoonful warm water (one half of this is a dose for a week-old chick) every three hours and keep warm and dry, two doses always and invariably cure the worst cases if taken in time. If very bad, give few drops of castor oil first, and in two hours give a small piece of dry chalk, and the chlorodyne one hour after. To raise them successfully they must be kept warm, dry, and clean.

To overcome an extra amount of friction at certain points of the revolution of wheel turning up lamp-wick, I substituted a pair of small brass rollers, slightly fluted for the star-shaped wheels usually employed, and find them a great improvement. The roller with short journals (see Fig. 5) fits in slotted bearings, and is pressed slightly towards the other one by a thin spring at each end. A small piece of watchspring, one end soldered to lamp, and the free end pressing against journal I used for the springs.

If I could have procured *pure sheet rubber* I would have made a regulator thus. In place of the cone C on regulator-pipe, screw or solder a shallow brass cup having a screw-thread cut on the outside; on the top of the cup place a rubber disc over this screw, a cap having a shoulder inside to fit over the edge of lower cup, to secure a tight joint with rubber disc. Inside the cup, and resting on the rubber is a piston, the rod of which passes through a hole in the centre of cup, and engages the under side of lever *g*. I fancy the rubber disc, being more elastic than the tin base of cone C, it would act quicker, and the strain on heater and pipes is much less. A sketch of this is given at Fig. 6. If any of your readers act on this suggestion, I hope they will say how it answers. When you trim the lamp, always let it stand a few minutes before replacing, or it will blaze up too high. Turn it down to as near the same height as it was when you removed it. If you have occasion to remove the lamp for more than an hour, you must open plug *d* to allow the air to enter as the water cools, or something will collapse, and the heater will no longer act as a regulator. About a gallon and a half of oil will run the incubator three weeks if kept in a moderately warm room. The temperature of room affects the consumption of oil.

Backwoodsman, B.C.

NEW ZEALAND RAILWAYS—ENGLISH MANUFACTURES, &c.

[24946.]—THOUGH I am unconnected with the firms implicated in Mr. Richardson's charges ("C. R. M.," 24892, pages 140, 141), I take some interest in the matter, and should like to make a few remarks thereon. The charges have the more weight and interest with myself as I have reason to believe that it is a matter for congratulation to the colony that they possess a Public Works Minister of the capacity, experience, and probity of Mr. Richardson.

The bad quality of the work and materials, together with "the difficulty in getting redress," seem on this side of the line to simply point out that the orders were placed in bad hands. It looks very much as if the Public Works Department did not know the markets, or, to speak a little more plainly than courteously, their business.

That firms that do not understand their work or scamp it exist is true unfortunately, but the British Isles do not monopolise them. I have seen and had plenty of bad work from Germany, Belgium, the States, &c., as well as good and indifferent; very bad when the English brand was affixed.

It appears to me that good firms of any nationality turn out work that differs more in style than quality, and that prices differ for the most part temporarily, and often from accident.

I have unexpectedly had bad work from home firms of good repute, after being assured that everything "would be as it should be." The cause, I think is inefficient or insufficient supervision: there is something of the "name's up" about it; also in many cases the original founders are gone, and sons, grandsons, or successors "delegate" the work even of supervision, or lack the industry and ability of their forbears.

That indifferent or bad work comes from unexpected quarters, the notes one often sees from friends in our various marts—there is one in *Engineering* this week from South America—only too plainly show; all this, too, in the face of an eager and grasping competition.

For the better average quality of New Zealand made axles, &c., though it may be true enough, we have here only Mr. Richardson's statement, and the cheap and expeditious locomotive engines have not yet been tried, though I am aware that good work has previously been done in New Zealand by American locomotives.

As the workmen making the axles, &c., cannot well have been trained specially in the Colony, and hours are shorter and pay larger than here, it seems strange that a Government Department can yet beat private firms who have not to import their iron. Perhaps hours and pay are not what they were a while back; but is there not suspicion of the "new broom sweeping clean," and a doubt of the permanency of the low rate for turn out?

Enterprise and energy will do a good deal, as the new direct steam service shows; but if engines cost 27 per cent. more than home prices, why not axles, wheels, waggon work, &c.?

The conduct of our engine builders forms a startling contrast to that of the Baldwin Company; but if I know the firm, as I think I do, they are not of the same class as that company, nor of any particular merit or repute. The trade here was very busy when the New Zealand orders were given out, and that is perhaps why the orders lapsed into what appear to be very bad hands. Work is not so generally pressing now, and any orders would meet with a better reception, and certainly, in the ordinary course of business, much better and quicker execution. Prices, too, would most probably be lower; but some knowledge of the trade would be necessary in the placing of orders in any case.

Apropos of bad work, I have seen no little in New Zealand that it would take some effort to go further than.

The Baldwin Company, whether slack or busy at the receipt of their orders, have made a most creditable use of their time, and, if the engines do well, one of the keenest of bids for Colonial custom. The expedition and the price appear to leave the shareholders little beyond their hopes of further orders and future recoupment.

Oct. 21. **Vulcan.**

OVERWORK ON RAILWAYS.

[24947.]—WE (several of us G.N.R. drivers and firemen at a meeting) read, with great delight, Mr. Stretton's letter in last week's MECHANIC, and we can corroborate him in all he says, and we can go further; and we heartily thank that gentleman and Mr. Sutherst for bringing before the public and directors such an important question. We can testify ourselves to the excessive hours we have been on the footplate within the last few months, making from 11 to 12 days, and over, in a single week, and this is not an exceptional occurrence, and we hope that the public will support our above-named benefactors to continue the agitation of such an important question, until excessive hours and drowsiness on the footplate are things of the past. We are informed that on the M.R. the men have their week's work distributed in an equal manner, making at the finish not exceeding 6½ or 7 days. Why cannot this be done on the Great Northern? **Patrick.**

THE TIME-BALL AT NEW YORK.

[24948.]—HAVING recently had the opportunity of seeing the working of our "time-distributing" apparatus, I trust the details may be of interest to some of your readers.

The ball works on a flag-staff set on a platform, which is about 287ft. above the street, and rises and falls about 25ft. on the staff. The ball is 4½ft. in diameter, made of 12 vanes of sheet copper, so disposed as to allow the wind free passage, and yet to appear like a solid sphere from all directions.

There are six vertical tubes

qualities, an internal tension. I therefore resolved to construct a piece of wood which should have a great internal tension. For that purpose I took strips of beech $\frac{1}{16}$in. thick to represent the hard grain A., and strips of pine ⅛in. thick, which strips were cut off from the end of a board, so that the fibres of the grain would be glued at a right-angle to that of the beech, to represent the soft grain. These pine strips were then soaked in water for 24 hours, and had by that time swollen fully ½in. longer, and in that condition were glued between the beech. Now, the water having evaporated, the pine strips naturally would shrink; but, being fixed to the beech, a tension of at least a horse-power is in the board. But, when I shaped the breast, it struck me that what I had gained in one way I had lost in another. However, considering the vice versâ, enough strength was left me to finish it. Now here it is, a beautiful, equal, and free-toned violin, for the inspection of our respected friend, "Fiddler," or any one of "Ours" who may feel interest in such matters. I may mention that it is not for sale. **J. H. Schucht.**

14, Store-street, Bedford-square, W.C.

VARIABLE RESISTANCE FOR INCANDESCENT LAMPS.

[24952.]—With your permission, I will describe a resistance coil I have devised (a modification of one I saw several months ago, of French make), which I think will be of use to many of the readers of "Ours" who use incandescent lamps for illuminating the microscope.

The coil consists of a rod of soft wood, about 3in. long, ⅜in. in diameter. At one end a binding-screw is fixed, to which is attached the end of a length of fine German silver wire. The wire to be wound on the wood rod very tight, and fastened to a pin at the other end. Care must be taken that the coils do not touch each other. Over the coil a copper or brass tube slides, one end to be split down about ½in. to form a spring to press on the wire, and at the other end of tube a binding-screw is fixed. By the aid of this coil, the current can be easily varied by pushing the coil into the tube, or drawing it out. The line wire to be joined to the binding-screws, so that the coil is always in the circuit.

In finishing my letter, I had better mention that, on looking through my private letters, I find some of my correspondents have not inclosed their address, consequently have not been able to answer them.

Dulwich. **W. Habgood.**

CLOCK STRIKING.

[24953.]—The usual mode of transferring the striking of a house clock to other parts of the house, electrically, is by the back stroke of the hammer touching a spring, thus making contact in circuit with the works of the clock. I have had my clock thus fitted for several years; but I have been desirous of having it give notice of the warning as well as of the hour. I first thought of doing so by the falling of the rack; but the necessary adjustment being confined to the fall of a single tooth, was too delicate for ordinary purposes, so I turned my attention to the gathering pallet, which falls in warning from its banking pin through an arc of 30°, resting there till released for the striking; and would, in this short distance, by striking a pin in circuit, give one blow of the electric bell. This pin is attached to a light lever, pivoted to a standard on the seat board; the break in circuit being between this lever and the clock-works. The lever is lifted into position by a spring arm of thin sheet brass, soldered on to the sleeve of the lifting piece, and connected to the lever by an insulated link of fine wire hooked on to the arm, and attached to the lever by a short, strong loop of silk. The warning pin is thus lifted into position to receive contact with the gathering pallet in the warning, and when the lifting piece falls for the striking, the lever falls with it, and the pin is taken out of range of contact with the pallet. The spring arm gives the necessary elasticity to the lever, so preventing the pallet from banking on the pin. Another pin may be attached to the lever so as to fall with it into the path of the pallet, and so strike the hours; this I have tried, but do not like it as well as the original method.

21st Oct. **R. J. Lecky.**

MYSTIFICATION.

[24954.]—It was only this week that I chanced to see letter 24648, "H. B. F.'s" kind remarks on 24589, my letter *re* the above. I cordially thank him; but must beg his, and all chemists the world over, pardon for my error *re* cupric sulphate; it was sheer ignorance, gentlemen; for I am not a chemist, but a simple engineer; and sulphate of copper, or blue vitriol would, with me, and many more, be quite as well understood and fully as much appreciated.

Now that the season for meetings and lectures is approaching, a revival of the subject may give some persons a useful hint, and if simple results in plain terms were given instead of abstruse formulæ and hypotheses, it would make many a dry subject both interesting and popular, and prevent the waste of much valuable time at such meetings. Why, Sir, some months since I was at a meeting abounding in interesting matter, when nearly an hour was absorbed by a worthy rev. gentleman filling a blackboard 6ft. by 4ft. with formulæ, until he went down on his knees to finish near the floor, where no one present could see a figure—all to prove something akin to the $\sqrt{-n}$, or of equal value; not fifteen persons out of eighty-seven present caring anything about the formulæ; and had he given his ideas in plain terms it would have been highly instructive, the equations, &c., being reserved for printing in the Society's *Transactions*.

I am far from wishing to prevent due illustrations being given, and only desire that our well-meaning instructors may not go to inordinate lengths in their elucidations, both as to time and excess of learning. **Rho.**

OXIDE OF IRON PIGMENTS.

[24955.]—On page 116, No. 1,072, your contributor, "An Analytical Chemist," in his "Exercises in Technical Analysis," deals with oxide of iron reds, and gives their composition. There is one point in regard to the composition of oxide of iron, viz., the presence of chalk in such pigments. I have examined many samples of oxide of iron, but never found chalk present in any of them, and I very much question whether it is ever present. I should feel inclined to state the composition of oxide of iron as:

Pure oxide of iron......	96 to 98 per cent.
Moisture	2 ,,
Silica or silicates.........	1 to 2 ,,

These "oxides of iron" are known in the trade under various names, viz.: Red oxide, Indian red, Turkey red, scarlet red, &c., and are obtained from natural hematite ores, in which case they usually contain silica, and from ferrous sulphate by calcining it, when they are usually nearly pure oxide of iron.

Another class of iron reds are those obtained from natural yellow colours, like yellow ochre, raw sienna, from which they are made by heating in a furnace; such pigments are sold as Venetian red, light red, burnt sienna, &c. Their composition is usually—

Oxide of iron	24 to 30 per cent.
Silicate of alumina ...	70 to 76 ,,

Water only small quantities.

Certain ferruginous chalks are sold under the names of Spanish brown, red raddle, red chalk, which contain oxide of iron, small quantities of silicate of alumina, and chalk in large proportion. Such bodies are the only reds which owe their colour to oxide of iron, that is, as far as I have been able to ascertain from the examination of a number of samples which contain chalk.

Salford, Oct. 22. **George H. Hurst.**

MODERN MAN-FLIGHT AND AERIAL NAVIGATION.

[24956.]—A. Fryer Evans, of Monmouthshire, will be glad to know that he does not need go to America for a perfectly navigable balloon, nor even 15 miles from the office of this journal (an idea of mine formed during the Franco-Prussian war). The advantages of the balloon are that it will go ahead or astern, ascend or descend 30 times an hour if required, so that it would be suitable for many purposes; and if any gentlemen, military or otherwise, care to take the matter up, they may look in this week's Address Column.

A Country Chip.

A MINERALOGIST'S BLOWPIPE APPARATUS.

[24957.]—As the specific gravity of minerals is one of the first things to determine, I will commence with a description of a specific gravity balance I have designed and made to complete my blowpipe set, a rough sketch of which I have drawn on the photo illustrating the other apparatus. The beam *b* is made from an ordinary steel knitting needle, and is 8in. long, having a pointer 2in. long, hard soldered, inverted from its centre. The beam is supported on a knife edge fixed tight in top of stand, a Λ groove being cut in beam at the middle of base of pointer for this purpose. A hollow pan P, ½in. diameter, is suspended from V on one end of beam by means of fine steel wire; the pan is prevented from accidentally being displaced by a small spring which covers the V groove; this spring allows perfect freedom to steel wire and pan, but allows of their easy removal for wiping, &c. The other half of beam, as will be seen, is graduated in grains and half grains from 0 to 10, as I thought 10 grains amply sufficient for any purpose. The weight W weighs 10 grains, and slides from end to centre of beam, cannot get lost or misplaced, as it will not slip over the counterpoise screw C on the end. The counterpoise screws up and down for making the necessary adjustment between air and water. There is also an index I, marked on stand in 10ths of a grain, to which pointer indicates. A wide necked bottle 2in. high filled to the brim with distilled water serves for immersing the pan containing mineral when ascertaining specific gravity.

The beam and pan are separately detachable from the stand for convenience of packing. I may here add that this balance is very delicate, and will indicate perceptibly $\frac{1}{100}$th of a grain. I forgot to mention that the stand is made of brass upright of thick wire 2½in. high, fixed into base 3in. by 1in. by ⅛th in., and all packs very conveniently into blowpipe case. The foot bellows here represented are wedge shape, 7in. by 3½in., and 3½in. when extended at the deep end, and close up flat to 1in. thick for travelling. The top and bottom are of ⅜th wood joined by two small hinges at one end, and a steel wire spring for opening them fixed inside near the other end. This spring is coiled in the form of a double cone, so that it closes flat upon itself and allows of the bellows being thoroughly exhausted each depression. The bottom is provided with two valves for inlet and outlet of air; these valves are made so that should anything require doing at the clacks they can be got at without disturbing the leather covering of the bellows. Outlet valve is fitted with ⅛in. of brass tube on which fits the end of a 4ft. length of indiarubber tubing similar to that used for a child's feeding bottle, the other end is placed on tube in connection with blowpipe and air reservoir shown in diagram.

The air reservoir for keeping up a steady pressure of air is in the form of a bag 3½in. square made of thin sheet caoutchouc cemented on two sides, and a short piece of I. tube at one corner for attachment to the blowpipe: this bag is capable of being distended with air from the bellows to the form of a balloon 8in. diameter without any fear of damage: it then gives a steady and even pressure at the blowpipe. It may also be worked without foot bellows from the mouth by having a short piece of I. tubing having a mouthpiece with back pressure clack to prevent the return of air.

I venture to assert that the blowpipe itself is the very acme of what a blowpipe should be for mineralogical work, the air and gas being perfectly under control at the most convenient point. The milled nut *a* forms a tap for regulating the gas supply, and *b* is a screw to regulate the air from reservoir; the air tube, made after the pattern of an ordinary mouth blowpipe, goes down the centre of gas tube, and is ground to fit tightly into the gas tap *a*, is parallel for about 1in. at the back so as to allow of being pushed in or out, thereby allowing the greatest nicety of adjustment to the coned flame; the gas tube is made from ordinary ⅜in. brass gas piping, *c* is for receiving the indiarubber gas supply pipe from any convenient bracket. The blowpipe is mounted on an upright stand made out of ¼in. brass gas pipe sliding vertically on a piece of thick brass wire with thumb screw for adjusting at any height desirable, there is also riveted on the top a jointed clip through which the blowpipe slides tightly for adjusting at any angle or distance from the Al plate. The Al plate is mounted to slide vertically on thick brass wire which fits into a hole in base board. I think the diagram will make all clear: I have pleasure in commending this method of supporting Al plate and charcoal slip support of our old friend Colonel Ross, as it leaves the hand perfectly free for other work. The base board carrying the Al plate holder and blowpipe stand in holes lined with brass tube is 8in. by 4in. by ½in. and form the lid of box inside of which all the apparatus packs for travelling.

I now proceed to a description of the accessory instruments figured on card.

No. 1. Plumbago crucible made use of by myself for melting small quantities of metal, and is nothing more or less than a circular block of James's "dome lead" hollowed out to receive the metal. I have pleasure in recommending these to dentists and other fine metal workers, as they are very useful for melting gold and making up alloys, and when not in use can be kept free from moisture in the original tin boxes in which they are sold. Caution before using for the first time: dry well in the oven and heat up very gently.

No. 2. Oil or grease lamp for use instead of gas. The air tube described in gas blowpipe fits both alternatively at *a*, and the lamp is adjustable on base board the same as the gas blowpipe. A cap covering the wick prevents any leakage when travelling.

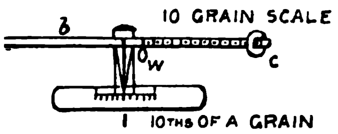
No. 3. Cylindrical steel mortar made in three pieces for handiness. The top *a*, and bottom *b*, are flint hard for crushing and powdering fragments of minerals.

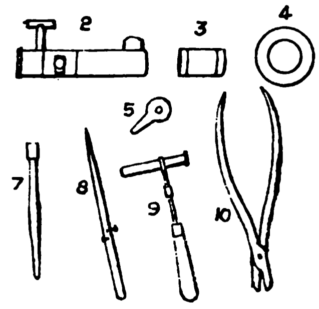
No. 4. Bone ash cupel.

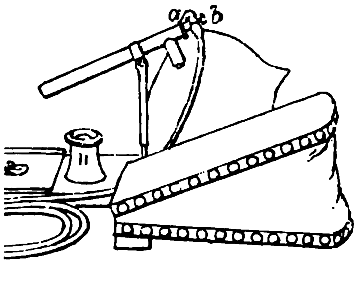
No. 5. Aluminium capsule for boiling bor[illegible] beads as described by Col. Ross.

No. 6. Platinum wire holder wit[illegible] the handle is perforated down wire, 6in. or 8in. long, to be conveniently so economising wire by using it up to the .

Steel tweezers for turning up platinum ps, or rings. One leg is concave, the other coned at the tips. To form perfectly rings place the end of wire between the and convex legs and press together tightly, light twist will complete the circle. The are magnetised for detecting iron, and







t in use the poles are kept closed by a small tube fitting on the tips. The tweezors are om thin sheet steel, the round leg being nd brazed.

Self-closing tweezers of German silver tinum tips. The projecting buttons are for the tweezers open when about to take up ent of mineral.

Test tube holder of half-round wire with de for closing same.

. Forceps for nipping off small fragmenis al for examination.

. Eye lens, 1in. focus, for examining beads,

. Tray for catching stray particles under pipe during manipulation.

our Editor's permission, I shall be pleased to any questions having reference to any porhis apparatus. If Col. Ross should see this, he will express his opinion on them. I am to inform him that I am one of his pupils. lesson on the blowpipe in mineralogy l in "Ours" from the pen of our gallant I do not mean to infer by this that I was tranger to the blowpipe. Far from that, de a very powerful blowing apparatus and e for my professional metallurgical work, have had in constant use many years. I am l. Ross has taken leave of "Ours," and wish ry success in his latest discovery.

B. C. R.

VELOPMENT BY FERROUS OXALATE.

8.]—In answer to several correspondents, I tted down the principal points to be obn employing the above as a developer for -bromide plates. Ferrons oxalate is so t in its power of bringing out a weaklyd image, and the resulting negatives are at clear, so brilliant, and so full of detail, that re its use attended with more difficulty than velopers, it would be worth while to overese difficulties; but when we consider that le development is much simpler, much der control, that much greater latitude can ved in the exposures, and, above all, that tions necessary for development may be p, and kept indefinitely without spoiling, ways ready at hand, and that the resulting lutions may be used over and over again ult to understand neglected so valuab

In the following brief outline of the best mode of producing pictures by the aid of ferrous oxalate, I have divided my remarks into two sections, the first treating of the preparation of the solutions and of their properties, the second touching more specially on the manipulatory details of development.

The five substances needed in the preparation of the ferrous oxalate developer are:—Pure water, potassium oxalate (neutral), ferrous sulphate, cupric sulphate, and potassium bromide. Two large stock bottles are needed, furnished with sound, well-fitting corks. The bottles should hold about half a gallon, and should be of glass, in order to admit of the contents being readily seen.

To make up the stock solutions, fill one of the bottles nearly to the shoulder with crystals of ferrous sulphate (sulphate of iron). See that the crystals are good and clean, pale bluish-green, with no yellowish edges. Now place a single crystal of cupric sulphate (sulphate of copper, blue vitriol) about the size of an almond in the same bottle, fill up with pure water, and agitate until the water has taken up as much as it will dissolve. Label this bottle "ferrous sulphate saturated solution."

Whenever any of this solution is used, more sulphate of iron and more water must be added, so as to keep the bottle always full to the cork with fluid, and half full of crystals. By this means the solution is always saturated, a most essential point. The occasional addition of a small crystal of cupric sulphate prevents the solution from going rusty; but it is hardly needed, unless the bottle is set aside for three or four months at a time.

A second bottle is now filled in the same manner with crystals of potassium oxalate (neutral), and filled up to the cork with water. This may be labelled "potassic oxalate saturated solution." The same precaution must be observed with regard to keeping this bottle always half full of crystals and full of fluid, as in the case of the other bottle. No cupric sulphate is needed in this bottle, as potassium oxalate is not affected by the air.

Now for the use of the solutions: Having taken an exposed plate into the dark room, we close all crannies, and proceed to pour out into the developing dish (that must be perfectly clean and free from pyro, which produces an inky soup with ferrous oxalate). We pour into this dish, I repeat, 3 parts by measure of potassic oxalate solution, and then add 1 part by measure of the ferrous sulphate solution. What these parts are to be depends on the size of the plates and the size of the dish. For myself, using small white porcelain square dishes, the size of the plates, I find the following quantities ample:—

For quarter plate	Potassic oxalate, ¾oz. Ferrous sulphate, ¼oz.
For half plates	Potassic oxalate, 1½oz. Ferrous sulphate, ½oz.
For 12in. by 12in. plates ..	Potassic oxalate, 3oz. Ferrous sulphate, 1oz.

Remember to pour out the potassic oxalate solution *first*, and add in the ferric sulphate afterwards, or you will have a thick peasoup.

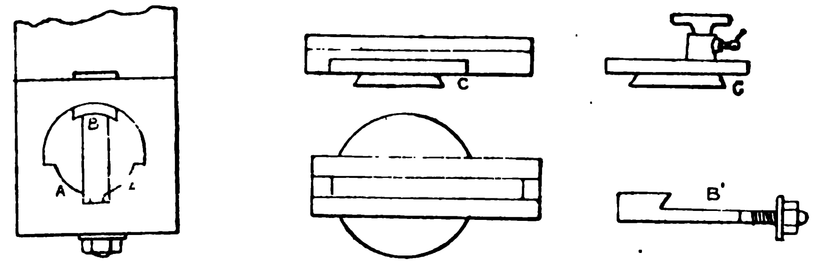
Now place the plate in the solution, and keep rocking until the image is well developed and shows through to the back. Do not over-expose; remember ferrous oxalate develops very powerfully, and that an over-exposed picture is always wretchedly thin.

If you fancy you have over-exposed, and if you find your pictures thin, add one or two drops of saturated solution of potassium bromide to the developer in the dish. The same batch of developer will develop from 15 to 20 pictures right off, and should not be thrown away even then, but set aside in small bottles, full to the cork, as it is very useful to commence the development of pictures suspected of having received too long an exposure.

S. Bottone.

GERMAN LATHES.

[24959.]—I inclose a sketch of a slide-rest for a screw-cutting lathe. It may perhaps be of interest to your readers, as it solves the difficulty which caused the discussion on the front slide time ago. In this rest the top slide is rojecting piece, as shown at C. The ut so as to fit piece C. B and B¹ is the tightening bolt. The plan is very good for those who want hand and slide-rest in one. Eckardt, of Stuttgart, has his lathe so fitted.



A. F. Shakespear.

Lüttichaustrasse, 14, III., Dresden.

LATHE OVERHEADS.

[24960.]—I was glad to see "F. A. M.'s" letter and illustrations. By the bye, no one answers his query about the correction of imperfection of screw threads. For my own part, I never saw or heard of the plan before seeing the arrangement sent by him to the English Mechanic a few weeks ago. As regards the overhead with one roller or one shaft only, the possible variations of speed are too limited. Moreover, it is an advantage to have a second shaft, not only as a means of further varying the speed, but for other uses, *e.g.*, cutting twists or spirals. Of course, with a spiral chuck and accompaniment of gear wheels, the traverse of the tool is perfectly carried on; but we do not all find the requisite dollars for this apparatus, and a second shaft enables us to drive the tool by a cord to a pulley on the slide-rest, while the first shaft is used to drive the revolving cutter or drill. In this case it is necessary to turn the slide-rest screw by a winch handle, or a straight handle screwed into the face of the pulley, from which a cord goes to shaft No. 1; a second cord from the same shaft going down to the mandrel pulley. To drive the cutter, a long cord goes from the flywheel to the second shaft, and then to the cutter spindle. With some rests—notably the three-slide rest—of which I have a particularly good and novel one by S. Brown, of Halesworth, of which I may not at present give a description pending other improvements, it is easy to carry a cord direct from the mandrel pulley to the slide-rest screw without the intervening overhead; but this cannot be easily managed with a two-slide rest, as the advance of the tool will slacken the connecting cord. The swinging or balanced overhead answers well for cutter driving and gives great speed with a minimum of friction; and this, with a single shaft, will do as well as two shafts for many purposes, but as the latter has other advantages it is to be preferred. Holtzapffel, Evans, and the late Munro used to make overheads with double shafts, I believe, but as the two former naturally stand by the spiral chuck as the more orthodox means of doing work of the kind alluded to, I suppose they have laid aside the old pattern. Mr. Haydon did not rest satisfied even with two shafts, but added a short supplementary one, partly to obtain still further variations in speed, but also partly for another reason—viz., to enable the speed pulleys to be turned upon their own axle in the lathe to which they belonged. They could thus be sized, tested, altered if necessary, and replaced in the frame without once removing them from the axle on which they were ultimately to be used. I remember that when I first saw the overhead and suggested that it was a big affair of complicated aspect, Mr. Haydon pointed out this *raison d'être* of the supplementary shaft. Once set up, moreover, there was but little shifting of cords and pulleys—the standing rigging sufficed for many rates in ordinary use without any change of speed pulleys. Order and arrangement were the watchwords of that notable mechanic, whose neatness was indeed a caution to careless and untidy men like myself. The pulleys were all stamped and lettered for pitches of screws to be cut with certain combinations, and hanging in a row upon the wall over a sheet of white paper were the several short bits of cord to be used singly or in combination, the figures or letters against each stating these combinations. Thus, if certain sized pulleys were to be used, there was no hunting up of cords to fit, but a glance at the above supplied the required information. Yet our worthy master was no kid-gloved operator, but could tackle a heavy casting or turn a stout shaft in real workmanlike style, or fit up delicate work with the delicate touch of a watchmaker. The overhead, after I saw it, had many additions and improvements tending to develop still further its capabilities, and a few of these appeared from time to time in letters to the Editor; but Mr. Haydon was too busy a man to spend much time in writing, and now I fear both pen and lathe are permanently at rest. Haydon's overhead and Haydon's cutter bar will, however, always stand as samples of his ingenuity and mechanical knowledge. O. J. L.

AMATEUR TURNERY.

[24961.]—I READ with great interest the articles on "Snares and Pitfalls in Amateur Carpentry," and hope more are to follow. I am sure a large number of your readers besides myself would gladly welcome a similar series of articles on "Snares and Pitfalls in Amateur Turnery." I hope some competent person will take the hint.

Spes.

AN OBSERVATORY HIVE.

[24962.]—I HAVE sent sketch of observatory hive for indoor use, and I hope this will be interesting to many of your numerous readers.

Fig. 1 is a general outline of hive about ⅛th the size: Fig. 2 section above bottom rail; B 1 Fig. 2, bottom board. The sizes given in this are the Association standard: the frames, therefore, are transferable to any standard hive. Fig. 3 shows metal end and top bar of frame, with saw-cut for comb foundations, also for securing glass dummy. Fig. 4 section of back and entrance end; the glass top rests on the ends, they being ⅛in. wider (and no more) than the sides, to give space for metal ends to slide the length of the hive. The guide to entrance should be secured by two brass plates, as shown in section of front end; it can then be easily removed from the hive when required. The bottom board should be clamped, and rabeted at front end, to prevent it being forced up when being shut, or by any accident during removal. Fig. 5, full-size section of column, showing grooves for glass, tenons, &c.

The top plate of glass should be one piece, cut in the centre, half of the hole for feeding to be cut out of each piece.

The length given in Fig. 1 is for eight frames and one dummy, leaving about 10in. to extend for particular observation. To extend the frames, take the metal ends that project over the side between finger and thumb, and the frames will move easily. D, movable glass doors; C, glass cover to entrance; A, dummy.

The hive may be placed on a table with guide to entrance against bottom rail of sash or window-sill or wall, care being taken that exit for the bees corresponds with guide to entrance V F, two 2¾ holes covered with perforated zinc on the top side of bottom. All the glass except the doors should be $\frac{3}{16}$in.; brass metal end $1\frac{1}{16}$in. thick will do.

J. L. C.

FIG. 4.

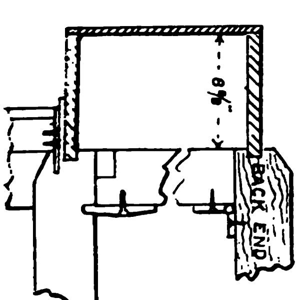
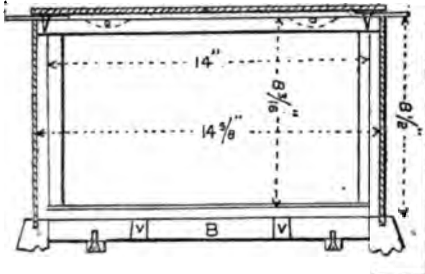


FIG. 2.



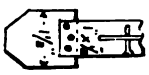


FIG. 3.

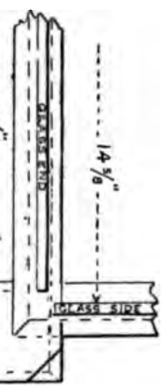


FIG. 5.

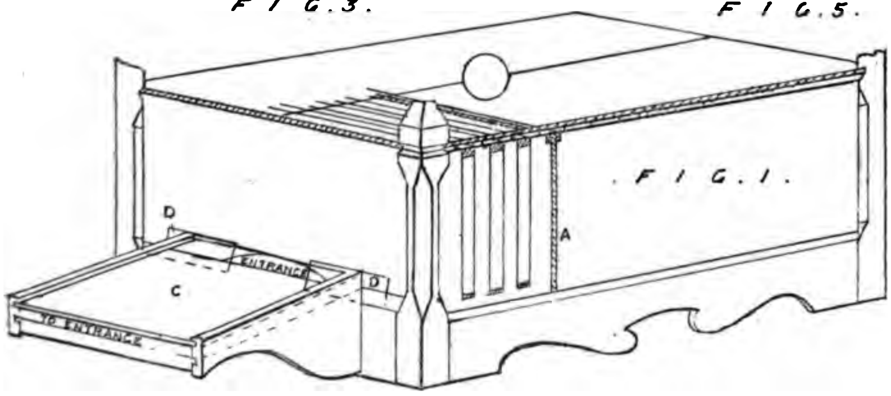


FIG. 1.

THE potato is an important article of food in Great Britain, some 4,000,000 tons a year being consumed by the inhabitants, about 200,000 tons of which are imported, the remainder being raised here. The average yield per acre is about seven tons, or 233 bushels.

REPLIES TO QUERIES.

◆

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[57328.]—**Sprained Elbow.**—You may try the following: if it does not cure it, it will do no harm: At night bathe it with warm water, and rub it with American "Kill Pain" for ten minutes; this will make the muscles flexible; in the morning bathe it with cold water to strengthen them. I may also add, for the benefit of any of "ours," that before singing a little Russian tallow and "Kill Pain" rubbed on the throat increases the flexibility of the muscles that work the vocal cords, and therefore makes singing easier. I speak from experience.—W. ROWLAND HART.

[57393.]—**Fish Curing (U.Q.)**—If the querist will advertise his address, we will try to assist him.—SUTHERLAND AND CO.

[57410.]—**Zinc in Boilers.**—I am obliged to "T. J. M." for his reply, which unfortunately does not cover the ground I indicated in my question. Would he, or any other reader, say what is the chemical action taking place, expressing same by chemical formula? Also say what salt of zinc is formed with feed-water of average quality? and what, if any, means can I adopt to prevent unnecessary waste of zinc?—JACOBUS.

[57417.]—**Calcium.**—Since Mr. Gerhard defends himself from the construction put upon his silence by "S. R.," perhaps he will be kind enough to answer the original query, of which I was the author, appearing in No. 1,067, and which asked, "by what physical properties and chemical reactions he recognised the white metal that will not oxidise, that he claims to have obtained as calcium, and what is the metal to which chemists have hitherto assigned that name."—B. B.

[57475.] — **Family Clothes-washing Machine.**—We use at home the "Empire Washer," and find it answers its purpose; a blanket may be washed properly and on the line in three minutes. If the clothes are very dirty they should be put in soak overnight; the dirtier the linen the more times it must go between the rollers, which do not break the buttons off the shirts. It does not wash by itself, or without any trouble, but it saves labour and two or three hours' work.—W. ROWLAND HART.

[57485.]—**Gillet's Telephone.**—This telephone consists of a single pole electro-magnet, excited by a battery current in the line circuit; and in front of this is a double membrance diaphragm of parchment, which is chemically treated to resist the effects of changes of atmosphere, moisture from the breath, &c. There is a disc of either steel or iron, about the size of one's thumbnail, placed in the centre of diaphragm and between the two pieces of parchment, and a small circle is cut away in the under piece, to allow the little disc to be exposed to the pole of the magnet. The two pieces of parchment which form the diaphragm are held between two flat brass rings, which can be either riveted or fastened together with screws. (In Gillet's telephone they are riveted.) The parchment must be wet, or at least damp, when placed between the rings, and these screwed tightly together. When dry, the diaphragm will be as tight as a drumhead. An ordinary Bell telephone case can be used, the brass frame for diaphragm being held down by the mouthpiece. I have made up four of these instruments, and find they talk very fairly well. Two I use as transmitters, and the other two as receivers. My line is a short one, about 100 yards, and I have four No. 2 Leclanché cells in circuit, two at either station. The connections are the same as for any other telephone circuit, in which you use the main circuit on the line, and they have been several times given in back numbers of the "E. M." I believe this telephone to be perfectly clear of any infringement of patent rights; it was distinctly disclaimed by Bell, and, I think, it is what is commonly called the "Glasgow Receiver," described by Sir William Thomson. You must not, of course, expect to get such good results from these instruments as you would if using carbon transmitters; but I believe they are the only ones we can legally make up and use, and they certainly are "better than nothing at all."—ACOLYTE.

[57524.]—**Banjo.**—There is much information about banjo making in Vol. XXXVIII. See also p. 17, Vol. XXXIX. It is best to copy the dimensions of a good maker. Tune to concert pitch. No advantage in having handle hollow.—BLACKY.

[57525.]—**Cleaning Stove Front.**—What is the metal and what colour is the bronze? There are not sufficient details to answer the query.—S. R.

[57527.]—**Etching Nickel Plate.**—Cover the plate, as in the ordinary etching process, with a "stopping," or coat of wax or varnish; draw the design with steel or other tools, and flood the lines with nitric acid or aqua regia. Sulphuric and hydrochloric acids will act, but they are both slower than nitric.—S. R.

[57534.]—**Tallow.**—It is next to impossible to remove the smell of tallow. Something can be done by melting and adding a soda ley, injecting steam at the time; but tallow always gives off an odour when melted. The querist should look up the subject in such works as Payen's "Industrial Chemistry."—S. R.

[57543.]—**Address Luggage Labels.**—They are prepared, I believe, by covering the textile fabric with paper pulp, which is sized, as in the ordinary way when making writing-paper.—G. J.

[57556.]—**Secondary or Storage Batteries.**—If this querist will refer to the indices of, say, the last four volumes, he will find that a great deal has been given about secondary batteries. I don't think there is any work specially devoted to them.—NUN. DOR.

[57557.]—**Oysters.**—Would lead or zinc wire do? You should have given some idea of the purpose to be served. Perhaps japanned iron wire would answer.—S. R.

[57566.]—**Sawdust.**—Both dust and shavings are readily removed by exhaust tubes, the current being produced by a fan or Root's blower.—S. R.

[57594.]—**Gunboat.**—Many thanks to James M'Cash Govan for answering my query; I consider myself a fair hand at models as regards workmanship, therefore, as I said before, I wish to have it as perfect as possible. I am sure both myself and our readers would heartily accept details or sketch, as so very little is said on ships and steamers. I may also mention the boat I wish to make will be over 6ft. long.—C. GODDARD.

[57599.]—**Gauge of the Great Western.**—It is some years since I had anything to do with broad-gauge lines; but, if I recollect right, the gauge is 7ft. 0¼in. clear of rails, the odd ¼in. being due to the gauge having originally been a "centre to centre" one of 7ft. 3in. The rails were shallow and broad, being 2¾in. wide at the top, which, deducted from 7ft. 3in., leaves the width 7ft. 0¼in. in clear. The width between the up and down lines was also 6ft. centre to centre; but I think at present the 6ft. is measured in the clear. Probably your occasional correspondent, "M.I.C.E.," can confirm (or correct) what I have stated.—A. S. L.

[57618.]—**Loss of Taste.**—The descripti given by "J. A. P." is too incomplete. Ha he suffered from a severe sore [illegible] Wa syphilitic? Can he taste, and [illegible] or all of following:—1st, [illegible] sauces; 2nd, acids, as vin or citric acids; 3rd, sugar as quinine? Galvanism is ployed, though I cannot advise him how and in what direction to apply it (the direction in which the nerves run) till he answers the above questions. —MEDICUS.

[57646.]—**Steam-Engine Formula.**—I am unable to reply fully to the question at page 167, for I have not got Rankine's book on the Steam Engine, the equations which I before explained I found among a few others, at the end of his "Applied Mechanics"; but the formula now referred to is not among these. I will try, however, to give an explanation from first principles. Conceive, then, a cylinder, the area of whose section or base is equal to a square foot, and within it a piston dividing the cylinder into two parts, the lower part filled with a pound of steam of the given pressure and temperature, the upper part being a complete vacuum, and sufficiently large that, with the lower part, they may be together just large enough to hold the steam when it has become expanded, so as to have the tension of the vapour at the freezing point of water. Now, the steam being shut off from the boiler will expand, as if it were a gas, and the expansion will take place in accordance with Mariotte's law, the pressure diminishing in the inverse ratio of the volume, the gas or steam doing work in moving the piston, which here must be supposed to offer a resistance equal to the final pressure of the vapour. If V be taken to represent the volume of the steam at first, in cubic feet; p its pressure on a square foot; t°, its temperature; and if p^1 be the final pressure of the vapour at a temperature of 32° we should then have the relation—

$$\text{Work in ft.-lb.} = Vp\,.\,\log.\,\frac{p}{p_1} \times \text{hyperbolic log. } 10.$$

We have first to determine V. Now, the volume of 1lb. water = ·016 cubic ft.; the relative volume of steam at the temperature 257° = 792. Hence V = ·016 × 792 = 12·672 cubic ft. The pressure p = 33·7 × 144 = 4,852·8lb. per sq. ft. The tension of vapour at 32° has been variously stated by different writers. From the result that has been arrived at, I think Rankine must have taken it at ·278lb. per sq. in., which is higher than it ought to be. If we use this as the value of the tension, we shall have $\frac{p}{p^1} = \frac{33{\cdot}7}{{\cdot}278}$. And the formula now becomes—

$$\text{Work in ft.-lb.} = 12{\cdot}672 \times 4{,}852{\cdot}8 \times \log.\,\frac{33{\cdot}7}{{\cdot}278} \times 2{\cdot}302583.$$

But $\log.\,\frac{33{\cdot}7}{{\cdot}278} = 1{\cdot}5276299 - \bar{1}{\cdot}4440448$
$= 2{\cdot}0835851.$

$$\begin{array}{rl} \text{Log. } 2{\cdot}0836 & = {\cdot}3188143 \\ \text{Log. } 12{\cdot}672 & = 1{\cdot}1028152 \\ 4{,}852{\cdot}8 & = 3{\cdot}6859924 \\ 2{\cdot}302583 & = {\cdot}3621996 \\ \hline \text{Log. } 259{,}502 & = 5{\cdot}4698515 \end{array}$$

Thus the above formula gives as the answer 259·502 ft.-lb., Rankine's formula as quoted giving 259·410.—MILVERTON.

[57675.]—**Dynamo.**—To Mr. BOTTONE.—I am much obliged to you for your answer to my query. I have tried connecting the wires up as shown in your sketch on p. 147; but I get no better results, and there is not room for any more wire, as the 3lb. already on fills the field-magnets. The dynamo is intended to be worked as a shunt machine; but I connected it in series when I joined it up after your directions. Since writing before, I find there is a little less than ½lb. of wire on armature, which is 3½ by 1¾, and it is not wound very evenly. Would that make any difference? I want, if possible, to light a 10-volt lamp that I have.—LAMINATED.

[57694.]—**Granule Carbon Battery.**—Four quart cells of the above would light a 2½ c.p. lamp easily; and if you have 12 cells, make them into three series of four each, connecting the three end carbons and three zincs together. They will then run three lamps in parallel, or one lamp three times as long as four cells. The best way to charge is: Outer cell, saturated solution bichromate, with one-tenth sulphuric acid; porous cell, water, with one-sixth sulphuric acid and a little mercury; no chlorides; add a little acid from time to time.—W. A. W.

[57702.]—**Coil.**—I think Mr. W. Taylor must have made a slip of his pen when he mentioned in last week's that the ends of the condenser should be attached to the secondary terminals. They should be attached one to the pillar on which the vibrating hammer is fixed, and the other to the pillar containing the screw adjustment for regulating the vibrations. See 57053, Sept. 11.—C. L.

[57718.]—**Annuities.**—In the tables given under this number at page 167 the annuity of the question is undoubtedly obtained from the approximate formula—

$$[illegible] \;.\; \frac{n+1}{2}\,.\,r \Big\} = n\,A.$$

is derived from t[illegible] compound inte[illegible] est, by neglecting terms involving the squares and higher powers of r in the expansion, and it is a kind of compromise between the equations at compound and simple. Thus the annuity that could be purchased for £100 calculated for simple interest would be £19 5s. 2d. Calculated by the above formula, it would be £19 11s. 8d., and by that for compound interest it would be £19 14s. 3d. Next with regard to the two columns headed principal and interest. The numbers composing these columns have a purely artificial construction, forming a kind of rough average, as will be evident from what follows. If we divide £100 by 6, the given number of years, for which the annuity is granted, we have the quotient £16⅔, multiplying this successively by 6, 5, 4, 3, 2, 1, we form the first column below:—

	Interest.			Principal.		
£	£	s.	d.	£	s.	d.
100	5	0	0	14	11	8
83·3	4	3	4	15	8	4
66·6	3	6	8	16	5	0
50	2	10	0	17	1	8
33·3	1	13	4	17	18	4
16·6	0	16	8	18	15	0

Consider now that the numbers in this first column are a rough estimate of the present values of the annuity, or the worth of it, at the beginning of each of the six years. Then computing the interest on each of them for a year, we have the column headed Interest. The column headed Principal is formed simply by subtracting each interest in turn from the annuity, £19 11s. 8d. It may be interesting to see what the correct numbers are, of which these are given as an average. Computing according to compound inserest, using £19 11s. 8d. as the annuity, we have the corresponding columns:—

	Interest.		
£	£	s.	d.
100	5	0	0
85·416	4	8	3¾
70·104	3	10	0½
54·026	2	14	0¼
37·144	1	17	1¼
19·418	0	19	5

Had we computed using £19 14s. 3d. as the annuity, the sum of the interests would obviously have been greater.—MILVERTON.

[57754.]—**Gas Supplies.**—To "R. M. P." (page 168).—If your remarks apply to this city, I have observed that the gas engineer has apparently of late considerably increased the pressure upon the gasometers, simultaneously with a reduction in the price per 1,000ft., and also reduced the quality of said gas for lighting purposes, as the flame seems to me to be much redder than it used to be, and if consumers do not attend to their stop-taps, and check this extra pressure, especially when using gas after the shops and "pubs" are closed, their quarter's bills will astonish them. Want of sufficient water in the meter will cause a sudden fall of all the lights if an additional tap be suddenly turned on full, in order to obtain another light.—A., Liverpool.

[57754.]—**Gas Supplies.**—Several treatises have from time to time been issued, dealing wholly or in part with this subject, and probably the one mentioned by Lever in your last issue is as good as any; but, as many of your readers are no doubt users of gas, and will probably not have the opportunity of seeing any of such treatises, the following remarks may not be out of place:—Beginning with the meter, this may be either a "wet" or "dry" one, both of which seem equally serviceable, but each having points of superiority over the other. All meters are tested officially as far as capacity of the drum is concerned, and if found correct within the limits of 2 per cent. fast or 3 per cent. slow are stamped. The indexes, however, are not examined, and it is quite certain that many are in use not having the correct number of teeth in the wheels. The writer can give instances where meters having been taking out for repairs have been found to have had incorrect indexes; in one case the indicator was 25 per cent, and had been for years, against the consumer; in another the same amount against the gas company. This defect is well known in the meter trade, and recently the best makers have set up machinery for counting the teeth. It will, however, be easily seen that the best index must be one which can be checked by the official when testing the meter, and of this class one or two kinds have very recently made their appearance. Both kinds of meter, from a consumer's point of view, should be placed in a cool position (but not in one where there is any likelihood of its getting frozen, if a wet one), as by so being placed the gas passes through it in a somewhat more condensed form, and will take up less moisture, and as a consequence less condensation will be the result. The pipes should be laid, where practicable, in such a manner that the condensed water will return to the meter. Where this is impracticable, the pipes should be [illegible] so as to cause the water to pass into siphons, [illegible] should be placed in convenient positions; [illegible]hould have screw plugs at the end to let out the water occasionally. Open-end siphons are dangerous, as if placed in a warm situation there is the possibility of the water evaporating, and particularly during the summer months, when little or no condensation is going on in the pipes. With respect to reading the meter, most gas companies issue cards showing how this is to be done. In reading the ordinary index for the first time, put down 0 0, then take the number to which the right-hand finger points (if *between* two numbers then take the *lowest* one, thus if between 7 and 8 take 7, but if between 9 and 0 take 9 as 0 is really 10), and put this to the left hand of the 0 0 thus 700. Next take the lowest number to which the next finger to the left points (or if between two numbers do as above described), and put this to the left of the previous number, thus 2,700, and the same with the others, if any. There is no mystery at all about it; nevertheless, the writer recently came across a plumber, who had been at his trade for fully five years, who actually confessed when put to the test that he was unable to read one. No wonder, then, that the public generally are not as a rule proficient in it. There are, of course, many other points connected with meters, size of pipes, &c., that cannot be entered into in a letter such as this, which is only intended to touch upon matters which the writer believes are of the most general interest. Now, with respect to the amount of light obtained from the combustion of gas, rapid strides have of recent years been made, as the legal standards, which in their day gave the best results, are quite outshone by burners of the regenerative type. By their use the light in some cases is more than doubled with the same consumption of gas. This extraordinary result is attained by causing the air for combustion with the gas to become very highly heated by coming into contact with the surfaces heated by the escaping products of combustion. These regenerative lamps, however, require a globe as an integral part of their construction, and without this they are useless. They also require very careful regulating as to quantity and quality of gas; otherwise the light will not be of its proper intensity, or smoke will be formed. They also give out a great deal of heat, so that, although they are very efficient, they require more attention than the public as a rule care to give. For general use, therefore, the ordinary union jet or slit-burner (not excepting Argand's, which have done good service) will long occupy the foremost place, as by the use of the best of these—*i.e.*, those particularly adapted for the quality and quantity of gas intended to be consumed—very good results are obtained, little, if any, inferior to the standard, and in many cases double those at present in use, which are put on by men having no special knowledge on the question. It is not the writer's purpose to advocate any particular make of burner, but only to indicate the general line on which to go to get the best value out of the gas for money. To do so, the gas should issue from the burner at a very low pressure, a fraction only of that at which it is usually supplied in the mains; and very probably the reason of the hissing noise at the burner, mentioned by "R. M. P.," was that the tap had been to some extent closed to prevent the gas issuing at too rapid a rate. It would, of course, hiss if too great a quantity of gas were passing, and great waste be the result. Now, a burner to consume gas supplied at a low pressure must necessarily have the holes or slit of the requisite sizes for the particular quantity to be consumed, having regard to the shapeliness of the flame, and it has been found by long experience that the nearer smoking a flame is the light given is greater; but as this principle, if carried too far, would give us extremely flabby flames, a medium has to be struck. For good street lamps the flames may verge upon smoking; but where there is the slightest draught the flame must be more active, with, of course, a consequent diminution in light. Again, for instance, a flabby flame cannot be tolerated where writing has to be done; but for the general illumination of a room, and especially if the flame is surrounded by a globe having a wide bottom, called a "comet," a flame less active, and nearer its maximum of light, may with advantage be used. Argands, on account of their steadiness, are very often used for writing by. To insure the proper pressure of gas to the burners, what are termed "main governors" are very much in vogue, and where a large quantity of lights are dependent upon them, they are, perhaps, the best investment that could be made; but for the ordinary consumer, with his five or six lights at the most, what are termed "governor burners" are unquestionably the best. These burners contain in their interior an arrangement whereby only the particular quantity of gas for which they are constructed is allowed to pass, whatever the pressure at which the gas is supplied, so that, in purchasing these the size should be stated. Thus, a No. 5—i.e., 5ft. per hour, with ordinary gas, will light very fairly a room 12ft. square, and is a very common size; Nos. 4 and 3 are, however, in requisition by the more thrifty people. I would just say in conclusion, that the simple hissing of a burner, unless attended by streaks, so to speak, is no criterion whatever that the burner is wasteful, as the hissing is very often not at the burner at all; but at the tap: this can readily be verified by taking off the burner.—GASLIGHT.

[57756.]—**To Mr. Wimshurst.**—I am sorry that my query has been so badly worded; but I meant to be as explicit as possible. My neutralisers are fixed in the manner recommended and described by you. I have, since my query was inserted, got my machine to work, but it was a very frosty day and dry. I only succeeded in getting sparks about 1½in. long, and there seemed to be a great leakage across the plates to the brass bosses on which I have mounted my 18in. plates. If you think that the bosses are at fault, I will replace them with wooden ones, as there seems to be no other fault with the machine.—C. P. C.

[57757.]—**To W. H. Eaves or S. Bottone.**—I am sorry I cannot help you in this case, as I have had no experience with small dynamos giving so high an E.M.F. (110 volts). I fancy you must have made a mistake. In your query you state that 100 volts and nine ampères are required to run eight 16-c.p. lamps. The lamps you propose to use must be very wasteful of current. I have always found 50 volts and six ampères ample for eight 16-c.p. lamps; and with one ampère to each lamp, they are run far above their normal candle-power. If a 50-volt machine will do, I will do my best to help you.—W. H. EAVES, Coventry.

[57765.]—**Gramme Dynamo.**—TO MR. BOTTONE.—Such a dynamo should have field magnets about 8in. long, 1½in. thick; ring armature about 3in. diameter. Use about 4lb. of No. 16 on the fields, and about 1lb. d.c.c. No. 20 on the armature. —S. BOTTONE.

[57771.]—**Commonplace Book.**—The genuine old-fashioned "commonplace book," as I understand it, is a sort of "waste book," or journal, into which go down all sort of miscellaneous scraps of information, or ideas, one after another, just as they come, in no particular order. It answers to the "waste book" of a warehouse. This sort of book has one advantage—that the note may be jotted down instantly without loss of time in finding a suitable place or subject to class it under, and it will suit many busy people best for that very reason only. Now, in business, the "journal" (as it is now generally called) implies a ledger into which these random entries are carried, each to its proper account and place, but (in nine cases out of ten) the entry is not recopied *in extenso*, only the gist of it is entered—to wit (in commerce), date, amount, due date, and reference folio of journal, so that the full particulars may be instantly referred to. Use exactly the same system with your commonplace book, or daily "journal," of facts and ideas. Have a ledger or index to it (for the ledger of commerce is really an index to the journals), in which open an account for each subject or branch of a subject at your discretion, only use a little consideration first, and, above all, leave plenty of space in your ledger, so as to have as little transferring of accounts as possible. Commercial people will know what I mean; you may have endless journals, but a constant change of ledgers is a nuisance—hence the large size generally used. Besides this, there is always an index to the ledger. Have the same to your "ledger;" this is really an index to an index; but so far from complicating matters, will save endless time. I mean you to have a large index, like a ledger, in which each subject will have a sufficient number of pages devoted to it, and these pages will be an index to the entries in the journals, only a somewhat extended index with short particulars of each entry, besides the folio where it may be found, so that one may judge instantly which entries are likely to bear on the subject required without having to turn up and refer to each of them. Then at the beginning of this book will be a simple index (just as in a ledger) merely showing the folio where the extended index is to be found in the book. An example will show best. Say I wish to refer to particulars of the "Chronodeik," an instrument for getting time from the sun, described in "Ours" some time ago. I have, we will say, utterly forgotten its name, but I turn up my index under "Time," and am referred to page 201 in my ledger. I run my eye down various references—"mean time, origin of term"; "equation of time," "Paris time," "time from Jupiter's satellites," and so on; but no Chronodeik—these short headings have saved me turning up all shese irrelevant entries in my journals; but it was very lazy of me not to index Chronodeik under this heading of "time." However, I know it must be found under "scientific instruments," so refer to index, and am sent to page 403 in ledger. Here there is a very long list to wade through, but as each reference has a short description or digest, I run through it quickly without referring to useless entries, till I suddenly espy "Chronodeik, instrument for getting time from sun by two observations, before and after noon, self-adjusting," which last word would let me know this is what I want, even if I did not recognise the name. Therefore, if the journal system suits you, that of jotting down things right on, just as they turn up, keep also a "ledger" to it, with an alphabetical index at beginning to refer you to the subject, and under each subject a list of references with short particulars, to the various entries in the journals. Let the "ledger" be a good size, and leave plenty of space for each subject. It is, however, worth considering whether it is not worth while, in many cases, not to enter things higgledy-piggledy all in one book; but rather to give more space to each subject, and to enter each "note" in full, there and then, under its proper subject. It has its advantages and its drawbacks, the principal advantage being that when you want to go right through a subject you have it all together. Disadvantages: 1. That you must have a large series of books on hand all at once if you are to leave proper space for all subjects. 2. It is not, though it sounds paradoxical, so easy to find any particular entry, from the number of pages that one has to turn over, and the absence of the short headings or abstracts, and even if one puts short headings written boldly, they do not follow each other closely, and cannot be glanced through so quickly. 3. It is almost impossible to know what space to leave each subject. 4. A subject looks very mixed and confusing when it grows to large dimensions. 5. An entry can only go under one heading, and though one may put a short reference to it under another heading, this reference is there swamped in a mass of other entries written *in extenso*. And lastly, this is not a "commonplace" book at all. Still, it is worth while to devote a special book to special prominent subjects (such as one's business or profession), but keep up the ledger system, with plenty of room for each subject, and an index of "subjects" at beginning. An ordinary smallish ledger without columns serves well for this.—NORMAN.

[57778.]—**Shunt Dynamo.**—To "W. H. E."—Yes, the dynamo is perfectly suitable for charging accumulators. There is no special ratio between the res. of battery and dynamo. The battery must have a res. considerably less than the dynamo. The lower the resistance of the battery the more efficient will it be. The resistance of 25 cells, taking a charging current of 30 ampères, and having capacity of 200 ampère-hours, would be about 0·02 ohm. The dynamo must of course have an E.M.F. a few volts in excess of that of the battery.—W. H. EAVES, Coventry.

[57781.]—**Tracing Paper.**—The paper is generally fastened down by drawing pins, or it may be gummed or glued round the edges; in the latter case, the tracing paper should be sufficiently large to allow the gummed margin to be cut off after the tracing is finished. When coloured, the tracing should be allowed to get quite dry before cutting off or taking out the pins; this will prevent the wrinkling; the colouring should be the same as the drawing. When using tracing linen, colour the back side of the tracing; the ink is easily rubbed off if the colour brush is passed over the front glazed face. Drawings on ordinary tracing paper should be coloured before the writing or printing is put on, and allowed to dry. Some tracing paper, and most parchment, is very awkward to colour upon, especially if a large surface is to be covered, a drop of liquid ox gall (see "Sale Column") works miracles, and will cause the colour to flow freely. Keep the brush well filled, start at the top left-hand corner, and work quickly along the top and downwards, having your drawing board on a gentle slope; keep a sheet of blotting paper under your hand to take the surplus colour from your brush when towards the finish.—ARCHITECTUS.

[57783.]—**Dynamo.**—TO MR. BOTTONE OR OTHERS.—Take my advice, and do not build it. You would use half the power transmitted to the pulley in exciting your F.M.'s. In a good modern dynamo the current used to excite the fields is a very small fraction of the whole. This system was used some years back to obtain a steady E.M.F., but it failed, as any one who knows anything about dynamos would at once see. Suppose the speed and the current sent round the F.M.'s to be kept perfectly regular, then, as the external resistance is lowered and more current allowed to flow, the E.M.F. of the machine falls, and continues to fall so long as the current is increased.—W. H. EAVES, Coventry.

[57787.]—**Induction Coil.**—I do not think the iron tube a good thing; its place would be better occupied by wire. The diameter of core is rather small, on which account I should say 4lb. of No. 36 would be enough, and I should certainly advise winding it in discs as recommended by "Inductorium," and as in my own coil, for description of which see Nos. 779, 782, 797: this is both easier and better than the old plan. The secondary should not occupy more than 6in. of the middle of the core, and would probably give over 5in. spark, if the other parts are right, with five Grove cells.—J. BROWN, Belfast.

[57788.]—**Electric Bell Action.**—My sincere thanks to Mr. Bottone and "Sigma" for their kind replies on p. 169. As Mr Bottone offers to send a plan of arrangement, I should feel greatly obliged if he would do so, as I require the electric bell action for practical purposes, and should be grateful to him and to others for any suggestions they may feel disposed to give. I may inform Mr. Bottone that I shall require to play "full chords," and should like, if possible, to work the whole arrangement with one large powerful battery.—G. FRYER.

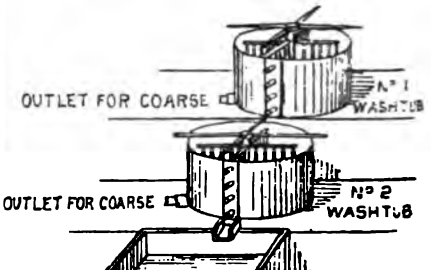
[57790.]—**Rusty Boiler.**—If "J. W." will advertise his address, I will send him particulars of a certain, simple, and permanent cure for this domestic trouble, which, though only of recent introduction, has already to my knowledge effected cures in many hundreds of cases about—ACCRINGTON.

[57790.]—**Rusty Boiler.**—Thanks to "Bowling" for his suggesting gas tar, burgundy pitch, oil, and resin. Could he say what kind of oil? and whether it is the mixture or the pipes that is heated to 400° Fahr.; is it not the latter? And as said pipes are mostly for water mains where cold water only flows, if he knows whether it will answer for hot up to boiling point. If I knew the proportions, might experiment on a piece of metal, and also as to its flavouring the water.—J. W.

[57799.]—**Dynamo.**—An error has slipped in in the dimensions of armature, diameter of which is 4½in. In your reply, you say wind armature with 1lb. No. 20; this, to me, seems altogether too little for such a large one, so before winding thought I had better call your attention. Please say if former quantities and numbers will be right, or if armature quantity be altered, say if field requires altering also. Should also be glad to know if these instructions are for series-wound machine. Will report results shortly. Also, does it matter whether pulley is on same end of axle as commutator?—in machine I have, it is arranged so, although all I have seen are otherwise.—T. H. HAWLEY.

[57803.]—**Amateur Photography.**—I can recommend a simple toning bath consisting of about as much bicarbonate of soda as will cover a shilling, heaped up, melted in about 10oz. of warm water, added to 1½gr. chloride of gold. Prints not to be completely washed before being toned. If querist does not succeed, I shall be pleased to tone some prints for him if he will send them to me, in order to see if his paper is all right. Does he print dark enough?—C. J. RYAN, Ventnor.

[57808.]—**Sifting.**—Would not a double wash tub suit your purpose, if arranged somewhat in the following manner? The powder being run into No. 1 tub with a large quantity of water, the contents then thoroughly mixed by moving and reversing the arms in the tubs, which are fast to central shaft, and moved by handles, as indicated. Then rest ten minutes if substance is fine, and sp. gr. about 2·5; afterwards run the fine fluid off by plugs, taking out top one first, and so on, into the No. 2 tub; repeat the washing here, and settle again about ten minutes, then run off into tank. The coarse is let out of the washtubs by a plug at the side, which is placed lower than the others.—POTTERY TECH.



[57815.]—**N.E. Railway Engines.**—These engines will be some of the finest in the world and are called "Tennant's Express Engine." Diameter of body, 7ft. 2in.; wheels (leaders), 4ft. 6in.; wheels (centres), 8ft. 6in.; wheel base, 16ft. 8in.; cylinders, 18in. by 24in.; boiler pressure, 140 per sq. in.; heating surface, 1,400ft. The tender has wheels 3ft. 6in. diameter, with steel axles. It will hold 2,800 gallons of water and 3 tons of coal. Weight of engine in steam, 42 tons; ten[illegible] 28 tons. On trial trips they attained a [illegible] 80 miles an hour. They will run from [illegible] Edinburgh and vice versâ in [illegible] takes two engines to accompl[illegible] BUIG MACTÔMAE.

23.]—**Dynamos.**—For machines of such a ize, to be used against a constant resistance, s no great advantage in using a shunt wind- A Siemens' H armature, laminated, gives ood results. If you will consult my book, Dynamo: How Made, and How Used," you id every detail as to winding and propor- The dynamo should, however, be at least large again, and the wire on the armature instead of No. 20.—S. BOTTONE.

26.]—**The "Genesta."**—The following di- ons are taken from the *Field*; I give those of tan" also:—

	Genesta.		*Puritan.*
1 on water-line ...	81ft.	...	81·01ft.
....	15ft.	...	23ft.
ht of water	13ft.	...	8ft. 3in.
cement	141 tons.	...	105 tons.
keel	70 tons.	...	27 tons.
t	2 tons.	...	17 tons.
deck to hounds ...	52ft.	...	59ft.
ast	47ft. 6in.	...	42ft.
boom	70ft.	...	76ft.
rit outboard.........	35ft.	...	40ft.
aker boom	63ft.	...	64ft.
il yard..................	42ft.	...	46ft.

Measurements for Sailing Length.

	Genesta.		*Puritan.*
eight	97·20	...	102·01
aff	46·00	...	47·00
ase	140·50	...	144·06
il area	7387	...	7982
.W.L.	81·60	...	81·01
il length	83·05	...	83·85

ield continues:—"It will be noted that the York Yacht Club has made the water-line of *enesta* 7in. longer than the Y.R.A. The cement of *Puritan*, it will be seen, is put at ns; we are inclined to think that this is a ke, and that 120 tons, as first announced, be nearer the mark." The *Genesta* was built ssrs. Henderson, Glasgow.—BOWLING.

27.]—**Dissolving Alloy out of Gold Ring.** l brush the ring in hot soapsuds, then make in a spirit lamp, then dip it in nitric acid arts, water one part, for about ten seconds, rinse in water, then brush.—ONE THAT S.

27.]—**Dissolving Alloy out of Gold** —If the ring is 15 carat or upwards, then it coloured by boiling in colouring mixture. 2oz. salt, 2oz. alum in powder, and 4oz. salt- mix and put into a pipkin with a little which place on the fire, or over a spirit lamp kettle boiler, and keep it boiling as near as le at the thickness of cream; when getting ick, add a little boiling water from time to The ring having been thoroughly cleaned ee from grease, is suspended from a bit of or soft platinum wire fastened to a bit of and boiled till the required depth of colour is ed; then wash off in hot water, using a stiff soap, and carbonate of soda, and dry by ig in a bag of hot boxwood sawdust. If the under 15 carat it would be best to give to a ng jeweller to finish, either by polishing or g.—DENS.

28.]—**Sprained Elbow.**—It is probable ou are suffering from a slight dislocation of int of the elbow. It is, therefore, a case for eon, with whom you had better communicate ut further delay. Your elbow never will be until the joint is placed in its proper loca- In such a case as this bathing is of no use. o not state whether there is any inflammation it.—G. FRYER.

328.]—**Sprained Elbow.**—After you ed your elbow, was it put in a splint, or your out in a sling? Can you fully bend your (without jerking or twisting it) without yourself much pain? The most probable of your pain is that the adhesion, which s forms round a joint that has been rested, es to be broken down. Read "Some Com- njuries to Limbs," by E. Cotterell, published K. Lewis, 136, Gower-street, W.C.—C. H.

331.]—**Induction Coil.**—It does not follow the secondary current, as measured by a nometer of comparatively low resistance, or as tested physiologically by the shock pro- , will be increased by the addition of more in series with the first portion; on the con- it may be decreased. The current in a dary—say, one mile long—is proportionate to ectromotive force, divided by the resistance wire, said electromotive force being propor- l to the number of turns of wire and the gth of magnetic field. Adding another mile es the [illegible] but not the E.M.F., since we [illegible] turns out of a mile, be- [illegible] cylinder. [illegible]

No. 2 portion of wire contains rather more turns than No. 1, and has its ends brought out separately and joined to the same terminals as No. 1, so that the pair work in parallel circuit or multiple arc, the resistance would then be reduced so as to give a much greater current through a low resistance between the terminals. This does not apply to spark discharge, because then the resistance between the terminals is so high that we may, roughly speaking, neglect that of the wire, and hence the spark length in air is increased by increasing the length of secondary in series.—J. BROWN, Belfast.

[57834.]—**Electric Light.**—A central chandelier with five 20-candle power Swan lamps would do this effectually. A small dynamo and gas-engine would supply the necessary current. Total expense of plant, about £50.—S. BOTTONE.

[57835.]—**Working Load of Chains.**—Safe load in tons is equal to diameter in eighths of an inch squared and divided by 9—thus $W = \frac{D^2}{9}$ Take for example a $\frac{3}{8}$in. and $\frac{1}{2}$in chains: $\frac{3}{8}$in. $= 3 \times 3 = 9 \div 9 = 1$ ton. $\frac{1}{2}$in. $= \frac{4}{8}$in. $= 4 \times 4 = 16 \div 9 = 1{\cdot}77$ tons. Look at Molesworth's Pocket-book.—X.

[57835.]—**Working Load of Chains.**—The following is a rule for finding diameter of iron for given load, or vice versâ:—

D = Diameter in eighths of an inch.
W = Safe load in tons.

$$\text{Then}\quad D = \sqrt{9\,W};$$

$$\text{and}\quad W = \frac{D^2}{9}.$$

$$\text{If}\quad d = \text{Diameter of iron in inches,}$$

$$\text{then}\quad W = 7{\cdot}111 d^2.$$

The table below gives working loads of chains from 1in. diam. to 1$\frac{3}{4}$in. diam., advancing by sixteenths to 1in.

Diam., in.		Load, tons.	Diam., in.		Load, tons.
$\frac{1}{4}$	...	·44	$\frac{13}{16}$	...	4·69
$\frac{5}{16}$	...	·70	$\frac{7}{8}$	...	5·44
$\frac{3}{8}$	...	1·0	$\frac{15}{16}$	...	6·25
$\frac{7}{16}$	...	1·36	1	...	7·11
$\frac{1}{2}$	...	1·78	1$\frac{1}{8}$	...	9
$\frac{9}{16}$	...	2·25	1$\frac{1}{4}$	...	11·11
$\frac{5}{8}$	...	2·78	1$\frac{3}{8}$	...	13·44
$\frac{11}{16}$	...	3·36	1$\frac{1}{2}$	...	16·0
$\frac{3}{4}$	...	4·0	1$\frac{3}{4}$	...	21·78

—BOWLING.

[57835.]—**Working Load of Chains.**—The rule, according to Molesworth, for safe load on chains is as follows:—

D = diameter in eighths of an inch.
W = safe load in tons.

$$D = \sqrt{9\,W}\cdot$$

$$W = \frac{D^2}{\cdot 9} = 7{\cdot}111\,d^2,\ \text{where}$$

$$d = \text{diameter of iron in inches.}$$

This table of safe working loads is also given—

Diam. in inches.	Load.	Diam. in inches.	Load.
$\frac{1}{4}$	·44	$\frac{13}{16}$	4·69
$\frac{5}{16}$	·70	$\frac{7}{8}$	5·44
$\frac{3}{8}$	1·0	$\frac{15}{16}$	6·25
$\frac{7}{16}$	1·36	1	7·11
$\frac{1}{2}$	1·78	1$\frac{1}{8}$	9
$\frac{9}{16}$	2·25	1$\frac{1}{4}$	11·11
$\frac{5}{8}$	2·78	1$\frac{3}{8}$	13·44
$\frac{11}{16}$	3·36	1$\frac{1}{2}$	16·0
$\frac{3}{4}$	4·0	1$\frac{3}{4}$	21·78

Messrs. Brown, Lenox, and Co. give the proof strain of chains as follows:—

Diam. of cable in inches.	Stud chain cable in tons.	Average weight per fathom in lbs.
$\frac{1}{2}$	4·5	14
$\frac{9}{16}$	5·5	17
$\frac{5}{8}$	7	21
$\frac{11}{16}$	8·5	25
$\frac{3}{4}$	10·125	30
1	18	54
1$\frac{1}{8}$	22·75	68
1$\frac{1}{4}$	28·125	84
1$\frac{3}{8}$	34	102
1$\frac{1}{2}$	40·5	122
1$\frac{5}{8}$	47·5	143
1$\frac{3}{4}$	55·125	166
1$\frac{7}{8}$	63·25	191
2	72	217

It is safe to use one half only of proof strain.—T. R. SAXTON.

[57837.]—**The Wimshurst Influence Machine.**—"J. O. H." will find these machines work best when there is no resistance in the brush circuit, and great resistance in the outer circuit. The combs, or points, are of course in the outer circuit, therefore they may be far enough away from the glasses to make quite sure they do not touch the [illegible] at any part of its revolution; perhaps a ¼in. [illegible] the point and the glass is enough for the [illegible] difference in the size of the two [illegible] is necessary to produce a long spark —they must be situated relatively to the (+ or −) character of the electricity.—J. W.

[57838.]—**Induction Coil.**—I should strongly advise "Novice" to get Sprague's "Electricity." From it he will get all the practical information he asks for and far more besides—an understanding of the reasons of things, of far more importance than the mere rule of thumb directions necessary to obtain one circumscribed object.—J. BROWN, Belfast.

[57840.]—**Bichromate Battery.**—The exciting fluid is made by dissolving powdered bichromate in hot water, the proportion being about 2oz. bichromate in 1 pint water. When cold, add sulphuric acid in the proportion of 1 part of acid to 12 parts bichromate solution. The addition of the acid generates heat, and when the solution is again cold it is ready for use. The charge will keep in the cell for a considerable time with the zinc raised out of it, and the battery will be always ready for action. Its action, however, is not long sustained, as it fails very fast within an hour; but raising and lowering the zinc restores it. It is a very useful battery where a powerful current is required for a short time.—BOBADIL.

[57843.]—**Prepared Emulsion.**—If you wish to become a successful photographer, you ought to learn to make all your preparations. I do not mean that you ought to prepare your own chemicals, though it would do you no harm to learn to do that; but all your solutions, and all the manipulatory processes, should be tried by you until you have succeeded. Then, and then alone, can you know on what failure or success may depend. With regard to the second part of your query: The pyroxiline used by photographers is a nitro-compound of cotton, very similar to gun-cotton in constitution and properties. Its chief differences are that it is soluble in mixed alcohol and ether (which is not the case with the explosive), and it is not so explosive as its more highly nitrated brother.—S. BOTTONE.

[57844.]—**Dynamos.**—The paragraph in question refers to the older form of machines, and savours of an advertisement for the Gramme machine. A well-made Siemens machine is as capable of feeding several lights as a Gramme. The armature figured at No. 1050 is the best for small machines.—S. BOTTONE.

[57845.]—**Storage Cells.**—TO SELIMO BOTTONE.—My practical acquaintance with accumulators is but small, and not very favourable. Two cells would certainly not light a two-candle lamp, unless of very low resistance indeed. How did you couple up to charge—in series or in parallel? Try to charge your cells by coupling up in parallel, and leave them for half an hour or more connected up to the charging battery. Disconnect, and couple up in series for work. Give an account of results for the benefit of your fellow-readers.—S. BOTTONE.

[57848.]—**Dynamo.**—TO MR. BOTTONE.—Coupling in parallel reduces the resistance of the F.M.'s to one quarter what it was; hence, the magnets receive more current as the resistance is less. In practice, I find that the quantity of wire on the fields should be largely in excess of that on the armature; but it must be brought to a correct balance (a trifle over the running resistance of the armature) by coupling up in parallel. The electromotive force is largely governed by the speed; it rises rapidly with the speed till it reaches the critical point, which is different with each machine, then it actually decreases if the speed be increased. A velocity of between 1,500 to 2,000 revolutions, I should think, would be ample.—S. BOTTONE.

[57852.]—**Binocular Microscope.**—Except for low powers the binocular is not satisfactory. When I say low powers, I mean up to and including ¼in. Since the same objective receives the image of the object, and its distance is not varied when the tubes are racked out to compensate for any inequality in the focality of the two eyes, it follows that the motion of the eyepieces simply compensates for any difference in focal length, without showing any other "planes."—S. BOTTONE.

[57855.]—**Electro-motor.**—TO MR. S. BOTTONE.—Will you kindly refer to page 387 of Vol. XXXIX. of the ENGLISH MECHANIC? You will find the description of two motors; the second will suit your purpose admirably.—S. BOTTONE.

[57858.]—**Brass Castings.**—Has "E. P." tried dusting the surface of sand with plumbago dust after taking the pattern out, and then smoothing it over where practicable? The plumbago dust should be put in a rather fine canvas bag, which should be held by the mouth, and shaken up and down over the moulding. The casting will always be hard on the outside, but can be softened afterwards by heating.—BOWLING.

[57861.]—**Portable Electric Light.**—The battery described by this correspondent is not Skrivanew's: it is a cross between Marie Davy's and Leclanché's. So small a battery would be of no use for a 10-candle lamp. It would require at least 10 cells of a Grove, or other similar battery of about 2 volts E.M.F., to do this work properly.—S. BOTTONE.

[57864.]—**Magneto-Electric Machine.**—TO MR. BOTTONE.—You wish, in point of fact, to construct a dynamo with bobbins. Such a core is known as the "Victoria." The bobbins should have iron wire cores (power is much less without), and might be wound with No. 22, though this is very fine for dynamo work. The running resistance of the wire on the bobbins should then be measured by a bridge and resistance box, and the magnets wound with a coarser wire, say 16, until they rather more than balance.—S. BOTTONE.

[57865.]—**The Wimshurst Influence Machine.**—The arrangement of plates sketched by "Anxious to Know" in his question will answer very well for a multiple plate machine; he must, however, have the spindle large enough to prevent any springing; also he must have the bosses so long that the plates run true: short bosses are liable to trip, and let the plates come into contact. Say let the length of boss be equal to one-sixth the diam. of the plates, and for 18in. plates let the spindle be of ¾in. steel. The brushes are better carried independently of the spindle, and the whole of the brushes must be in metallic connection with one another. A machine with 11in. plates arranged as above is giving very good results, and another machine with 24in. plates is in progress.—J. WIMSHURST.

[57866.]—**Violin Neck.**—If "Bruno" will describe where his neck is broken, or if he lives near, show it to me, I will explain his difficulty through "E. M." It is not necessary to take off back or belly.—T.

[57866.]—**Violin Neck.**—You should not put a new neck to your violin, no matter how it may be broken. With care, you can glue it up again. Good glue is stronger than wood. But if that cannot be done, apply to some of the musical instrument warehouses, and obtain a neck with scroll quite finished, excepting the part where it is to be fitted on the body, which must be finished after you have fitted it on. The back and breast must not be taken off. Fit it well, and use best glue.—J. H. SCHUCHT.

[57868.]—**Gas.**—The use of cannel coal, more or less, is the cause of the richness spoken of.—BREAM'S BUILDINGS.

[57868.]—**Gas.**—Because gas in Scotland and the north is usually made from cannel coal. Cannel gas is supplied in London, but only to parts of Westminster, I believe.—S. R.

[57870.]—**Luminous Paint.**—A sign painted with luminous paint would last like ordinary paint if properly painted and protected by an over-varnish (sold for the purpose), or any good transparent varnish; wash the dirt and smoke off occasionally. It would cost about four times as much as ordinary paint. The sign must be placed in a position where white paint could not be seen at night. A sign properly painted and large enough, and placed in a perfectly dark place, would prove an effective advertisement.—W. ROWLAND HART.

[57874.]—**Tank.**—Zinc, like many metals, is more or less affected by rain water, but there is practically nothing to fear. The best plan, no doubt, would be to have a properly cemented brick or stone tank, or lined or built with asphalte or "Hygeian Rock" composition, of Mr. White, of Victoria-street, S.W. Write to Mr. C. J. Roberts, Haslemere, for copy of his circular, "Rain-water Separator"—a most excellent arrangement where rain water is used. Inquire of T. B. Batsford, of 52A, High Holborn, W.C., specially engaged in the publication of building books. He may have, amongst others, "Henry Roberts, on Cottages and Dwellings for Working and Labouring Classes for Town and Country"; of Seeley's, Nisbet's, Parker's, and others; 4s. cloth. 1853. Third edition.—BREAM'S BUILDINGS.

[57876.]—**Bisulphide of Carbon Prism.**—It has been frequently stated that glue on paper, calico, or silk is the best material for joining the edges of these prisms. I should add a little bichromate of potash to the best clear glue.—S. R.

[57876.]—**Bisulphide of Carbon Prism.**—I have had the pleasure of answering this query twice in back numbers (Vol. XXXVII. p. 322, and Vol. XXXIX. p. 286), and here it is again. There is also an answer which gives full information (by Mr. Lancaster) in Vol. XXXVII. p. 342. The cement used is 3oz. of isinglass and 3oz. of glacial acetic acid, mixed in equal weights. It must be warmed when put on, and so must the glass. It is insoluble in carbon disulphide.—R. A. R. BENNETT.

[57876.]—**Bisulphide of Carbon Prism.**—In Weinholdt's "Physics" it is recommended to first fasten the pieces with thin glue, and then complete the joint with the following cement:—Soften ½oz. glue in cold water, pour off the water, and add ⅛oz. treacle, and heat cautiously; stirring continually till the glue is dissolved, and both substances thoroughly mixed. Boil, and then allow it to cool, to remove bubbles. When required, heat till it is thin, but not boiling, and apply a thin layer at intervals of a few hours, with a small brush. It does not become quite dry; but is bisulphide-tight.—J. BROWN, Belfast.

[57883.]—**Steam Pressure.**—"G. W. A.'s" boiler will blow off at 13·5lb. approximately—that is, if the 7lb. means weight of valve plus any extra weight that may be on valve. The following is the rule:—

$$\begin{aligned} D &= \text{Diameter of valve} \\ A &= \text{Area of valve} = D^2 \times \cdot7854 \\ W &= \text{Total weight on valve-seat in lb.} \\ P &= \text{Pressure of steam in lb. per sq. in.} \\ &= \frac{W}{A} = \text{in this case } 13\cdot5004, \text{ \&c.} \end{aligned}$$

—BOWLING.

[57883.]—**Steam Pressure.**—To find the pressure of steam per square inch required to blow off a dead-weight safety-valve, multiply the square of the diameter of valve by ·7854, and divide the result into the weight of the valve in pounds. Taking the numbers given in your example we get pressure per square inch $= \dfrac{7\text{lb.}}{\frac{13}{16} \times \frac{13}{16} \times \cdot7854}$

$= \dfrac{7}{\cdot5184} = 13\cdot5\text{lb.}$ (about). Thus your safety-valve will blow off when the pressure of steam in the boiler exceeds 13½lb. per square inch.—BOSKEY.

[57883.]—**Steam Pressure.**—The rule for finding the pressure at which a dead weight safety valve will blow off at is to divide the weight by the area, thus:—

W = Weight in lb.
A = Area in square inches.
P = Pressure in lb. at which the weight will blow off.

$$P = \frac{W}{A}.$$

Your valve being $\frac{13}{16}$in diameter has an area of ·5185, and your weight being 7lb., you will see by dividing 7lb. by ·5185 the pressure of steam it will take to blow off your valve will be 13·50lb. If you have not taken the weight of the valve itself into consideration, you should of course do so.—T. R. SAXTON.

[57888.]—**Earache.**—Under nearly similar circumstances, some years ago, I was afflicted with this pain. It was, I well remember, instantly relieved by putting a small mustard poultice on the head immediately behind the ear.—EYE-WITNESS.

[57888.]—**Earache.**—I should recommend "Semper Fidelis" to try a blister behind the ear, either mustard-leaf or emplastrum cantharides. If this does not afford relief, it would be advisable to seek the advice of an aural surgeon at one of the hospitals, if convenient.—MEDICUS.

[57888.]—**Earache.**—This may sometimes be relieved by placing a small piece of cotton wool, saturated with laudanum and sweet oil, in the cavity of the ear. Earache proceeds from more than one cause, and the treatment depends on the cause from which it proceeds. The remedy suggested will, in most instances, afford relief. A "permanent cure" depends entirely on the possibility of removing the real cause.—G. FRYER.

[57889.]—**Power for Dynamo.**—Such a dynamo will require about one man power to drive. I do not think you would get that power out of a ½in. water-pipe, even with a fall of 30ft.—S. BOTTONE.

[57892.]—**Diagnosis.**—"W. B." does not say his age; and why does he not take his temperature in the night? From the description given, it is most probable that "W. B." is suffering from gout.—C. H.

[57892.]—**Diagnosis.**—"W. B." is probably suffering from weakened nerve-power in certain nerves, the blood-vessels which those nerves regulate thereby losing their elasticity and tone, and becoming in consequence dilated. As a result of this, the blood is driven through them with greater rapidity and force by an increased *vis à tergo*—viz., the heart, which is roused to unusual activity in order to propel the stream onwards and prevent stagnation. The condition is not erysipelas, nor is it necessarily hereditary. Wholesome and nourishing food (avoiding for the present that of a saccharine and starchy nature, as tapioca, sago, corn flour, arrowroot, rice, and potatoes) taken at regular meals, with fresh air and exercise (if possible on a tricycle), plenty of sleep at night, and a few doses of Easton's syrup, preceded by an aperient, will probably complete the cure, which might be expedited by, if the head will stand it, from five to ten grains of quinine for three or four successive nights. Will "W. B." kindly state the result in the ENGLISH MECHANIC if he adopts the plan suggested?—PRO W. B.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

57275. King's College Dynamo, p. 551.
57285. Focus of Lens, 551.
57287. Angular Aperture of Micro. Objective, 551.
57293. Razor Grinding, 551.
57299. Steel Castings, 551.
57300. To "Invicta," 551.
57314. Electrical, 552.
57318. Lippmann's Ampèremeter, 551.
57319. Electro-magnet, 551.

57519. Semi-Fixed Engine. p. 68.
57523. Painting on Velvet, 68.
57532. Speeding Pulleys, 68.
57538. Running Staffs and Cylinders into watches, 68.
57541. Legal (Drainage), 68.
57542. Pull-up Weight, 68.
57550. Fusion, 68.
57551. Secondary Cells.—To "C. D. R.," 68.
57554. Watch Jewelling, 68.
57563. The Isle of Man Steamer, *Mona's Pride*, 69.
57567. Compressed Gases, 69.
57568. Problem, 69.

QUERIES.

[57894.]—**To Mr. W. H. Eaves.**—Will you please tell me what I might expect from a dynamo of the following description? Armature drum, wound as Siemens with 1lb. 9oz. No. 20 wire in 10 coils; size, 6½in. long by 3in. dia.; R. between brushes, ·43 ohm; F.M.'s upright; cores, 3½in. by 4½in. by 1in., cast iron, wound with 17lb. of No. 20, four wires at once—i.e., in parallel. With the limbs coupled in parallel, so that eight wires formed the conduction R = ·35, and coupled in series with armature at 2,000 revs. and five ampères, the E.M.F. was eight volts. With the F.M. wires in series, so that R was 19·6 ohms, and machine coupled as shunt and driven at same speed on same circuit, it gave but a very small current. It was intended for a shunt machine, and I adopted this method of winding the magnets so that I could vary their resistance by coupling differently. Can you kindly suggest any means of improvement? I am sure it ought to do more than this. Could it be successfully made a compound, using the present wire for the shunt coils? Also what size and number of lamps for circuit? I may add that the armature coils are correctly connected to commutator and the insulation is perfect.—CARNFORTH.

[57895.]—**Violin Bow.**—What weight should an ordinary violin bow be? I have heard that the lighter they are the better. Is that true?—J. W. A.

[57896.]—**Belts v. Pulleys.**—Will someone please inform me how to make driving-belt grip the pulley? I have a pair of belts under my supervision, both apparently alike, but one refuses to do effective work, and causes constant loss by slipping. A good recipe that I can make myself will be esteemed a favour.—MULE SPINNER.

[57897.]—**Indigo Dye.**—I buy a large quantity of indigo-dyed cloth. Will any reader give me a method for testing it, to see if indigo-dyed or not?—INDIGO.

[57898.]—**The Solar Spectrum.**—What metals found in the condition of glowing vapours in the spectrum of the sun cannot be volatilised by any heat applicable to man, as specified in textbooks on astronomy?—LEVANT.

[57899.]—**Weak Coil.**—I have made a coil containing about 14oz. primary and 6oz. secondary wire, and between 50 and 60 sheeets (4½ by 3½) in the condenser, but have only succeeded in obtaining a spark about the size of a pin's head, and cannot properly illuminate a small vacuum tube. The shock is strong, unless the condenser is removed; it is then very weak. Insulation has been carefully done with a mixture of paraffin wax and resin, covered with paper; all connections have been soldered where practicable, spark at contact-breaker is large, three bichromate cells (plates 6in. by 2in.) have been used. An acquaintance of mine has a coil, by a London maker, which does not appear to contain as much wire as mine; but, worked with only two of my cells, gives enormously superior results. Will someone kindly say where the error has probably been made?—SPARK.

[57900.]—**Upholsterer's Fringe.**—I want to make small quantities of this in worsted, to form tassels 4in. deep; it is bound after each twist with wire. I want to know the process, and, if made by machine, where can I get a small one that will suit my purpose?—J. CARVER.

[57901.]—**Dynamo.**—Sincere thanks to Mr. Bottone and Mr. Eaves for their kindness in replying to query 57706. I have carefully tested for insulation, and can find nothing deficient. I then examined the commutator: the cuts between the halves were about ⅛in. apart, and one cut was from right to left, the other from left to right, dividing it into two unequal parts. Mr. Bottone, in the "Dynamo: How Made," says it should be in two equal halves. I put on a new one, in equal parts, and separated about 1-16th, put on the brushes, as I had before, and found a decided improvement, as it lighted up a 5 c.-p. lamp at half-speed. It nearly lighted a 10 c.-p., but did not light up the five lamps. I want to ask about the connections. I thought the wire coiled round the F.M. was to be joined at one end. This one is connected thus: one end of wire to left binding screw around left F.M. to left brush, from right brush around right magnet to right pillar. Is this the right way to connect the wires? The F.M.'s are 11in. broad by 4½in. high, the wire covers about 2in., and there may be about 4lb. or 5lb. on each magnet; the armature is 11in. by [illegible] and works at the upper part of magnets. I thought, I [illegible] seen it advertised in the MECHANIC [illegible] to sell. Am I expecting too much [illegible] Any further information as to [illegible] carefully attended to by—BRI[illegible]

[57902.]—**Bunsen Battery.**—TO MR. BOTTONE.—Will you kindly let me know what number of cells (Bunsen) I should require to light four 10 candle-power lamps? Size of zincs and carbons, 8in. by 6in. Would a Cruikshank answer for electric lighting, and would it be cheaper in use than Bunsens? What would the probable cost be per hour for each lamp?—NO SIG.

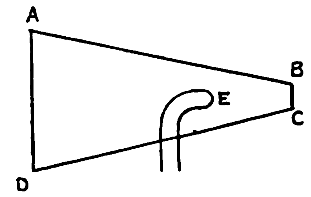
[57903.]—**Beam Engine Repairs.**—The parallel motion of a beam engine is out of order. What is the usual and best method of finding the correct length of radius rods, &c.—FIVE INCH.

[57904.]—**Compound Engine, Tandem Type.**—H.-P. cylinder, 2in. bore; L.-P., 3in. bore, with 3in. stroke; steam pres. 75lb., and cut off at ¼-stroke. So far, are these dimensions correct? If not, what should they be? Required also the sizes of ports, length of suitable boat, and propeller dimensions.—FIVE INCH.

[57905.]—**Yield to Investors.**—Can anyone supply me with a rule to work out the column "Yield to Investor at latest price, redemption included," in the "Investor's Monthly Manual"?—GALLUS.

[57906.]—**Bearings for Lathe Mandrel.**—In the various letters on lathe matters I have never seen the use of hard steel split bearings mentioned. I shall be glad if some practical correspondents will give their opinions on the matter. What objection is there to the use of hard steel split parallel bearings in place of those usually made of the same form in brass? If an amateur tries his hand at fitting a pair of cone bearings, he may possibly succeed, because they admit of adjustment; but if parallel bearings are attempted, failure is nearly certain, because the four surfaces must be brought to a perfect fit at the same time, as they have received a final polish. If not, they will soon work loose and be unsatisfactory, and there is then no means of remedying the fault, except by replacing the bearings with new ones. Whereas, if the bearings were split, any slight shake which might develop itself from imperfect workmanship could easily be removed. I am, of course, alluding to lathes in which the mandrel has a bearing at each end instead of the conical tail pin.—ORDERIC VITAL.

[57907.]—**Pneumatic Ejector.**—The figure A B C D represents section of a conical vessel, whose length A B is 9in., aperture A D is 4in., and mouth B C is ⅜in. It is required to find the size, form, and position of the mouth of a blower, E, which, for a given pressure of blast, shall produce the greatest possible draught of air through the vessel A B C D—that is, the blast pressure remaining constant. The quantity of air per minute delivered at the orifice B C is to be a maximum. What influence has the shape of A B C D on this maximum?—O. V.



[57908.]—**A Gravity Question.**—A pendulum vibrating 60 times in a minute on the surface of the earth will give a less number of beats if carried to a great height, and a greater number at the bottom of a deep mine; but at the depth of, say, 3,000 miles its vibrations would be almost nil. Will some correspondent state at what distance from the centre of the earth the number of beats would be the same as at the surface, supposing the earth to be homogenous and 8,000 miles diameter?—B. R.

[57909.]—**Florentine Bronze.**—Can anyone give me a recipe for Florentine bronze (a good chocolate colour), to be used on brass or gun-metal?—ATHOL, Calcutta.

[57910.]—**Ink for Embroidery Printing.**—Would any reader kindly inform me how to make a good ink for embroidery printing—white or pale yellow; one that will not easily rub off?—EMBROIDERY PRINTER.

[57911.]—**Accumulator.**—TO MR. BOTTONE.—I want to make an accumulator to light one 10 c.-p. for about three hours. Will you kindly tell me how many square inches of surface I shall require, and if I shall make it in one cell or more? Also if there is any benefit in having perforated plates?—S. CAMP.

[57912.]—**Potential of Static and Induction Spark.**—I am anxious to know the probable and relative E.M.F. of a spark of equal length when derived from an induction coil and from Wimshurst's machine, say with machines yielding maximum sparks of 4in. long or sparks of 1in.? I can find no data in any textbooks at my command.—SILICON.

[57913.]—**Photography by Arc Light.**—Can any of our readers give me information on the following points? How many arc lights are generally used for the above purpose? What is the nominal candle-power of such lights? What is the general arrangement of the lights in taking portraits? Are any condensers or reflectors necessary? and, if so, what are the best kind to get?—H.

[57914.]—**Furnace for Bending Plates.**—Can some of your subscribers give a sketch and particulars of a furnace for making ⅜ plates hot enough to bend, the plates being 9ft. by 4ft.?—FURNACE.

[57915.]—**Hot-air Engine.**—Will Mr. Sutcliffe, or any of our readers, be so kind as to give us a drawing of a hot-air engine.—G. H. HEPWORTH.

[57916.]—**Mechanics.**—Can any of "ours" give an [illegible] formula for working out the following example? [illegible] 15 20 units act in directions containing an [illegible] and the resultant. Law gives:

$$\overline{20^2 + 15 \times 20 \text{ Cos. } 120^\circ}.$$

[illegible] with the result obtained [illegible] 23·6 units, but [illegible]—STUDENT.

[57917.]—**Valuations, &c.**—Could any reader of "Ours" inform me where any exam. papers on valuation tables can be procured? I have "Inwood," but want exercise in using it. Does the Chartered Accountants' Institute publish any of its exam. papers?—PRIVATE STUDENT.

[57918.]—**Light Pony Trap.**—Will any kind reader furnish inquirer with information how to rig up a small light pony trap on as cheap a scale as possible, giving a sketch of any necessary particulars? The wheels and springs I could buy from dealers, but the body I want to work out myself?—PONY.

[57919.]—**Breaking in a Pony.**—Would any kind reader of the "E. M." give me the following information? I have just bought a small Welsh mountain pony, two years old, and will have to break him in to harness myself, inasmuch as I have not money at my disposal to employ a professional man to do the work for me. I should feel very grateful for any information how to commence with him in order to insure success.—PONY.

[57920.]—**Power for Lathe.**—Will some reader of the "E. M." kindly tell me what power of an engine I shall require for a lathe 3in. centre for turning metal? Also size of boiler and cylinder for same?—AMATEUR.

[57921.]—**Drilling Bicycle Hubs.**—Will a correspondent tell me how to get the right gauge for drilling holes in bosses for any size machine, so that the wires screw in straight? Also, is there any rule to go by to get the distance between the holes—for instance, say you wanted 36 holes round a boss, how would you get the exact distance between each hole?—ONE ANXIOUS TO LEARN.

[57922.]—**Photography.**—I shall be much obliged if some reader of the "E. M.," who has used wooden troughs for washing gelatine plates and albumen prints before and after fixing, will inform me whether the insides of such vessels should be varnished, coated with paraffin, indiarubber, or other waterproof material? If so, what is the most suitable substance to employ, and the best way of applying it to the surface of the wood?—EYE WITNESS.

[57923.]—**Locomotives.**—Can any reader oblige with a sketch, principal dimensions, and coal consumption of the bogie engines designed for the Caledonian Railway by Mr. Drummond, or if they have already appeared, and in what No. of the "E. M." they were given? Also dimensions of 488 "Galashiels," N.B.R., and 111, G. and S.W.R.?—G. D. SEATON.

[57924.]—**Riveting China, &c.**—Can any of our readers kindly give any information of the process of china and earthenware riveting? Also where the thin sheet zinc used for stencils may be procured?—A. MADOCKS.

[57925.]—**Leclanche Batteries.**—Will any of "ours" kindly tell me what the Victoria battery is? I understand it is a modification of the Leclanché. I have seen it working a small electric light very successfully. What are the principal modifications of the Leclanché cell?—W. ROWLAND HART.

[57926.]—**Wimshurst Machine.**—Will Mr. Wimshurst kindly say what is the best cement and method of fixing the glass plates to the bosses? I have used electrical cement, but the plates are continually working loose.—W. ROWLAND HART.

[57927.]—**Pacinotti Dynamo.**—I have one of Mr. H. Jones's 30 c.-p. castings, eight cogs. The F.M. has been wound with 5lb. of No. 16 d.c.c. wire and A. with 1lb. No. 20 silk. The fields, although wound evenly, when screwed down on base-board, with coils touching each other, leave a clearance of ⅛in. between fields and wire on A. The machine only holds gal. needle at a deflection of about 15 deg. when A. is revolved 1,000 per minute. Insulation good; joined up as a series. When A. is taken out, it makes needle deflect at 3in. off. The beginning end of the wire on each division of the A. is joined up to the beginning of the coil on the opposite side, and the endings of each coil go to the respective slip of commutator nearest to each. Would sheet-iron put on fields rectify clearance, &c., effectually?—FOILED.

[57928.]—**Chruickshank's Trough Bichromate Battery.**—Will any reader of the "E. M." kindly give me his advice? I have got a six-chamber trough battery, with coppers and zincs fixed together in pairs. I want to substitute carbon for copper, so as to make it applicable for a small electric lamp. I have got the carbon in blocks from the gasworks. How am I to cut it, it being so hard that a saw makes little impression on it? Also how am I to flatten zinc plates which are bent?—H. G. M.

[57929.]—**Legal.**—TO MR. WETHERFIELD, OR OTHERS.—The authorities of a canal have put up notices, saying that trespassers will be prosecuted for travelling along the towing-path, which has been open and travelled by the public for over 70 years. It cuts off a near route to several works for some hundreds of workpeople, of whom I am one. Can they legally stop it?—CONSTANT READER.

[57930.]—**Dynamo.**—TO MR. W. H. EAVES.—If not giving too much trouble, will you kindly give me dimensions and wiring for a dynamo, same pattern as the 30-light machine described by you some little time ago, but to light thirty 20 c.-p. Swan lamps and four arcs of, say, 500 c.-p. each. As the number of lamps would be varied, I presume the F.M.'s would be best compound wound. About what power would be required for driving?—H. G. B.

[57931.]—**Legal.**—A. takes a grocer's shop on lease from B., and afterwards gets a beer license for same. At or before the expiration of term, can A., with sanction of magistrates, transfer the license to premises in which B. has no interest?—X. X. X.

[57932.]—**Telescopic.**—TO "J. C. L."—I am much obliged to him for his hint with respect to query 57388, as I was rather surprised it was not answered. I have made a telescope with ⅝in. dia. eyeglass, 2in. focus, and 2¼in. o.g., 18in. focus. Is it not possible to make this into one worth using? As it is, it shows the colour of the rainbow all round the large lens. Could I not, by adding other lenses, make it achromatic, or nearly so, or, at least, improve it very much?—CHESTERFIELD.

[57933.]—**To "Sigma."**—Will you kindly answer me [illegible] following questions? Will an 18 cell, largest size, [illegible] battery ring a 5in. bell twelve hours without [illegible] Will one cell, same size, ring the same bell as [illegible] 18 cells before running down?—TINMAN.

[57934.]—**Storage Batteries.**—I have a small dynamo, driven by 1 H.-P. engine, giving an E.M.F. of 50 volts and 9 ampères. I wish to make storage cells to be charged by this dynamo, and then carried some distance to light eight or ten incandescent lamps, 10 c.-p., for a period of, say, six to eight hours. I have looked up last Vol., and find some replies to queries on storage batteries by Bunsen, but they are much too small, I fancy. I am in possession of tools, and could make easily, but require information. Also, I should like to make one to drive a Cuttriss motor of the latest type, for working sewing machine.—E. T.

[57935.]—**Induction Coil.**—I have 55 yards of about No. 25 double copper wire, each length covered singly with paraffined cotton, and both covered together with cotton, making 110 yards, reckoned as a single wire. I wish to utilise it in making an induction coil. Will some reader kindly tell me about what quantity and No. of wire should be used for primary coil? what length and diameter of bobbin and diameter of core to give best results? The double wire could be wound without twisting the plies, as the wires lie flat and parallel. Would each of the secondary wires thus wound give half the results of the double wire?—B. W. G.

[57936.]—**Formulæ for Object-glass.**—Will "Prismatique" kindly give what his experience has proven the best formulæ for very short-focus o.g.'s, say with a proportion of eight to ten times the aperture, for o.g.'s from 3in. to 6in. aperture? Please give the curves in radii, and in simple proportions of the focal length. If good results can be obtained with equi-convex curves of crown, so much the better; but if the highest results are to be obtained with unequal curves, the extra number of tools is no objection, highest results with greatest certainty being the main point; glass to be used being Chance's hard crown and dense flint (or extra dense, if better), or Feil's ordinary crown and flint.—SHORT FOCUS.

[57937.]—**Egg Albumen.**—What process is employed in the manufacture of egg albumen (white of egg pulverised by heat) used in manufacture for fixing colours in woven fabrics, and also by cooks for culinary purposes, the cost of such manufacture, and the principal firm engaged in the business?—J. A. DALZIEL.

[57938.]—**Linseed Oil.**—I am constructing an apparatus in which it is necessary by force to pass and repass through a small cylinder provided with out-and-in valves (not metal), linseed oil, at a temperature of about 340° (or 300° below its boiling point). As I wish the valves to work silently, I use indiarubber, but I am given to understand that oil quickly destroys indiarubber. Can anyone greatly oblige by informing me whether the indiarubber used could first be subjected to any chemical action (or otherwise treated) which would preserve it?—ANONIMO.

[57939.]—**Electro-Magnets.**—TO MR. BOTTONE.—Given two soft iron cores 2in. long and 7-16in. diameter, it is desired to form the strongest E.M. possible. What quantity and what size of silk-covered wire should they be wound with, and what size and number of Leclanches should they be worked with in the two cases of, first, with the battery close by, and, second, with the battery and magnet connected by ¼ mile of ordinary telegraph wire, on poles and insulators as usual? Should the cells be coupled up for quantity in the first case, and for intensity in the second?—S. P. Q. R.

[57940.]—**Legal.**—About 18 years ago I borrowed £300 on mortgage of houses; two years later I borrowed, from the same party, another £100, on similar property. I have regularly paid the interest on the £300, but the £100 appears to have been overlooked, and the mortgagee has never applied for the interest on it. The mortgagee is now dead, and the exors. call on me to pay the £300, and £100 lent, and also interest on the £100 which has never been paid. I am willing to pay the principal, but not interest. I am advised that the exors. cannot legally claim either principal or interest of the £100, as the interest has not been claimed for over 12 years. Is this so? If so, can the exors. claim the principal and 12 years' interest?—MORTGAGER.

[57941.]—**Fan.**—I have a small fan, about 12in. wings. What revolutions should it make? Will it run too fast at 2,400, as I can drive at that speed? Also, how many fires would it supply? Will it loose wind by connecting it 30ft. or 40ft. away? Should the tubing be carried the same size up to the forge, and then reduce? Also, will it require cooling chambers by tuyere iron?—IGNORANT.

[57942.]—**Damping up Fire.**—Will some of our readers inform me if I can damp up the fire of a semi-portable engine, about 8 H.-P., and how to proceed? I have a damper on ash-pan only. I understand that the dampers are inclosed in chimneys.—A CONSTANT READER.

[57943.]—**Keyways.**—I cut a good many keyways in drums, &c.; but beyond knowing that they are square with face of boss, I do not know they are correct. I have seen them worked out ready for cutting with two circles on face of boss. Will someone kindly inform me if there is a method of marking them out to insure they shall be correct?—H. H.

[57944.]—**Binary Star Orbits.**—Will "F. R. A. S.," or other mathematical correspondent, kindly say how the position of perihelion (λ) in the orbit of a binary star is reckoned? In computing an orbit by the graphical method, I find position angle of node ($☊$) = 45° 25′; position angle of projection of major axis of real ellipse (λ') = 17° (and 197°). Then, by the usual formula, we have $\tan \lambda = \tan (\lambda' - ☊) \sec \iota$, where ι is the inclination of the orbit to the plane of projection, in the present case 47° 26′, whence I find $\lambda = 360^\circ - 38^\circ 39' = 321^\circ 21'$. Is this correct? or should it be $180 + 38^\circ 39' = 218^\circ 39'$?—COMPUTER.

[57945.]—**Galvanometer.**—Some time ago "Sigma" gave a plan for testing the resistance of a galvanometer with the aid of another one. Can anyone oblige me with the page and Vol. of the "E. M." it is to be found in? If not, perhaps some of our electrical readers can describe the process. The instrument to be tested is a delicate astatic one. The other galvanometer is by a good maker, but vertical.—M.M.I.SC.S.

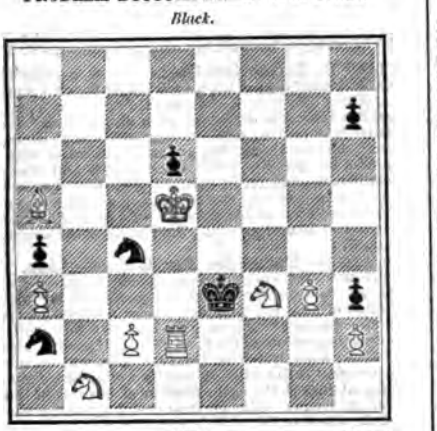
M. MARCEL DEPREZ states that his experiments in transmitting power between Creil and La Villette are completely successful, as he has effected the transmission of 40 out of 80 horse-power.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLXIII.—BY J. A. MILES.

Black.



White. [9 + 7

White to play and mate in four moves.

SOLUTION TO 961.

White.	*Black.*
1. Q-K R 7	1. K-B 3 (*a*)
2. Kt takes P (ch)	2. K moves
3. Kt or Q mates	
	(*a*) 1. K-Q 5 (*b*)
2. Kt-B 2 (ch), &c.	
	(*b*) 1. Kt moves (*c*)
2. Kt-K 7 (ch), &c.	
	(*c*) 1. P-B 7
2. Kt takes P. &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 961, by J. A. Miles (very neat and pretty), H. E. T. Glover, R. A. Bennett, A. Bolus, and H. Culmer.

H. F. L. MEYER, J. A. Miles, J. P. Taylor, and I. Whalley are thanked for problems.

A. A. E. LECLUSE.—Thanks for note with inclosure.

SOLUTION TOURNEY

NO fewer than thirty-nine competitors entered for this Tourney; but, from various causes, the number dwindled down to about a dozen. Several of the solutions sent have been very elaborate and complete, and show the greatest pains-taking. A. S. Olver stands first, scoring full marks, 290. Next to him succeeds A. A. E. Lecluse, 274, who lost ground over that four-fold snare, Problem 958. H. Culmer, F. O'N. H. and R. A. Bennett are bracketed third, with 267. Had it not been for Problem 958, there would have been practically no difference between these five solvers, which amounts to saying that no three-mover can floor any of them; we must, therefore, on some future occasion try their mettle with some four-movers. E. S. and Streetgate follow next, with 250. Other correspondents have scored well, but, probably through lack of time, have not sent solutions to quite all the problems. Among these we may mention especially J. A. Miles, V. S. Pochin, E. S. Folwell, G. Stringfellow, and F. A. Vincent. The prizes we have the pleasure of awarding are, therefore: 1, A. S. Olver, £1; 2, A. A. E. Lecluse, Tomlinson's "Amusements in Chess"; 3, H. Culmer, F. O'N. H., R. A. Bennett, Collins' "Problems," or Miles's "Problems and Poems," or Beechey's "Chess Blossoms."

WE hope to start other Solution Tourneys shortly, as this has been such a success, in two, three, and four moves.

MR. MILES will shortly publish a pamphlet containing 36 of his compositions since 1882, with solutions. It will be paged and the problems numbered consecutively after those in "Poems and Chess Problems," so as to be fit to be bound up with that. The price will be 1s. We strongly advise our readers to secure copies.

The Judge's report of the two-move problems to hand, but too late for insertion.

Tests for Hemp Ropes.—Messrs. Frost Bros., of Shadwell, adopt the following method of testing hemp ropes:—They take pieces of ropes, one made from pure Manilla hemp, one from pure Sisal, and one from an equal mixture of Manilla and Sisal, the fibres having been carefully intermixed before the yarns were spun. Each of the ropes is untwisted, and from a strand of each is taken a piece of the yarn about 6in. in length. Each piece of yard is untwisted and separated into loose fibres, which are separately rolled between the palms of the hands, producing three balls of fibre each about the size of a large walnut. These three balls are then placed on an iron fire-shovel and each lighted and thoroughly burned out. The Manilla hemp produces an ash having a dull, greyish-black appearance; the Sisal hemp leaves an ash of a whitish-grey colour, while the combined Manilla and Sisal fibre gives a grizzly white and black, and reminding one of nothing so much as a man's beard when turning from black to grey.

ANSWERS TO CORRESPONDENTS.

_ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

_ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 28, and unacknowledged elsewhere:—

W. GRIMSHAW.—Rev. H. Dowsett.—W. S. Brereton.—S. M. Hopkins.—H. B.—Loco.—Nemo.—Amateur Organ-Builder.—Lear.—I. W. Ward.—Motor.—J. B.—H. C. B.—G. G. Blackwell.—Practical Bookbinder.—Dr. Ferguson. C. R. G.—Romania.—John Ballot.—Experiment.—Gas Engineer, Chelsea.—J. S. P.—W. Oldfield.—Rois ne Puis; Souza je Suis.—Silex Seadrift.—W. Hosken.—R. A. Bennett.—G. Legge. Herbert Ingall.—Belgian.—A Fellow of the Royal Astronomical Society.—W. Wyatt.—S. Bottone.

TO VARIOUS CORRESPONDENTS. (The pressure on our space is so severe, that we must beg the consideration of our readers, and especially ask them to study brevity in their communications. There are some correspondents who seem always anxious to convert the replies and queries into texts for endless controversies on side issues. For instance, one correspondent whose letter is before us headed as a reply to query 57684, on Roman Arithmetic, which has already been fully answered, wants to occupy space with a totally new question, utterly unconnected with the original query, and arising out of a remark made by "E. L. G." in a previous reply, to the effect that Pope Sylvester II. was "buried in unholy ground." We hope we shall not be considered wanting in respect for the memory of the lamented Pontiff in question if we express our belief that not one reader in a thousand cares a straw whether Pope Sylvester was buried in holy ground, or, indeed, if he was buried at all! There are other correspondents—some of our very best among them—who occasionally transgress in the same fashion. May we ask them, and all who wish to serve us, kindly to stick to the matter immediately in hand as much as possible, and thus save space?)—M. (Directions for making and setting up sundials given several times. See pp. 388, 391, last volume; Vol. XXXVI. pp. 316, 525, 541, 549, 570, and the indices generally.)—ANTIOPA. (Why not have repeated the query when you found it unacknowledged and not inserted? If received, which is doubtful, it must have been mislaid.)—G. H. HEPWORTH. (See Hints No. 5. Anyway, we do not know it.)—WORCESTER. (A blowpipe is the usual thing, the size depending on that of the substance operated on. See the indices.)—H. FLINT. (We do not know whether a cycle is made for persons having the use of only one leg, but most of the large makers have machines which can be driven by the use of the arms alone.)—JACK. (Against the rules; but any of our advertisers who deal in chemists' sundries can supply crucibles of the kind.) A. Z. (It is not soluble in water. 2. Do you mean steam or kitchen boilers? Whichever you mean, the query has been frequently answered. See indices of recent volumes.)—NOVICE. (Directions for making spark coils have been given over and over again.)—ENQUIRER, New Zealand. (No idea of the system adopted has ever been published. 2. Nothing to be done except keep them as clean as possible, and look carefully after the general health of the child. The decay is constitutional.)—AN ENGLISH MECHANIC. (Cannot you get some astronomical observer to show you. The use of the circles is described in most textbooks of practical astronomy, and in such a book as Heather's "Surveying and Astronomical Instruments," Lockwood and Co., Stationers' Hall-court, E.C., price 1s. 6d.)—53 JOE CRIPPLE. (Such a query should appear in the Wanted Column. Any wholesale glass dealer can supply you.)—AMATEUR. (Prepare them by dipping rope into melted rosin or tar. Tow rolled up in paper will do.)—NEMO. (No examination of the kind. You should go in for the Whitworth Scholarships, particulars of which can be obtained from the Secretary of the Science and Art Department, South Kensington, for sixpence.)—J. T. O. (See indices. Borax is the "flux," if that is what you mean. 2. Consult the surveyor of taxes. Refreshment houses pay 10s. 6d. a year if under £30 rent; £1 1s. if above that sum.) J. MCILWRAITH. (If you mean the articles on Blowpipe Analysis, eleven out of twelve can be had, post free, 2s. 3½d.; but we presume you know that they are published in book form by Lockwood and Co., Stationers' Hall-court, E.C. Col. Ross's "Pyrology" is published by Trübner, Ludgate-hill, E.C.)—LUBRICATOR. (How can anyone say without examining it? You will find a great deal about Roscoe's lubricator in Vol. XXVIII. pp. 102, 147, 201, 249, 300.)—T. GRIFFITHS. (You do not seem to have tried it, even in the experimental form, on a body partially immersed in water. Between the toy carriage and a toy boat there is a vast difference.)—ENQUIRER. (If you mean dissolving it, use wood naphtha.)—MECHANIC. (We never heard of such a society.)—G. BUESNEL. (See indices under Plumbing and Hot-water Apparatus. You say nothing about the heights of the pipes.)—A YOUNG LITHO. (You will find directions in most handbooks of the art—in Capt. Abney's, for in stance, published by Longmans. See also back volume The principle is the use of bichromate of potash wit solutions of glue or gelatine. Capt. Waterhouse de scribed a good process in the *Yearbook of Photograph* for 1877.)—H. DUNANT. (We described the pyropho in Vol. XX., and subsequently.)—AMATEUR DRIVE (You can calculate the power to be obtained from an engine by the formula frequently given in o columns, or to be found in the pocketbooks. As "dynamo construction," we would suggest a referen to recent back numbers and volumes.—ENGLIS (Data too indefinite. Usual plan is to light t igniting jet and turn the flywheel round.) WILL O' THE WISP. (Obtaining oxygen from air. d scribed on p. 134, No. 916. If you mean the process Messrs. Brin, which has recently attracted attenti because it is shown at the Inventions, you will find th fully described in No. 864, with supplementary inform tion in No. 893.)—SHEEP SKIN. (Your skins beco hard because you do not "work" them well wh moist. They must be crumpled up and pulled abo all directions while they are still pliable. 2. It is qu possible for an "amateur" to dye furs; but see p. No. 989. You know, of course, that a really compete workman can obtain a good salary in the colonies.) HAVELOCK. (Your idea is about as old as the rota engine itself, and in an improved form has been tri many times. It acts fairly well, but cannot be k steam-tight, and soon knocks itself to pieces.)—AN E PERIMENTER, Dundalk. (Your queries have been fu answered in recent volumes—even recent numbers. Y should not have expected bichromate of potash to la for five nights.)—MAC. (You must have a "blast." S the list published by Mr. Fletcher, of Warrington. Look up the indices for articles on the subject of th coal-tar colours.)—T. BELL. (We really do not see a prospect of "commercial success" for aërial navigatio at present. Should like to have the feasibility of th aërial navigation demonstrated.)—C. E. (You must b articled to a civil engineer. You cannot obtain admis sion to the Inst. C. E. without.)—J. BROWN. (We reall do not understand how a battery is to drive a orguinette.)—GAS METER. (Not compulsory. Whe stamped by the public inspector they are supposed n to vary more than 2 per cent. in favour of seller, and n more than 3 per cent. in favour of consumer.)— EVANS. (We do not remember it. Do you mean book? That is published by J. D. Potter, London. Yo will find many papers on the subject in recent volume —HUMBUG. (See p. 396, last volume, and the indice 2. Not that we know of. Ask the vestry clerk to poi out why it is illegal.)—W. H. P. (Do not understan It may be one of the hektograph processes, or a pho graphic method for all we can learn from your quer See if there is not something about it in recent volum or send a specimen.)—WILLIAM WINWARD. (We d not remember it.)—NORTHUMBRIAN. (Unsuitable fo obvious reasons. See indices.)—A. J. B. (You mu make your own choice, as the number of such book too great. 2. Perhaps you did not inclose a stamp: b you can get the Guide from the Science and Art Depa ment, as frequently mentioned in this column and el where.)—G. A. (The next examination where? The is no necessity to attend classes to sit for the exami tions of the Science and Art Department. If that i what you mean, communicate with the secretary of th local committee.)—T. MORRIS. (If you mean recoveri silver from the fixing bath, see No. 1,066, p. 34)— HONOURS. (What kind of an electric clock do y mean? See pp. 198, 234, Vol. XXXVI.; p. 166, Vo XXXIV.; p. 483, Vol. XXX.; p. 44, Vol. XXVI. an the indices generally. 2. You must consult the boo sellers' lists. There are several works of the kind, b that they meet your requirements it is impossible f us to say.)—AMATEUR. (You cannot go far wrong wi any of the makers who advertise, but we cannot reco mend either individually.)—GEO. F. SALTER. (W cannot advise in such matters.)—GRATIA. (Give several times; can be found in most of the textbo and in special tables which can be had of such make as W. T. Glover and Co.)—A. E. B. (In type.)

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Advertisements must reach insure insertion in the follow obvious that in applying it all that is necessary is to pull the band down to the pulley of the cutter-frame in the tool-box of slide-rest.

It has been urged against this form of overhead motion that, in consequence of the pulleys attached to the tension bar, there is an undue amount of friction: but this exists only in theory, and the statement is quite erroneous: also that the guide pulley being overhead, the oil is likely to be dispersed over the operator. This is also entirely an illusion. If properly oiled, there is not the least occasion for such a result, as practical experience has clearly proved. As I have previously stated, some slight alteration and addition to my plan is required in order to render it more effective in combination with the self-acting slide-rest, which possesses so many advantages that its use must become general.

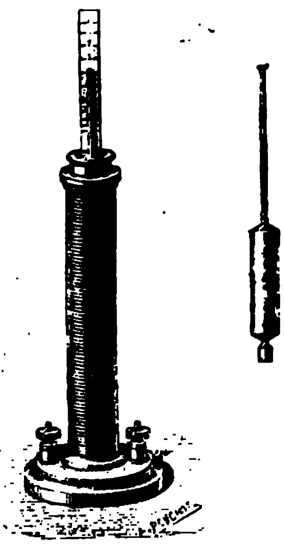
It will be seen by the engraving that a second tension bar is requisite for driving the self-acting gear of the slide-rest.

In my next paper I shall describe the automatic counting apparatus invented by Mr. Ashton, one of which is now to be seen at the International Inventions Exhibition at work, and has been a considerable attraction to my exhibit of lathes and tools, &c., for which I have received the highest award, the gold medal.

I omitted to mention in my last paper that all the automatic arrangements can, without difficulty, be added to existing slide-rests.

LALANDE'S CURRENT MEASURER.

APPARATUS for measuring electric currents, which employs magnetic needles or permanent magnets, is liable to be affected to a considerable degree by the variations of terrestrial magnetism, as well as by changes in the condition of the magnets themselves. Instruments constructed on that principle are, in short, incapable of giving accurate results, unless frequently calibrated, which is a serious inconvenience, to say the least, when they are used for industrial applications: M. F. de Lalande has recently presented to the Paris Academy of Sciences ampère-meters and voltmeters which dispense with permanent magnets, and are consequently not liable to be affected by the causes above mentioned. They are based upon the principle of Becquerel's electro-magnetic balance, and their action depends upon the effect produced by a solenoid on a bundle of soft iron wires movable in its interior, and maintained by an antagonistic force. M. Lalande says his instrument might be called an electric areometer, as it consists of a bundle of soft iron wires placed within a metallic areometer, which is plunged into a test tube containing water. The test tube is encircled by a coil, through which passes the current to be measured. The level of the liquid in the tube is kept constant, and the initial position of the areometer being always the same, it will occupy a fixed position of equilibrium by sinking to a certain depth, which varies with the intensity of the current traversing the coil, but is constant for equal intensities. The upper portion of the stem of the areometer is flat, and serves as an index working over a scale, which is experimentally graduated for each instrument. The stem is guided through a metal eye immersed in the liquid, a disposition which avoids friction against the sides of the tube, and does not affect the sensibility of the instrument. It will be understood that, by varying the dimensions of the parts—*e.g.*, of the coil and of the bundle of soft iron wires, a range as great as may be desired can be obtained for a given intensity. In the instruments already constructed by M. J. Carpentier, of the Rue Delambre, Paris, who has studied the device with much care, a displacement of ·10 mètre (3·937in.) corresponds to an intensity (quantity of current) of from 10 to 25 ampères, according to the apparatus, or to a difference of potential of 100 volts. The coils of the ampère-meters are made up of thick wire in one or two layers, the resistance being ·01 or ·02 of an ohm, so that the instrument can be introduced without inconvenience into most circuits. The coils of the volt-meters are of fine wire, and have a resistance of about 1,700 ohms. The instrument is distinctly aperiodic, and is not influenced in a sensible manner by variations of temperature, nor are its indications affected by the vicinity of large masses of metal or of powerful magnets. These instruments are being introduced into this country by Mr. J. A. Berly.



ELECTRICAL INSTRUMENT-MAKING FOR AMATEURS.—V.*

By S. R. Bottone.

§ 12. COULOMB'S TORSION BALANCE.—Apart from the actual use of this instrument as an accurate measurer of electric and magnetic force, it is extremely serviceable in inculcating the laws of electrical attraction and repulsion—viz., that these are "inversely as the squares of the distance, and directly as the charges."

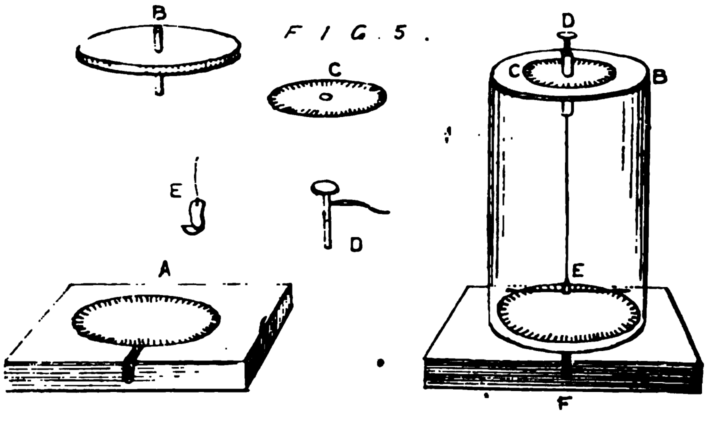


FIG. 5.

To make such an instrument, we select a glass chimney, similar to that shown in our last section, Fig. 4 A. This must be fitted with a metal top, precisely like that described for the bottom cover of the electroscope, Fig. 4 C. In the centre of this a small aperture is made to admit of the introduction of about 1in. of thin brass tube, having about ⅛in. bore. This is soldered neatly into the cover, so that the tube projects about ½in. on either side of the cover. A block of mahogany or deal, about 4in. square by ¾in. thick, is now planed up and made truly square. A circular channel, about ⅛in. wide, and of the same depth, is now cut in this base-board for the glass to stand in. If deal, this base should be stained black and varnished; if mahogany, it should be polished.

§ 13. An efficient black stain for such pieces of white wood may be made by working upon a slab a teaspoonful of lampblack with a tablespoonful of thin glue, until quite smooth, wit a muller. This stain may be applied *whil warm* to the wood, well rubbed in, and whe *quite dry*, varnished with "white hard varnish which will be dry in about twelve hours.

§ 14. A circular card, graduated to the 360° (a circle, and of the same diameter as the i terior of the glass chimney, is now to be glu on to the central circle of the base board; th zero point coinciding with the centre of one (the flat edges, *not* with the diagonal corner Previous to gluing down the card, a slot abou ½in. deep and ¼in. wide must be cut i the upper surface of the base board, reachin from the position of the zero point to the ex treme edge of the board (this serves for th introduction of a soft iron rod, or of differen magnets).

The next step is to make a similar, but rathe smaller graduated circle to slip over the projecting brass tube in the upper cover. This circle should be cut out of a sheet of tinned iron or zinc, and the degrees of arc (of which there should be also 360°) marked clearly upon it by scratching deeply with a sharp steel point. In the centre of this circle, a hole, just sufficiently large to admit the passage of the piece of brass tube, should be punched. This circle is to be slipped over the tube and lie flat on the cover, *but must not be fastened down*. A short brass rod, about 2¼in. long, and just thick enough to enter freely into the brass tube, is now procured, and fitted with a circular brass head made by filing up a piece of ⅛in. sheet brass into a circle about ⅜in. in diameter, and soldering the rod in the centre of the circle. Or, the pinion of an old paraffin lamp burner with the teeth knocked off may be used instead of this rod, provided it fits the tube.

Whichever is used, a short index of brass wire must be soldered at the upper extremity of this brass rod, near the head. This index serves two purposes. First, it prevents the rod going too deeply into the tube; secondly, it serves to point out the amount of *torsion* or twist given to the wire or fibre which supports the "stirrup," in which is placed the magnetic needle or insulating rod, which are used in magnetic or electric measurements.

The lower end of the rod must project just below the lower end of the tube which passes through the cover, and to this lower end of the rod must be soldered a short length of No. 40 German silver wire. To the other end of this German silver wire must be attached by soldering a "stirrup" in the form of a wide J. The length of the wire, inclusive of the stirrup, must be such that it just swings clear of the lower graduated circle when a magnetic needle or other rod is placed across the stirrup, and the cover is on the top of the glass cylinder.

A well-magnetised needle, a little shorter than the diameter of the cylinder, completes the instrument if it is to be used as a magnetic measurer. The needle may be a piece of a good steel knitting needle carefully magnetised to saturation. If required for electrical experiments, the magnetic needle must be replaced by a light shellac rod, carrying a one extremity a small disc of thin sheet b or copper. In this latter case al[illegible] the base-board must be fitt wire shaped like the letter small brass ball at each must be carefully insu coated with good red se

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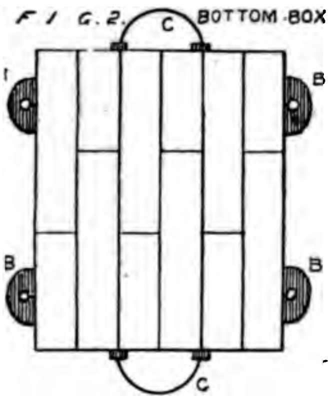
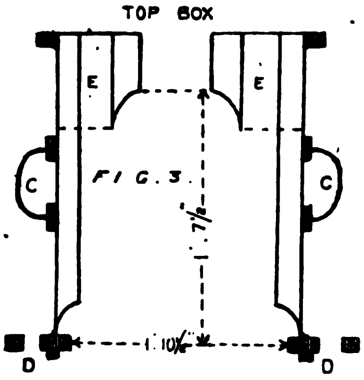


FIG. 2. BOTTOM BOX


TOP BOX
FIG. 3.

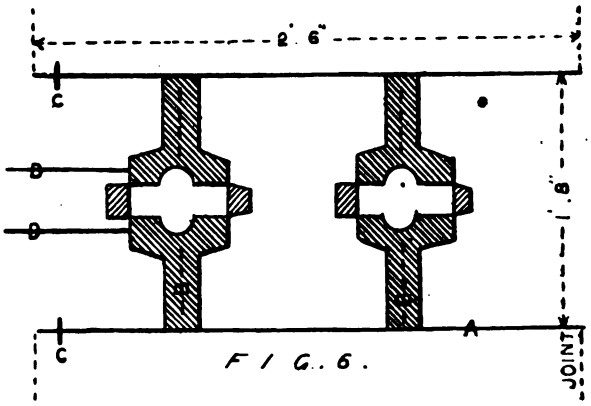


FIG. 6.

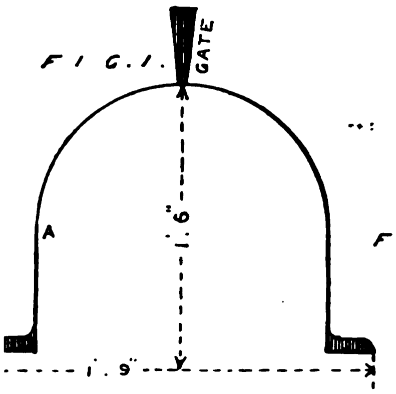


FIG. 1.

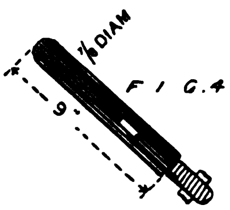


FIG. 4.

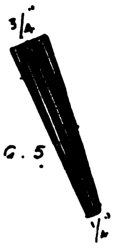


FIG. 5.

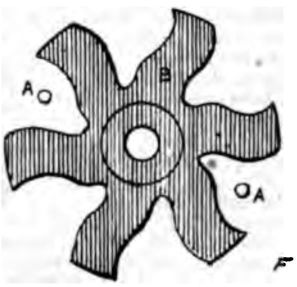
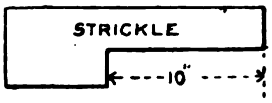


FIG. 8.



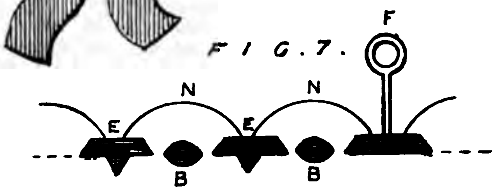


FIG. 7.

at least ¼in. all round, except at the two tremities where the balls are situate.

Fig. 5 illustrates the different parts and the mplete instrument. A is the base-board with e slot and graduated circle attached; B is e tin cover, with its brass tube, the whole ing cemented to the top of the glass cylinder ıen once the wire has been soldered to the lled head; C is the upper graduated disc; D e rod carrying the index, and actuated by e brass head; to this rod is attached the wire d stirrup E; F shows the instrument put gether, and lettered homologously.

MOULDING.—I.*

By Sand Rat.

UNTIL comparatively modern times, iron-moulding in England was very little ought of. It is something like 100 years ce it was introduced into England by Dutch ulders. I will not go much into its early tory; but I may state that one of the prin- al causes of failure with the ancients was e want of knowledge in venting, and in these dern times we have to be always on our ard how to get the air from the face of the uld. It will not do to have a green sand uld too hard on the face, as it causes the ting to scab and become a waster. Then we ve the different compositions of sand; for ge work, we require sand very strong to ist the metal: it may be made stronger by tting more road sand in, also by putting dry m and extra coal-dust in the sand. For all castings, it is well to grind the d and put very little road sand in, , by grinding the sand, it makes it tough l close, and more adapted for light work, h as fine pitched wheels. I will com- nce by giving a sketch how to mould a ler, such as is used in laundries, or commonly led washing boilers. Fig. 1 shows boiler tern to be about ¼in. thick, with flange a le thicker, as shown. Usual size, about n. diam., 18in. deep. To make them in numbers, there ought to be special boxes, in sketch, to be cast face down, and road. thin gate, as shown in make them a th thickn It

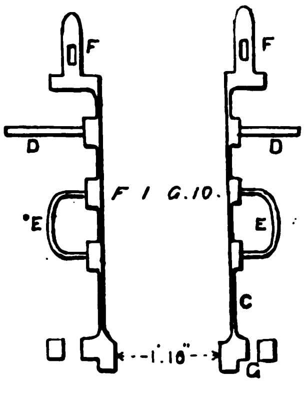


FIG. 10.

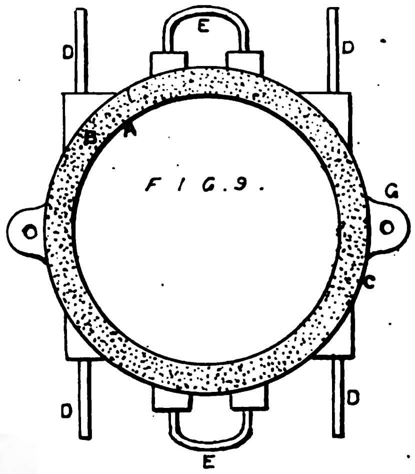


FIG. 9.

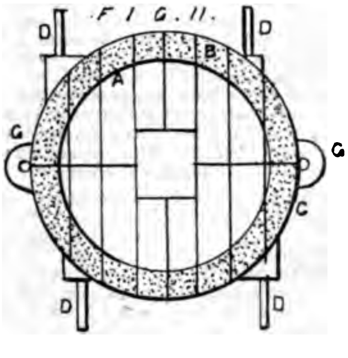


FIG. 11.

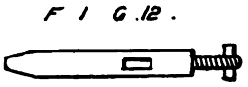


FIG. 12.

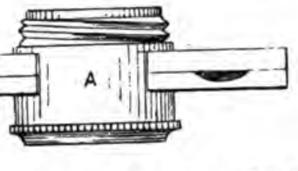
B B B B. The box bars ought to be level on one side of box; but the bars next to the pattern should be ¾in. clearance for sand. Fig. 3 shows top part with box bars cast in, with about the same clearance; but this box ought to have a small internal flange, as shown, as it greatly helps the lifters in keeping the sand in the box. I have left space for the running gate. E E shows box bars, shaped to the pattern; C C shows bow handles, so that they may be lifted by the crane chain; D D shows holes in snugs for ide-pins. Fig. 4 shows guide-pin with cotter n: by cottering the boxes it saves an weighting, and is much safer in the oiler is to be rammed inside first, ted; next ram the bottom part, r, and make the point level with the flat face, then put on top part and ram up. The inside will require stronger sand than the outside, and much more venting There is no rising gate required for these. The vent must be got freely away, or they will scab awfully. Fig. 3 can be cast with box-bars about 9in. deep if wanted for a jobbing box, but will always require lifters to carry the sand. Fig. 6 is a sketch of a broad strap-pulley with two sets of arms 20in. broad and 30in. long. I think it is requisite to make all strap pulleys with loose arms as shown, and to have them bent arms, as they are much safer, and don't fly in contraction same as straight arms, and recess cores, so that the metal is more equal. I would recommend the pattern to be about 12in. long, turned inside and outside, with two holes in, as shown at C C, Fig. 6, about

$\frac{3}{4}$in., so that a hook can be put in at each side to draw it with. Then a pulley, any length, can be moulded of the same pattern; or if a narrow one is wanted, it can be bedded in the floors and strickled round to 10in. or any length desired. B B shows arms in their place, with shape of core; D D shows gates on top boss; A is pulley rim. Fig. 7 shows lifting plates for each set of arms, with two loop handles to carry them about with. N N shows cramps to fasten all together. They ought to be made first and cast into the L P. If for middle arms the cramps ought to be cast iron; but if for one set of arms they ought to be wrought iron. F, loop handles; B B shows arms with about one-eighth of an inch clearance all round; E E, plates with guide pins cast on joint, to be made at dotted lines. Fig. 8. B shows arms; A A shows where loop handles go. Next is a set of pulley boxes for the same. I have arranged these either for hand or crane, by putting both straight handles and bow handles; D D is about $\frac{7}{8}$in. diameter, 7in. long; bow handles, 6in. broad, 4in. long; two snugs top and botton. G G (Fig. 9) snugs; C, box; A, pulley pattern; B, sand; E E, bow handles. Fig. 10 shows box inside and outside; F F, guide-pins; G G, holes in snugs for guide-pins; box to have a small internal flange, as shown, and a facing all round the end of box. Fig. 11 shows top box; A, pulley-rim; B, sand; G G, snugs; D D as on the other boxes. Fig. 12, guide-pin, about 9in. long, $\frac{5}{8}$in. diameter, with cotters in. Fig. 11 will do both for top and bottom boxes. It is usual to have boxes of various depths, some 12in., 9in., 6in., 3in. long, so that if a pulley is wanted 18in. long or 21in. long, by having all snug centres the same, it is easy to arrange them. Ram the bottom box level with joint at dotted lines, then ram up the inside to joint at centre of arm-bed on the plates, and proceed, as before, to next set of arms. Make joint bed-plates as before, ramming the outside; at the same time use strong sand for the arms, and weak for outside. Make joint at top, ram top, then lift off. Next draw the pulley-rim, lift outside of mark inside parts, then separate them, take arms out, put in core of bottom arms, and put together again and cotter all up. Cast very hot; feed top boss.

DEVICE FOR TESTING REFRACTIVE INDEX.*

A NEW device for testing the refractive index of immersion media, and indicating how near an approach to homogeneity with crown-glass can be made, was described at the recent meeting of the American Society of Microscopists by Prof. H. L. Smith, who claims for this simple device superiority, both as to ease of manipulation and accuracy of indication, over the well-known wedge and bottle furnished by Mr. Zeiss.

In testing any medium for immersion purposes, but little more than a drop of the liquid is required, and the slightest variations of refractive index are indicated by a considerable latitude of motion, when, in the ordinary use of the wedge, these variations would be inappreciable. The instrument is used upon the miscroscope, and a reference to the Fig. will make the application plain. *A* is an adapter about $\frac{3}{4}$in. in length, with the society screw outside and inside. This is attached to the microscope, and carries a 1in. objective. *a* and *b* are two slips of crown-glass, as near the refractive index of the cover-glass as possible, 2in. long and $\frac{1}{2}$in. wide, each about $\frac{1}{10}$in. in thickness. In one of these, *b*, near the end, a concave is ground to a depth of about one-third or more of the thickness of the glass, and polished. To test whether a medium has the same refractive index as the glass, and also the dispersion, a drop of it is put into the concave, and the two slips of glass are placed together and inserted into an opening cut in the adapter-tube, as shown in the figure. A thin stratum of the medium will flow between the two slips. The whole being now in the position shown in the figure, the 1in. objective is screwed on below, and the microscrope is focussed on some well-defined object on the stage. Looking through the two slips in this way, the focus will be found not to differ appreciably from what it would be if the glass plates were removed. When the object is clearly defined the plates are pushed in, bringing the concave, filled with the liquid, directly over the back of the objective; if the medium be optically homogeneous with the glass slips, there will be neither spherical nor chromatic aberrations produced, and the definition and focus remain unchanged. As none of the immersion media now known are strictly homogeneous in this sense, but may, nevertheless, have the same mean refractive index as the crown-glass, clear vision with these will be obtained with the general focus unchanged, but an excess of colour will fringe the outlines of the object. If the focus has been obtained by means of the rack and pinion, the fine adjustment always remaining the same, one can readily ascertain the refractive indices of various media proposed for use with immersion objectives in this way. Let a mark be made on the rack-bar or sliding tube, as the case may be, when the focus is obtained with the plates in the position shown in the figure; this mark will indicate, for example, a refractive index of 1·52. Filling the concave now with cinnamon oil, and focussing again (using the same object, objective, and eyepiece), we get another position for a mark indicating refractive index of 1·6. Using water, we get still another, 1·33, and with glycerine 1·41, the extremes will be about $\frac{1}{2}$in. apart, as measured on the bar or tube, and, by interpolating, we can thus get pretty nearly the refractive index of any fluid medium. I have found the so-called homogeneous media sold in the shops to differ very greatly, fully $\frac{1}{4}$in. out of the way in many cases. A specimen of cedar oil from Zeiss caused a change of focus only about $\frac{1}{20}$in., which was less than was required by any other samples I have tried.



When one has a fine objective, and with a given immersion medium has obtained certain positions of the screw-collar for the best work on certain tests, the exact refractive index of the medium can be ascertained, and afterwards always secured. A non-adjustable immersion objective, a $\frac{1}{4}$ by Spencer, which performed most admirably, both with oblique and direct light with the medium furnished by the maker, showed but indifferently well with another medium, which, on being tested with the little apparatus above described, required an alteration of focus necessary to obtain distinct vision, or rather the most distinct vision, of fully $\frac{1}{4}$in. On diluting the second medium to bring it to the same index as that sent out by the maker, the performance was entirely satisfactory. It will be understood that there should be a diaphragm in the adapter of such size as will prevent any light passing through when the concave is put over the objective with the immersion fluid to be tested in it, except what actually passes through the fluid.

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[*] From the *American Monthly Microscopical Journal.*

Cocaine for Filling Teeth.—A dental surgeon recommends the following in the *British and Colonial Druggist*:—Cocaine pur, 6gr.; iodoform, 10gr.; gum mastic (q.s.), 3gr.; ol. eucalyp. vel eucalyptine, 8gr.; chloroform 2dr. Dissolve the cocaine and iodoform in half the prescribed quantity of chloroform and the other ingredients in the remainder, then mix the two solutions. If required for "painting" around a tooth, on the gums or elsewhere, but not for "stopping" purposes the mastic should be omitted altogether; while on the other hand, the quantity may be increased if a tenacious semi-fluid substance (rendered mobile by warming) for direct application to a hollow stump be needed. This preparation should be kept in tightly-corked tubes or bottles.

IN a paper in the "Proceedings" of the Instituiton of Civil Engineers on "The effect of the Drought of 1884 upon the pollution of the River Thames below London," Mr. R. W. Peregrine Birch, referring to a former paper in which he described a method of calculation now known as the "chlorine method," used by him in 1882 to determine the rate at which the metropolitan sewage is carried away by the river, and the extent of the sewage pollution, gives an account of observations made during the drought of 1884. The following conclusions are arrived at:—All the fresh water and sewage which had entered the river between Teddington and Southend since June 25th was still there on September 8th, and that which entered on June 16th was still there on August 30th. The sewage had remained in the river forty-five days and the fresh water occupied seventy-five days for its passsage from Teddington Weir to Southend. There was less fresh water and more salt water in the river than in September, 1882, and the foul mixture travelled seawards at a much slower rate. The calculations also show that though in time of drought there is more seawater in a tidal estuary than in a wet season, its circulation is so slow that its effect as a diluent is greatly reduced. The circulation in November, 1882, a time of flood, was nearly three times as great as in August, 1884, a time of prolonged drought.

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

THE first meeting of the session was held on the 14th ult., at King's College, Strand, W.C., the President (Dr. Dallinger, F.R.S.) in the chair.

Mr. Crisp called special attention among the donations to the second part of Prof. Retzius' magnificent work on the organ of hearing of the vertebrate; also to a Japanese scientific publication, mostly printed in the native character.

Mr. Crisp, in exhibiting D'Arsonval's water microscope, said he did not know that they were bound to notice every instrument which anyone chose to devise; but the one before them had been designed by an eminent Frenchman, and had been recorded in their Proceedings by high authorities in France, and he thought, therefore, they were entitled to criticise it. It was put forward as a suggestion for improving the means of focussing, the ordinary fine-adjustment being considered hardly good enough. The body-tube of this extraordinary instrument contained a glass cylinder which was connected by an indiarubber pipe with a syringe. On turning the handle of the syringe water was forced into the cylinder, and the focus was altered accordingly as more or less water was pumped in. Of course, an alteration of focus did result from the operation, but the arrangement destroyed the correction of the objective, and the least disturbance of the surface of the water rendered the image so unstable that unless the instrument stood upon a very firm foundation it was useless to attempt to examine an object with a high power. There was also the question of capillarity, which would clearly exert considerable influence. He thought the defect of the plan before them might be summed up as irrationality, and that not of the spectrum only.

Dr. Anthony, in commenting upon the instrument, said that the simplest method of giving a last touch to the adjustment of the focus was by gently pulling out the eyepiece, by which means a very delicate focussing was obtained.

Mr. J. Mayall, jun., said that the plan of focussing by the eyepiece by means of a specially devised rack was applied by Prof. Amici some 30 years ago, and consequently long before M. Ranvier's suggestion, which was noted and figured in the *Journal* two or three years ago.

Mr. J. Mayall, jun., described Riddell's binocular microscope, which was exhibited by Mr. Crisp, and was of considerable interest as being a duplicate of Prof. Riddell's original microscope, which now belonged to the Army Medical Museum at Washington. He pointed out as a noteworthy feature that it was provided with a means of separating the prisms so as to give to each eyepiece a full field of view. There was also a screw with a right and left handed thread for separating the tubes to suit the width of the observer's eyes. An ingenious application of reflectors at the top of the eyepieces effected a perfect inversion of the image, so that the instrument could be used for dissecting purposes. He had tried a few experiments with it, and had found its performance to be very fair. There were some inconveniences which might be improved upon with advantage, such as the rotation of the prisms above the eyepieces, so that it was not easy to prevent them from getting shifted and causing a confusion of the images. There was also too little room for the nose between the tubes, and during a protracted observation the breath condensed upon them to a great extent. There was no fine adjustment, but he believed the microscope was only intended to be used with low powers. It was, he thought, an instrument of great interest as having been made so early as 1853. He hoped that English makers would take up the point of providing some means of separating the prisms, which offered such advantages that he wondered a similar method had not been adopted hitherto. Prior to this instrument being made Prof. Riddell had devised another, also described in the Society's *Journal*—the form afterwards adopted by M. Nachet. It was, he thought, a point of special interest in the history of the development of the modern binocular microscope, that so early as the invention of this microscope Prof. Riddell had applied two mirrors for the purpose of equalising the illumination in both fields.

Mr. J. Beck said that the form of binocular microscope made by Professor Riddell was an extremely ingenious failure. He believed he was quite correct in saying so, because it never came into practical use at all; whilst the merit of bringing the binocular into practical use was undoubtedly due to Mr. Wenham. He saw the instrument at New Orleans in the year 1871, but with the exception of that, and the one on the table before them, there was never another made, because, though it was ingenious, it was not useful. Whenever a thing was made which was useful, it would be sure to come into use, as was shown in the case of Mr. Wenham's arrangement, for which the demand had been enormous. Though he thought the instrument was not of any great practical use, it was very useful to have these successive stages in the history of the binocular microscope brought before them.

Mr. Crisp exhibited a "twin" simple microscope having two lenses of different powers, also two forms of magnifiers sent by Mr. Hippisley as examples of the capabilities of lenses made out of spherules of glass, and of a simple method of holding them.

Mr. Badcock called attention to the fact of the re-discovery of *Cordylophora lacustris* at the Victoria Docks by Mr. C. Mitchell, of the East London Natural History Society. Some years ago it was very abundant there, but since then it had entirely vanished, until a few weeks ago. Some further interest attached to it on account of there being a quantity of *Floscularia elegans* parasitic upon it. The same gathering also contained some *Bacillaria paradoxa*.

The President regarded this as a highly interesting gathering, especially that of the *Bacillaria*.

Dr. Maddox read his paper, "Further Experiments on Feeding Insects with the curved or 'comma' Bacillus."

The President thought the Society would be very pleased to have before it the further results of Dr. Maddox's researches in this direction, which was one in which there was not merely very much of interest, but also much of practical importance yet to be learned. The fact that no practical result had yet been arrived at was no doubt disappointing, but it was, after all, only an excitement to still patiently pursue the subject until it was overcome.

Mr. Cheshire said that perhaps some of the difficulty experienced by Dr. Maddox might be got over by using invert sugar instead of the ordinary kind. By using barley sugar, or boiled sugar, they would get it in a form which would not give up its moisture so soon.

Dr. Maddox said he should prefer to feed the insects entirely on fluid food, if it were possible to do so, but evaporation was the drawback there.

Mr. Cheshire had some experience in feeding bees, and would suggest that the difficulty met with as to the feet might be got over by feeding the insects through a grating.

Mr. Michael thought it would be much more difficult to feed flies in this way than bees, on account of the very different structure and length of their tongues.

Mr. Groves suggested that it might be useful to place a cover glass over the preparation, having a small hole in the middle.

Mr. Crisp exhibited one of Messrs. Beck's new pasteboard boxes to hold 300 slides. He had found them very convenient for storing long series of slides, such as diatoms, micro-fungi, minerals, &c.

Mr. Groves said that though not a very new suggestion it was a very useful one. He had had some half dozen of them in use for years.

Dr. Anthony feared the material of which the case was made was too slight for the purpose, so that if pressure was exerted the flexure would give space enough for the slides to override each other and knock the cover-glass off.

Mr. Groves said he had never found this to occur in practice; indeed, he often used two of the trays —without the box—to carry slides about in, and he put them under his arm without ever finding they got displaced.

Mr. Crisp said they had received six slides of material taken from the intestine of Lieut. Kisslingbury, U.S.N., one of the victims of the unfortunate Greely Arctic expedition. When the question of cannibalism was being discussed, his body was exhumed, and a good deal of the flesh was found to have been cut off the bones. In order to ascertain if possible what was the last food of which the deceased had partaken, and to establish whether the officers had joined in the cannibalism of the men, the contents of the stomach were submitted for examination. The letter of Mr. C. E. Abling accompanying the slides (which were sent by Dr. Mandeville and himself) was read to the meeting.

Mr. Groves said that although it might be possible to say from an examination of these slides whether the material consisted of the flesh of a mammal, a bird, or a fish, it would be quite impossible to say if it was human flesh or not, unless it happened that a large quantity of hair had been taken with it.

Mr. Crisp said that he had submitted the matter to Prof. Stewart, the Conservator of the Museum of the Royal College of Surgeons, who had given him the same opinion as Mr. Groves, adding only that a means of identification might be found in the small hairs of the general surface of the body. He (Mr. Crisp) had examined the slides, but could find no trace of hairs.

Mr. D. P. Penhallow's note was read as to a handle for cover-glasses, as follows:—

"In the August number of the *Journal* (p. 753) Mr. Cheshire mentions the use of a semicircular disc of wax, somewhat smaller than the cove lifting the latter and adjusting it in mounting. Several difficulties appear in the use of the wax as recommended, and I now use what seems to me a more convenient form. An ordinary penholder, with a ferrule which is not split, is employed. The ferrule is cut off to such length as to leave a short tube ¼in. long on the handle. This tube is filled with wax in such manner as to leave a well-rounded end; this is easily done, by simple dipping. A permanent handle is now ready for use at all times. In use, the wax only requires to be applied very lightly to the centre of the cover, when the latter may be lifted and placed in position without the least difficulty. The advantages of this handle are: (1) Minimum contact of wax and glass; (2) the specimen can be seen and its proper position secured as the cover goes on; (3) very slight pressure with a needle seems to release the cover from the handle; (4) there is the least quantity of wax to clean off."

Mr. Cheshire said he was not in the least disposed to criticise the method suggested, though it appeared to him to have its disadvantages, for if they had a contact on one side only the pressure would be so unequally distributed as to be very likely to unsettle the object or to displace it, particularly when working at the end of a penholder.

Mr. C. Beck exhibited a compact form of Mr. Stephenson's Catadioptric illumination.

The President said that those who saw Mr. Stephenson's original apparatus would notice how very much more compact the one now before them was. He had tried the former, and found it to work exceedingly well.

Mr. Kitton's and Mr. Kain's notes on Balsam of Tolu were read. Mr. Kitton wrote:—

"Since the publication of my note on Balsam of Tolu, I obtained another sample of the gum. This was very different from the first, which was darker in colour, not brittle, and dissolved freely in benzole without residue. The second sample was brittle, and capable of being pounded in a mortar. It was also soluble in hot benzole, which, on cooling, deposited a very dark viscid mass, leaving a pale golden brown liquid above. This is said to contain all the cinnamic acid, the denser gum being Tolu, and which is only soluble in absolute alcohol or chloroform. I tried it in the latter, but its very dark colour made it very objectionable, excepting in the very thinnest film.

"The lighter fluid was apparently about the same refractive index, and I mounted several diatoms in it, which, in the course of a week or two, showed a plentiful crop of crystals. It afterwards occurred to me that heat would volatilise the cinnamic acid. I therefore prepared a slide on which I placed a drop of the medium and boiled it, and when cool covered it. By the side of this I placed a second drop, warming it to drive off the benzole; this I also covered. After the lapse of a fortnight, I found this contained plenty of crystals, whilst the adjoining drop was entirely free from them.

"I afterwards ascertained that the second sample had been boiled in water in order to extract some of its medicinal properties."

Mr. Kain's note (in reply to a letter from Mr. Crisp) was as follows:—

"As you remark in your letter, there is considerable confusion in regard to the matter of Tolu. I am unable to account for the differences, unless upon the supposition that different samples of the gum behave differently. By reference to the "U.S. Dispensatory" (15th edition, 1883, Wood and Bache), I notice that there is a factitious Balsam of Tolu containing about 60 per cent. of styrax. Now styrax is soluble in benzole, and it is just possible that some experimenters may have got hold of this factitious balsam. The following extract from the same work may be of interest to you:—

"'It (Tolu) is entirely soluble in alcohol, and the solution shows an acid reaction with test paper. It is almost insoluble in water and benzine. Warm disulphide of carbon removes from the balsam scarcely anything but cinnamic and benzoic acids. On evaporating the disulphide, no substance having the properties of resin should be left behind. Boiling water extracts its acid.'

"From the above, it would appear that the easiest way to get rid of the acids whose crystals are so objectionable is to use disulphide of carbon, water being objectionable on account of the difficulty in getting rid of it by evaporation. I ought, perhaps, to add that my use of benzole for that purpose was the result of an accident, I having attempted to make a solution of the gum in benzole. After digesting several days, none of the gum was dissolved, but the benzole yielded beautiful crystals of cinnamic and benzoic acids upon evaporation."

Mr. Kitton's note on a new diatom, *Navicula Durrandii*, was read.

Mr. J. C. Stodder's note was read as follows:—

"Inasmuch as I have noticed in your *Journal* occasional expressions of the opinions of different microscopists as regards the formation of a small battery of objectives which should cover reasonably well all the requirements of the general microscopist, and inasmuch as I have never seen any published statement of the views held upon this subject by the late Mr. R. B. Tolles, I venture to send you a copy of a memorandum which I have just found among my loose microscopical papers:—

"'Boston, May 26th, 1882.

"'Meeting Mr. R. B. Tolles to-day at the office of Mr. Charles Stodder, I asked him what he thought was the best series of, say, four or five objectives to cover as well as possible the whole range of 'general microscopy.' He answered, after some reflection:

"'For four only—3in., 1in. 30°, $\frac{1}{6}$in. 110° dry, $\frac{1}{10}$in.—oil-glycerine-water immersion, which will work through $\frac{1}{100}$in. covers, and should have a balsam angle of not much less than 120° for best results.' He added: 'An excellent and useful lens to add to the above series would be a $\frac{1}{5}$in. 110° or 120° dry.'"

Mr. C. D. Ahrens' paper on "An improved Form of Stephenson's Erecting and Binocular Prisms" was read, in which he proposed to unite the lower prisms by a wedge of glass. He also proposed an alteration in the upper prisms (when they are used in place of a plate of glass).

Mr. Michael said he thought Mr. Ahren's plan provided the one thing wanting to perfect the Stephenson form of binocular, as the prisms, as at present arranged with cork to separate them, not unfrequently got displaced.

Mr. T. B. Rosseter's paper on "The Uses and Construction of the Gizzard of the Larva of *Corethra plumicornis*" was read by Prof. Bell, and prepared specimens in illustration were exhibited under microscopes.

Mr. Dowdeswell's paper on "The Cholera Comma Bacillus" was read.

Mr. Crisp stated that a communication had been received from the American Society of Microscopists on the subject of the Society Screw-gauge, which had been referred to a committee, and its consideration had better, therefore, be adjourned until the committee had reported.

The President called the attention of the meeting to the death of M. Robin, the eminent histologist, and one of the Honorary Fellows of the Society. He might be termed the creator in France of histology, for which a special chair was instituted. He had been Professor at the Faculty of Medicine in 1832. In 1871 he worked with Littré in founding the Society of Sociology "for the application of the positive and scientific methods to the study ofsocial doctrines." By his death (in his 65th year) the French Senate had lost all but the last of its scientific men. He was the author of the two well-known textbooks, "Du Microscope et des Injections," and the "Traité du Microscope," and contributed largely to the current scientific publications. In conjunction with Littré, he recast the "Dictionnaire de Nysten," and developed it into the now popular "Dictionnaire de Médecine," published by Baillière et Fils.

Sixteen new Fellows were elected and proposed.

Yellow Fever.—Dr. Carlos Finlay, of Habana has published the results of several experiments he has made on the inoculability of yellow fever. He performed the operation, or rather got it performed for him by mosquitos, which he caused first to sting a patient suffering from yellow fever and shortly afterwards a healthy person who was to be (with his own consent of course) the subject of the experiment. He found that the disease was only inoculable from the third to the sixth day. When two mosquitos were employed, so that a double dose was given, the symptoms of the experimental disease were somewhat more severe than when only a single mosquito was used. Of eleven cases of inoculation, six were efficacious, one doubtful, and four negative. The period of incubation varied from five to fourteen days; the symptoms consisted of headache, pyrexia, injection, with sometimes an icteric tint of the conjuntiva, and in some cases albuminuria. The fever lasted, as in the ordinary form, from five to twenty-one days. The author believes that this method of producing artificial yellow fever will ultimately be found very valuable as a prophylactic against the natural and dangerous form of the disease.

To Remove Rust from Marble.—This is an operation which depends upon the solubility of iron sulphide in a solution of potassium cyanide. Clay is made into a thin paste with ammonium sulphide, and the rust-spot smeared with the mixture, care being taken that the spot is only just covered. After a lapse of ten minutes this paste is washed off, and replaced by one consisting of white bole mixed with a solution of potassium cyanide (1 : 4), which is in its turn, washed off after a lapse of about two hours and a half. Should a reddish spot remain after washing off the first paste, a second layer may be applied for about five minutes.

SCIENTIFIC NEWS.

AFTER the first flourish, the discovery by M. Pasteur of a method of inoculating for rabies or hydrophobia is discounted by the reflection that so far from his two "cures" being unmistakable cases of rabies, there is no proof that the patients would have had attacks of hydrophobia. Similar mistakes have been made before in connection with alleged cures of snake-bite; but it has been shown that it is possible for a person to be bitten by a cobra and receive no poison at all. It is certain that many persons have been bitten by mad dogs without unpleasant symptoms following, much more a fatal result. The morbid poison of rabies is probably a micro-organism, and there is not much doubt that Pasteur's method of fighting it is the correct one; but the inferences at present drawn are premature, to say the least.

Dr. Ferran's method of treating cholera by inoculation finds little favour amongst many of those who declare that Pasteur's similar method of treating hydrophobia is infallible; and the scientific committee appointed by the Spanish Government have reported that it has not been demonstrated that inoculations secure immunity from cholera, and that it is impossible to deduce a general law from isolated facts.

The Session of the Royal Society will commence on Thursday, November 19th. It is understood that Prof. Huxley feels compelled to adhere to his decision, and will accordingly resign the presidentship.

Prof. Simon Newcomb was interviewed on his return to the United States by the enterprising reporter, who elicited from the distinguished astronomer the interesting statement that a "great gold medal" had been awarded by the Czar to Alvan Clark and Sons, makers of the object-glass of the great telescope at Pulkowa. According to Prof. Newcomb it is the finest refracting telescope in all its points that has ever been made. Prof. Newcomb visited Paris, and found that Feil had succeeded in casting a couple of discs for the Lick telescope, and he advised both to be sent to Clark and Sons for them to make a choice. These discs are 39in. in diameter.

By a slip of the pen "U Cygni" appeared in this column last week for V Cygni. A letter from Mr. Ward in reference to this variable red star appears in another column.

Mr. C. L. Wragge is in Queensland, having been authorised by the government of the colony to report as to the best means of establishing meteorological stations in Queensland, including Cape York Peninsula and Torres Straits.

Mr. Lazarus Fletcher, F.R.S., Keeper of Mineralogy, British Museum, has been elected president of the Mineralogical Society of Great Britain and Ireland.

At Dundee, on Nov. 12th, the Duke of Argyll will give the first of an autumn series of lectures to be delivered under the auspices of the Armitstead Trust. His subject will be the connection between the scenery of Scotland and its geology.

The Executive Council of the International Inventions Exhibition have been revising the awards of medals, and amongst the changes we note that a gold medal has now been awarded to the Wenham patent gas-lamp instead of a silver medal. Several "revisions" of this kind have been made; but we have not heard of any withdrawals of gold medal awards.

The Council of the Hartley Institution, assisted by the town councils, scientific societies, &c., of Hampshire, have succeeded in persuading the authorities to allow the Geological Survey to prepare a 6in. geological map of Hampshire and the Isle of Wight.

The Saturday evening free lectures at Leicester were commenced on the 24th ult., when Mr. C. E. Stretton delivered a lecture on "Practical Railway Working," illustrated by the limelight and models. Mr. Stretton's lecture on the breaking of railway axles has been published by Barber and Co., Leicester.

The Institution of Mechanical Engineers met at Coventry last week, when several papers on Cycles were read. Mr. R. E. Phillips, of London, read one on "The Construction of Modern Cycles," which has been printed with a number of illustrations, and will be found readable and interesting by all who are connected with "wheeling." A paper on an hydraulic buffer-stop for railways was contributed by Mr. A. Langley, of Derby.

An American correspondent sends us a copy of the *Wilmington Daily Commercial* (Delaware), containing an account of a remarkable run from Philadelphia to Washington of 142 miles in 157 minutes. The train was a special, consisting of an engine and one passenger coach, and the actual time was 2 hours 48 minutes, but 11 minutes were lost in stops. The road (Philadelphia, Wilmington, and Baltimore, and Baltimore and Potomac railroads) is probably the best in the United States.

The *Britannic* delivered her consignment of live soles from Mr. E. C. Blackford to the U. S. Fish Commission in excellent order. Prof. Baird will make strenuous endeavours to propagate the fish in American waters.

The *Great Eastern* is, it is said, to be moored at Gibraltar and used as a coal hulk. The *Livadia* is, we believe, fulfilling a similar purpose at Sebastopol.

The London, Chatham, and Dover Railway Company have ordered a paddle-steamer for their Channel service which is to have engines of 5,000 H.P. The vessel will be 320ft. long and 44ft. broad, and will be faster and larger than any steamer at present running to the Continent.

Dr. Gerhard Rolhfs contends that it is unhealthy to wear woollen clothing in the tropics. It is well known, he says, that nearly all animals in Europe have a thicker coat in winter than in summer. But in Tuat, Kufra, and other hot regions of Central Africa, sheep imported from colder climates lose their wool in the course of a year, and their skins are then thinly covered with hair. The lion, who at the Cape and Northern Africa has a long and thick mane, loses his mane entirely in Central Africa.

Lieut. Greely, lecturing recently before an agricultural society in Massachusstts, said that during his Arctic journeys he had discovered flocks of sheep with large heads, horns like oxen, and tails resembling those of horses. Their fleece is of the finest and thickest wool, almost surpassing that of the merino. He suggested that as in New England sheep are frequently lost during severe winters, it would be worth while to make an experiment in acclimatising the Polar sheep.

M. Sibiriakoff has, it is stated, definitely abandoned the hope of establishing a sea route to the great Siberian rivers.

A road is now about to be made from the Petchora, over the Ural Mountains to the River Obi. A canal is actually being constructed, which shall connect the Obi and the Yenissei, and extensive works are being carried out along the Angara for the purpose of making it navigable between Lake Baikal and the Yenissei. When these plans shall have been completed, all kinds of wares can be transported by water all over Siberia, for the Lena is already connected with Lake Baikal. The entire distance which will have to be traversed by land between St. Petersburg and the Obi will not exceed 170 versts, or about 114 miles.

American Machinery and Tools.—A new Catalogue of American Machinery and Tools has been issued by Messrs. Churchill and Co., of Cross-street, Finsbury, E.C. It is a quarto, containing 250 pages of illustrations and letterpress of machines, tools, handy articles for the house, including furniture, and all kinds of American novelties. Considering the variety of its contents and the usefulness of the articles depicted, it fairly earns the title of an "extraordinary catalogue."

Xanthine, a New Yellow Dye.—The Société Anonyme des Matières Colorantes of Paris have introduced a new yellow colour, to which they have given the name of "xanthine." It dyes readily wool, cotton, and silk which have been treated with vegetable acids; cotton is mordanted with tannin and sumach. This dye readily unites with fuchsine and Paris violet, producing an unlimited number of shades.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

INDIAN LONGITUDES — THE NAUTICAL ALMANAC—BINOCULAR MICROSCOPE — 31 M. ANDROMEDÆ — THE SOLAR SPECTRUM—GRAVITY IN A MINE.

[24963.]—I HAVE been reading, with considerable interest, the account of the telegraphic determination of the differences of longitude between various stations in India and Ceylon, and the Government Observatory, Madras, by that well-known astronomer, Mr. Norman Pogson, the official head of the establishment in question. To mention that several of these determinations were made under difficulties is only to say that Mr. Pogson succeeded in overcoming them; and, at any rate, I think I may assume that the longitude of Karachi, Avanashi, Roorkee, Pondicherry, Colombo, Jaffna, Muddapur, and Singapore are now as accurately known as they are likely to be for some considerable time to come. In my perusal of Mr. Pogson's book I have come across a passage or two which it may not be quite useless to extract. I have before now been accused of "nagging" at the *Nautical Almanac*; but the quotation which I am about to make will show that in continuing annually to publish erroneous predictions of the phenomena of Jupiter's satellites, and grossly misleading dimensions of the Saturnian system, that most conservative of institutions—the one in Verulam-buildings—is only following out rigidly the evil old traditions of its office. Speaking of the longitude of Madras itself, the Government astronomer says that "from a few observations in 1831" of "moon culminators" Mr. T. G. Taylor obtained the value 5h. 21m. 3·77s. east of Greenwich, "which was adopted in the *Nautical Almanac* list from 1835 to 1861. A much closer approximation was subsequently arrived at by Mr. Taylor from the discussion of lunar observations, between 1831 and 1844, which gave 5h. 20m. 57·20s.; *but, though published in* 1845, *it was overlooked and not admitted into the Nautical Almanac list until* 1862." Anything more illustrative of the chronic practice of the *Nautical Almanac* department than the words which I have italicised in the above quotation it would be hard to find anywhere. Equally true, too, though in a totally different way, are Mr. Pogson's remarks on American Instruments and Observations. "Perfection of accurate simplicity, eschewing all affectation of needless refinement, seems to be the distinguishing characteristic of American scientific instruments and researches in general"—a dictum not to be gainsaid by anyone familiar with the subject.

The most simple way for "E. P. G." (query 57852, page 171) to observe with a binocular microscope is to employ also a pair of spectacles accurately suited to the varying foci of his two eyes. This is what I always have to do in using a field glass or the like.

On my return to my observatory after an absence of a month, it will easily be imagined that the very first object upon which I turned my telescope was 31 M. Andromedæ. With a vivid recollection of its appearance on the last occasion on which I had viewed its strange stellar centre, I felt tempted to repeat what Virgil says of Hector's ghost—"Quantum mutatus ab illo"—so changed was the aspect of what had been, but a few short weeks since, so striking an object. It was really only with some little attention and, preferably, by averted vision, that I could fairly see the stellar stranger at all: though when I did succeed in holding it steadily, its non-coincidence with the nebular nucleus proper was very evident indeed. This distinction I failed to see, with my instrumental means, when the star was at its brightest; its brilliancy quite overpowering the more feeble light of the condensed nebula.

"Levant" (query 57898, p. 190) should quote verbatim from his "textbooks on astronomy," the remarkable statement that the metals, whose glowing vapours the spectroscope reveals in the sun "cannot be volatilised by any heat applicable by man"; inasmuch as no metal appears in the most recent list of those whose vapours have been detected in the solar surroundings which has not been artificially volatilised. I strongly suspect that your correspondent, or the work or works which he quotes, means something else; but it is not for me to suggest what that something is.

Is "B. R." (query 57908, p. 191) aware that were the crust or shell through which a mine is sunk (say, in the case of the famous Harton Colliery experiments) two-thirds of the density of the whole earth, the weight of a particle—and the rate of vibration of a pendulum—would be the same at the top as at the bottom of the pit? But if, as in his hypothetical case, the density of the shell exceeded two-thirds of that of the earth, the weight of a particle would be *less* at the bottom of the mine than at the top, or the pendulum would make fewer beats as we descended?

A Fellow of the Royal Astronomical Society.

THE VARIABLE RED STAR V CYGNI.

[24964.]—THIS remarkable variable star was discovered 1881, May 22, by the late Mr. Birmingham, who described it as a deep red or crimson star of about 9 magnitude, 2° 51·7′ north of α Cygni. Its position for 1885 has been determined by recent meridian observations to be R.A. 20h. 37m. 35·7s.; Dec. + 47° 43′ 53″.

When I first saw it, about a week after its discovery, I estimated it to be about 9¾ mag., and of a beautiful crimson colour; but I found that my estimates of magnitude were smaller than those of Mr. Birmingham. On June 9th, he estimated it about 8 mag., and on July 20th he found it had decreased to 9 mag. On Dec. 21st following it was about 12 mag. 1882: April 28th, 8 mag.; and May 6th to 16, about 8·8 mag., as if its maximum had then passed; but Prof. Safarik, of Prague, placed its maximum about June 17th, and Dr. Schimdt, of Athens, about July 17th following. The period was then supposed to be about a year; but these discrepancies rendered it difficult to assign the time accurately, and it would be desirable that a complete series of observations should be obtained. Various circumstances prevented my observing it systematically; but I append some rough eye estimations of magnitudes during the past four years which may be useful in connection with those of other observers: 1882 — May 18th, 8 mag.; Sept. 3rd, 9 mag.; Oct. 19th, 9½ mag.; Nov. 7th, 9½ mag. 1883—May 5th, 12½ mag.; May 27th, 12 mag.; June 2nd, 11½ mag.; July 26th, 8½ mag.; July 28th, 8¾ mag. 1885—Sept. 19th, 11¾ mag.; Sept. 26th, 11 mag.; Sept. 29th, 11 mag.; Oct. 5th to 15th, 10¾ mag.; Oct. 26th, 10½ mag. A close watch should now be kept on it, as it is probably approaching one of its *maxima*. Though the intensity has apparently varied at different times, its deep red colour is still obvious, even when at its *minimum*. The variable forms the southern end of an inverted cross with a triangle of stars (9½ to 10½ mag.) lying about 10′ north of it, and there is a 12 mag. *comes* at about 20° angle, and 50″ distance from the variable.

Belfast, Oct. 27th. **I. W. Ward.**

48 CASSIOPEIÆ.—TO MR. SADLER.

[24965.]—I MUST thank Mr. Sadler (letter 24941) for his promise to supply some additional particulars of 48 Cassiopeiæ (β518). The proper motion quoted *was* the one which he kindly supplied some time since, and was introduced as showing a possible explanation of the closing up of the components, if any such change has occurred. I am also much obliged for the correct distance of Bird's pair near Procyon, which, I see, is even closer than I previously imagined, and must certainly be reckoned a first-class pair. When speaking of double stars discovered in England, I did *not* refer to the wide pairs from the catalogues mentioned by Mr. Sadler (as the list might be extended almost *ad infinitum* by anyone possessing an instrument of moderate aperture, especially in the neighbourhood of the Galaxy), but to pairs of the class mentioned by Mr. Burnham, which must certainly be accepted as the highest possible standard of double-star work by everyone, whether working with a refractor or a reflector. **Kenneth J. Tarrant.**

SUSPECTED WHITE MARKINGS ON MERCURY.

[24966.]—AS promised in the previous note to "E. M." calling attention to this matter, it will now be endeavoured to give a short extract taken from my notebook of the observations for each day, entered as they were made. Unfortunately, I had to leave home on 26th July for over three weeks, and thus lost the observations of planet during its most favourable positions; nor, indeed, have I been able to obtain a single observation of planet since—absence and bad weather interfering.

On 21st July a telegram was sent Mr. Neison, Government Astronomer at Durban, asking him also to observe the planet.

Early in September a note from Mr. Grant—Mr. Neison's assistant—was received as follows:—"On receipt of your telegram every endeavour was made to obtain observations of Mercury, but without success. For the last month Mr. Neison, however, has been too ill to be able to observe."

If, as I take it, Mr. Grant failed to see the "suspected white markings," there would not seem any confirmatory evidence of their "real existence" from the Durban 8in. refractor, used by an observer apprised of their whereabouts—i.e., where and what to look for. These notes are nevertheless given with a conviction that such have been seen; but whether real, or caused by the instrument used, requires to be seen in time. I therefore kindly request observers to watch Mercury whenever a favourable opportunity may offer.

EXTRACTS FROM NOTES.

17th July.—Observed Venus and Mercury soon after sunset, before "glow" appeared, and as soon as eye settled to eyepiece, I thought to see a small white, horn-like point, near or on bright limb of Mercury, some 30° from (inverted) south cusp on terminator. Thinking it an illusion, I observed bright limb all round, but no other similar object was seen; slightly averted vision also always distinctly revealed it. A more careful examination placed it at about 55° from (inverted) south cusp. A few minutes later fancied to see a whitish patch deeper on bright limb, and perhaps a little further S. (inverted); it narrowed towards bright *limb*, and widened slightly on the bright *disc*. Planet's colour a reddish golden yellow.

18th.—No observation obtained.

19th.—At 10h., *local* sidereal time, picked up planet. Soon as eye had settled to e.-p., at once saw a "white patch" on preceding bright limb. For first hour and half the "patch" seemed an elongated half-ellipse, just on bright limb. Later on this "white ellipse" seemed to contract, but may be due to atmosphere. I now feel quite sure the "white patch" is no fancy.

20th.—No observation.

21st.—First view at 11h. 23m., sidereal time. White patch seen at once; the "white half-ellipse" seemed divided into two *knots* or condensations—one on each end, N. and S., the northern being at nearly 90° from cusps. Colour of planet, a dull 9-carat gold. Used four different powers negative e.-p.'s, from 100 to about 400, and a positive eyepiece; the white markings were certainly seen with each. Continued to observe planet until the "afterglow" had deepened to a deep salmon colour, when it (Mercury) appeared of a fine chrome yellow.

July 22nd.—Air slightly hazy. Colour of planet at 12h. 10m., 9-carat gold; white patch seen at once. At 12h. 50m. the two "bright knots" first detected yesterday were *plainly* seen. I fancied to detect a slight brownish shading in the "bay" following between the two. When "afterglow" deepened to red or salmon red, the planet appeared of a chrome yellow.

July 23rd.—First view of Mercury at 11h. 56m. Although "white patch" was observed at once, it seemed smaller and more narrowed, but extending *further* round bright limb. After a little while a brighter knot was seen near its southern (inverted) limit *on limb*, as if it projected slightly *above* the line of planet's bright edge; position about 80° from S. (inverted) cusp. The positive e.p. brought out colour of a creamy white on the dull golden yellow. At 12h. 5m. I felt nearly certain again of the brownish shading in the little bay—i.e, its place, following the bright knots; its colour seemed deepest just between the two. *Note.*—I find the eye requires a short rest every now and then, after 20m. to 33m. continued observation at e.p., so as again to see the "white markings" well. With positive e.p. the colour of "white markings" are brought out of a more yellowish-white appearance, after a prolonged and careful observation. The "white markings," even with best definition, had *at any time* by no means *sharp* borders or outlines.

24th July.—At 13h. 10m. the "white patch" was noticed as a white streak on edge of limb, extending, apparently, more northward (inverted). It is decidedly smaller than before. At 85° only one bright knot on limb is fairly well seen; higher powers seem to bring the "white streak" yet further round limb northward (inverted). 13h. 40m., fancied to see an elliptical white streak on bright disc between limb and terminator, with its longer axis directed to about 70°, or near to where the "white markings" are seen. The position of this streak (?) would suggest that planet's poles are nearly coincident with the cusps of terminator and bright limb. Who knows? Probably these suspected objects are huge, partly-detached masses of cloud belts.

25th July.—At 11h. 26m., air rather unsteady, limb of planet between 65° and 80° certainly brighter or whiter than remainder, but *no bright knots* seen. At 11h. 50m., I feel fairly certain of a smaller triangular patch on disc, a little behind—i.e., nearer terminator, where the *bright knots* were on 23rd; it appears fainter, and certainly *not* one of them. A little later on a *white streak*, extending from this triangular patch a considerable way towards terminator, was glanced; it is of a yellowish white. This confirms yesterday's suspected streak. *Note.*—Position of spots on limb of planet was estimated from the cusp and terminator, *as seen inverted*, south. Time was that indicated t sidereal clock in observatory, regulated by th transit of clock stars for this meridian; *no* allowanc being made for our E. longitude. Roughly, th longitude of my observatory may be assumed a 30° 5′ E., and latitude 27° 10′. Altitude above sea level, 6,000ft., with a beautiful clear sky. From the delicate nature of the observations above recorded, I have more than once felt dubious as to whether it could be an optical illusion caused by the telescope — a slight "wing" for instance. Turning it on Venus, however, no such was seen, and besides, the *variation* in shape and position of the objects made me feel inclined to think the "suspected white markings" are a reality, though possibly they may be of no permanent nature.

John Ballot.

Rolfontein, Transvaal, South Africa, 18th Sept.

IS IT A SUN OR AN EARTH?

[24967.]—AS far as I can learn, the outbursts of light called new or temporary stars were in no previous case detected till at their full splendour. This, in the Andromeda nebula, is the first one whose growth has been witnessed, and it seems to have occupied little over ten days. Observers saw nothing unusual on Aug. 17, but on the 19th it was seen by Mr. Isaac Ward at Belfast, and reached its maximum by the end of the month. In letter 24905, instead of "the blue rays it emitted *at first*," I should have said, "emitted *when brightest*." The accounts describe it as red at first, and now growing orange as it wanes, but having been white or bluish when at greatest brilliancy, exactly as happens with any dense matter artificially heated and left to cool more slowly.

In Faye's work of last year, "L'Origine du Monde," p. 176, there is a woodcut of this nebula, and though the letterpress only describes it as having a central condensation, the woodcut shows two distinct and nearly equal white spots, one in the centre and a lesser one about ½in. to the W.S.W., exactly in the direction that all accounts place the new star. The volume is dated 1884.

Oct. 31. **E. L. Garbett.**

EXPERIENCES WITH AN 8½in. REFLECTOR.

[24968.]—THINKING that my several years' experiences of an 8½in. reflector might interest some readers of the "E. M." (might be, in fact, some return for the entertainment and instruction I have often found in its pages), I will proceed in brief to set them forth.

Knowing the superiority of the outdoor performance of reflectors, I decided, at first, for no observing house; but carried the telescope and its altazimuth mounting in and out in separate pieces at each time of observing. Very soon, however, I found that this could not be long continued, for the weight of the different parts was very great, and the result a degree of fatigue the reverse of beneficial.

Then I made the telescope a fixture out of doors, and a tarpaulin cover protected it against the weather; but the dewing, under this cover, of mirror, flat, and bright-iron parts, was phenomenal and destructive.

I accordingly had constructed a simple wooden house, with a door at one end, fixed the house on wheels, and these on simple rails, and at last had an arrangement effective and practical. The door could be opened, and the house wheeled off or on with little loss of time or strength. Any handy person (with spare time) could construct such a house at a very trifling expense. The dewing nuisance was now immensely abated, though no wholly removed; but the raising of the house on higher wheels, and the boring of numerous ventilation holes near the roof (securing thus a free current of air) almost entirely removed it—so satisfactorily, indeed, that I should not now shrink from placing an equatorial and clock arrangement beneath the breezy, but not damp, shelter of my house on wheels. My mirror was still covered only with a simple lid, and consequently soon tarnished (there is plenty of sulphuretted hydrogen in a garden containing hot-beds), and still, sometimes, became thickly dewed on sunshiny mornings following cold nights. Then I effected a great improvement, which all reflectors should possess, by having an air-tight cover made for the speculum. Thus protected, and additionally by a woollen comforter on the cover, to prevent sudden changes of temperature, I have left the speculum for, perhaps, at times, a year or more untouched, and have been surprised to find it afterwards quite unchanged.

After observing on a cold night, it is true that even yet a very slight dewing may be occasionally morning; but the amount of this and ge to the film are alike quite insignificant. her hand, and again, when the instrument d, though left practically in the open air, weather, no alteration whatever of the s (however long the time) if only these ns are followed.

it unadvisable to leave the flat in the as in this case it frequently becomes use (being so cold to start with, and the breath so close at hand). It and the eye- best kept indoors for the same reason, ounting of the flat being marked, it can replaced in the right position. It was t to cover the ventilation hole of the tele- near the flat, to defend the latter from of the observer. Such are the simple nts which have made my later reflector s pleasant, facile, and certain.

or silvering. I have always followed rocess, and have never found the slightest I think there is only one secret. To e during hot weather) in a room with a Once, and once only, when the deposit n beginning, did I find it advantageous the silvering arrangements for a few bout a foot above a lighted Bunsen The result was a particularly dense and film. In fact, a large part of my silver- was actually done recently by my little , who regards it as a very fine piece of l. Do not polish the mirror often, and shing, use mostly the unrouged pad. The and hard rubbing always removes some er, more particularly if the film be some

ct to the never-ending but always enter- scussion of refractors v. reflectors, my s, as I have had opportunities of observ- the De la Rue reflector and the 12·2in. jective at Oxford, as also with a 4½in. actor at home, may be, perhaps, worth g. They are simply these: that the re- ive the steadier images, and are best on ights for micrometric work; but that in and lunar definition they are far rding the crisp and beautiful pictures -class speculum. The only matter for , that ordinarily, with the reflector, uisite glimpses are, in consequence of ic disturbance, but momentary and occa- l so observing requires time. But they orth waiting for, as during them, minuter d clearer vision are obtained than with ctors. In fact, Professor Pritchard's who kindly, throughout a long evening, he Oxford telescopes for me, told me ch preferred the De la Rue for planetary d yet, with that same perfect De la Rue ee but little more detail on Jupiter and an with my 8½in. mirror, the final cor- f which were made by Calver. It was before, but the star discs were a trifle der high powers than I liked. These h reduced after Calver's manipulations, eculum left his hands, in his own words, beauty, almost absolute perfection, and iticism."

ver will be pleased to know that his work by the lamented Prebendary Webb visit here, and received his unqualified tion.

wife and myself, accustomed to perfect sm, the sight of Jupiter in the 12·2in. ry bright and fairly sharp, but bathed in ht, was painful and disappointing. In : for mensuration give me a refractor; ion, and for pure celestial views generally,

ham. **G. B. Ferguson, M.D.**

ARTIALLY-GRAPHIC METHOD OMPUTING ECLIPSES AND LTATIONS.

]—I FANCY I can detect a little incon- between the boast of Mr. Woodside in number and what he says in a former ation. Your readers will appreciate this n when I place the quotations side by a communication (24066), writing from ass., on March 26, he says: "This method son's] is not only easy and accurate, it is emely expeditions. In computing the Rochester, N.Y., for Prof. Swift, I took ements, made the drawing, and obtained cts *in less than twenty minutes*." (The his own).

improved method, however, which Mr. has just suggested, he asserts that, "In omputations can be made in one-fourth equired by Pearson's method."

comment is needless. One-fourth of utes is *five* minutes, and this, therefore, e required for the computation of an n by Mr. Woodside's new method, accord- own showing. This is simply incredible.

James Pearson, M.A., F.R.A.S.

od, Oct. 30.

ELEMENTS FOR THE PREDICTION OF OCCULTATIONS VISIBLE IN THE BRITISH ISLES IN DECEMBER, 1885.

Star's Name.	Mag.	Dec. at Date.	Wash. M.T. of geoc. ☌.	Wash. H.A.	Y.	x′.	y′.	Limits.	
								N'n.	S'n.
		° ′	D. H. M.	H. M.					
96 Virginis ...	6½	− 9 47·4	2 10 54·2	− 10 20·1	0·7369	·5505	− ·1596	+ 79	+ 7
κ „ ...	4½	− 9 44·4	2 12 44·8	− 8 33·1	0·3925	·5507	− ·1579	+ 56	− 13
18 Aquarii ...	6	− 13 22·2	11 2 39·9	− 1 15·3	0·5435	·5308	+ ·1266	+ 64	− 4
78 „ ...	6	− 7 48·9	13 1 25·7	− 3 52·5	1·2621	·5252	+ ·1635	+ 83	+ 49
82 „ ...	6½	− 7 11·4	13 5 34·4	+ 0 8·9	1·2583	·5252	+ ·1658	+ 83	+ 49
20 Piscium ...	5½	− 3 24·0	14 5 3·7	− 1 3·4	1·1243	·5277	+ ·1750	+ 87	+ 34
μ „ ...	5	+ 5 33·5	16 7 55·4	+ 0 14·5	0·5176	·5475	+ ·1728	+ 69	− 5
64 Ceti	6	+ 8 2·3	17 3 11·2	− 5 7·6	1·1463	·5594	+ ·1623	+ 90	+ 39
ξ¹ „	4½	+ 8 18·8	17 3 55·7	− 4 24·7	0·9812	·5599	+ ·1617	+ 90	+ 25
48 Tauri	6	+ 15 6·7	19 8 25·9	− 1 48·2	1·0224	·5977	+ ·0969	+ 90	+ 36
γ „	4	+ 15 20·9	19 10 2·8	− 0 15·0	0·9378	·5981	+ ·0944	+ 90	+ 30
B.A.C. 1526...	5½	+ 16 58·3	20 0 54·1	− 9 58·8	0·5110	·6071	+ ·0665	+ 70	+ 7
111 Tauri......	5½	+ 17 16·4	20 11 21·9	+ 0 3·7	0·7896	·6120	+ ·0453	+ 90	+ 25
115 „	6	+ 17 51·6	20 12 25·1	+ 1 4·4	0·2543	·6124	+ ·0421	+ 50	− 5
117 „	6½	+ 17 8·4	20 12 45·8	+ 1 24·2	0·9804	·6125	+ ·0418	+ 90	+ 38
λ Gemini......	4	+ 16 44·3	22 6 30·4	− 6 34·5	1·1757	·6167	− ·0514	+ 90	+ 55
W vii. 685 ...	6	+ 17 19·3	22 11 42·2	− 1 35·5	0·3078	·6156	− ·0624	+ 54	− 4
29 Cancri......	6	+ 14 34·6	23 9 38·7	− 4 32·4	1·1511	·6071	− ·1059	+ 90	+ 47
ξ Leonis	5½	+ 11 47·8	24 11 0·1	− 4 10·4	0·7001	·5907	− ·1452	+ 90	+ 10
48 „	5½	+ 7 32·0	25 13 27·6	− 2 41·6	0·7318	·5754	− ·1724	+ 90	+ 8
γ „	5	+ 3 28·5	26 12 53·6	− 4 4·9	0·6495	·5645	− ·1840	+ 82	+ 2
θ Virginis ...	4½	− 4 55·5	28 12 8·1	− 6 24·6	0·6307	·5498	− ·1787	+ 78	0
W xiii. 825 ...	6	− 8 59·6	29 9 54·8	− 9 20·1	1·1609	·5476	− ·1653	+ 81	+ 38
η Libræ	6	− 15 18·4	31 13 27·0	− 7 27·2	0·6829	·5501	− ·1110	+ 73	+ 4

MR. WOODSIDE'S NEW METHOD FOR COMPUTING OCCULTATIONS—THE APPARENT INEQUALITY IN THE MOON'S MEAN MOTION AND THE OBSERVATION OF OCCULTATIONS—TO PROFS. NEWCOMB AND STONE—SOME SUGGESTIONS—THE AMERICAN NAUTICAL ALMANAC—ELEMENTS OF OCCULTATIONS FOR DECEMBER, 1885.

[24970.]—IN connection with my new method for computing occultations, I desire to draw the attention of astronomers (amateurs particularly) to a new field of usefulness in which they may find a good work to do. This work is the observation of occultations of stars by the moon with a view to furnishing data for a more rigorous determination of the moon's place; for now that the unexplained inequality in the moon's mean motion is receiving great attention, and is being made the subject of critical researches by the most eminent astronomers and mathematicians of the day, it seems to me that the accurate and systematic observation of these phenomena by observers in all parts of the earth will bring together important facts and data, looking to the solution of this problem, of a character nowhere else to be obtained. And here it is that this new method comes in and supplies a long-felt need of some short and less laborious way of computing the circumstances of these phenomena than the methods now in use. I do not doubt in the least that a great many amateurs now working aimlessly with their telescope would gladly enter into this work, but have heretofore been deterred from doing so (even for amusement) because either they do not understand the methods of computing occultations by logarithms, or that the expenditure of time and labour necessary in computing by logarithms is much greater than the results warrant. But this new method will, I believe, obviate both of these difficulties, for but very little time (not over fifteen minutes) is required, and its simplicity places it easily within the reach of persons of common education and intelligence. Nor will this work be confined to large telescopes; small ones will show most of the occultations, except those at about the time of full moon; and the latitude, longitude, and correct local mean time of the place of observation can now be accurately obtained from the nearest large observatory. But aside from this proposed work, it certainly affords one a good deal of pleasure to be able to compute for himself the circumstances of these beautiful and interesting phenomena. Nothing can call forth our wonder and admiration more than the sight of this ponderous globe travelling through space and hiding the stars from our view.

I sincerely hope that Prof. Newcomb, Prof. Stone, of the Royal Astronomical Society, and others interested in these investigations of the moon's motion will tell us the worth of this suggestion, and if it is practical, lay out a plan for the work and give us the necessary instructions to be followed in making the observations.

I had intended sending you a table of "latitude scales" calculated for every degree, but on reconsideration think it would be of little value as the scale is very easily found (as directed in my first communication on this subject), and that with a requisite correctness not to be obtained by interpolation.

To those of "Ours" intending to compute more than a few occultations, I desire to offer the following suggestions:—

First. As the latitude scale is *invariable* for all calculations involving the latitude for which it is constructed, it will be found to be very convenient to have the scale cut on a strip of brass like a rule. It should be spaced off into intervals of ten divisions each, and one of these intervals into divisions and half-divisions. This will insure greater accuracy in the measurements, and will be much more handy to use than a strip of paper. If, however, it is desired to make an occasional computation for any other place, the scale for that place may be made on a slip of paper as heretofore.

Second. For dividing the extent of the moon's motion during one hour into minutes, instead of using the two scales of equal parts as recommended, make one similar to Fig. 1, on page 179, the dimensions of which are as follows:—Top, 63 divisions of the latitude scale long: bottom, 52 divisions long, top and bottom to be divided into six equal parts and one of those parts into ten, and then connected by straight lines. In using this "hourly scale," measure the exact extent of the moon's motion during one hour (the hypothenuse of the right-angled triangle formed by the quantities x' and y') on a slip of paper, and lay this slip on the hourly scale at the proper place. Then mark off the minute and ten-minute intervals on the slip, and with it divide the moon's path as directed.

Third. If it is not desired to know the vertices of the moon, the centre of the earth need not then be found, and the distance of the centre of the ellipse from the centre of the moon at geocentric conjunction may be obtained by taking the difference between the quantities X and Y, remembering that when X is greater than Y the centre of the ellipse will be *above* the centre of the moon, and *vice-versa*.

Fourth, I have constructed an instrument for drawing the ellipses which I like very much, as it does the work more *accurately* and quickly than can be done otherwise. It is inexpensive, and anyone with a little ingenuity can make one, and, if desired, I will send a description of mine.

Lastly, for my own observatory I have bound together, like a pamphlet, three pieces of thick white card. On the first page is a table giving the quantity X, and the length of the minor axis for every fifteen minutes of declination up to 30°; on the second page is the "hourly scale" above referred to for dividing the moon's path into minutes of time, and on the third page is a diagram giving the ordinates of the ellipses corresponding to every five minutes of time. With the aid of these, the Nautical Almanac, paper, pen or pencil, a straight-edged rule, and a protractor for measuring the angles, I easily obtain correct results in from *ten to fifteen minutes*. I do not mean to say, however, that a beginner can do the same; but I do say that any ordinary person, having acquired that familiarity with the process which comes with a lit practice, can find the results in the times stated

In regard to the "American Ephemeris Nautical Almanac," which contains the ele for the prediction of occultations used in com by my method (and which the English does not), I would sa s may be of Messrs. Tru

London; or of the "Superintendent of the 'Nautical Almanac,' Navy Department, Washington, D.C., U.S.A." The price in the United States is one dol., post free. Messrs. Trübner and Co. would probably charge about the same and the postage on the book (3½lb. weight). Copies are now ready up to 1888, and that of 1889 is now in press.

As an inducement for those interested in this subject to try the method practically, I have again taken the liberty to copy from the "American Nautical Almanac" the elements of occultations visible in the British Isles in December, 1885. Some of these will probably prove to be "near approaches" only.

I shall endeavour soon to give some computations and observations for comparison: meanwhile, I hope those of "Ours" who can will do the same.

Charles L. Woodside.

Boston, Mass., U.S., Oct. 17.

A FEW PRACTICAL HINTS UPON THE WORKING OF THE WIMSHURST INFLUENCE MACHINE.

[24971.]—MANY readers of the ENGLISH MECHANIC are no doubt owners of the above electrical machines, and many of the happy possessors will have rejoiced at the brilliant sparks, and the beautiful brush discharges which they so easily obtain from the machines. But other possessors of the machine may, from the want of not understanding how best to adjust the parts, have been less fortunate in the results obtained.

The few lines which follow have been put together as the result of a somewhat lengthy experience in the treatment of the machine in question, and contain a few hints as to the more frequent causes of non-success.

Without any preliminary description of the parts of the machine, which have been already treated at length in these pages (No. 1,073, p. 142), we will at once examine the points which are essential to success.

First. How many sectors have you got upon the plates? If you have only ten sectors, you must not expect the machine to be self-exciting, unless it be in such an atmosphere as is usually found in an ordinary living-room; but when excited the ten sectors upon each disc is perhaps the best arrangement for length of spark. With this number of sectors, and with good Leyden jars, the spark should leap through space equal to nearly half the diameter of the disc. With twelve sectors, the atmosphere may be a little less dry; but with sixteen or eighteen sectors upon each disc, it will be freely self-exciting under almost every condition of atmosphere; while, if say forty sectors are placed upon each disc, it is only with difficulty, and under the very worst conditions of atmosphere, that self-excitement can be prevented.

It will be said by some that there are conditions under which it is not self-exciting, and the remark is true; the reason why is that in an atmosphere saturated with moisture, everything, including the machine, is coated with a thin film of water, and as electricity of this character is free to travel through water, it is not possible to upset the normal condition of the sectors.

Again, this fatal coating of water is readily produced in a fairly dry atmosphere, by condensation, and this may readily be tried. Let us first test that everything is in proper order, by exciting a machine in a cold room, and then carry it into a nice warm room, in which a few friends are anxiously waiting to witness the results. In about half a minute we turn the handle, and what do we find? Nothing. We keep turning the handle for, perhaps, two or three minutes before the electricity shows itself, and then all goes well. The explanation of this is that the cold surfaces had condensed the little vapour upon themselves, and then, after a few minutes, when they had acquired a temperature nearly equal to the surrounding atmosphere, the condensed vapour was again taken up by the atmosphere. This experiment shows that the temperature of the machine must not be any less than the atmosphere in which it works; while to produce and to exhibit the maximum results, say, in a lecture hall, the whole of the apparatus should be kept slightly warmer than the surrounding atmosphere.

Then, again, the neutralising rods and their brushes are important: the metal brush must be in absolute metal contact with the neutralising rod, and the brushes at each end of the rod must touch the sectors on opposite sides of the centre of each plate at the same time. If the rods are not of proper shape to cause the brushes to touch the sectors in this order, bend the rod to a proper shape.

Where are the neutralising brushes placed? You cannot expect much if they are wrongly placed. [illegible]ke your watch, hold it by the chain, and let its [illegible]k come to the spindle on which the discs re- [illegible] neutralising rod for [illegible] front disc [illegible] be parallel with a [illegible] XI and [illegible] e rod at the [illegible] ine, [illegible] glasses, mu[illegible] ing I and VII o'clock—that is, the two rods will make an angle with one another of 60 degrees. The above is about the best working position; though if the machine does not seem to pick up its charge readily, the rods may be turned into a more horizontal position.

The brushes must be kept in good condition and clean. If they are worn out, or are badly corroded, replace them with new ones. Nothing is easier: get the smallest quantity of fine wire, which any of the gilt-lace makers will sell, only be sure it is nice and fine; then a paper knife, or a card about 1½in. in breadth; take about ten turns of the wire on this, and cut the wire; now with a knife cut all of the ten turns at the one edge of the card or knife, slide the turns off, holding them firmly together, and then, with the other hand, tightly screw up the uncut end, and the brush is complete, except only that the loose ends will require to be clipped with a pair of scissors to remove the jagged ends. Pull the old brush out, and place the screwed end of the new brush into the hole at the end of the rod, and a small wooden peg squeezed in alongside the brush holds it securely in place.

The balls on the discharging rods should be unequal in size to give the best results. To obtain the maximum length of spark with, say, 17in. discs, the one ball should be about ⅜in. and the other about 1½in. diameter. They should be nicely polished. This arrangement also gives very good brush discharges. When the balls are of different sizes, attention must be given to make sure that the (−) or the (+) electricity is on that side of the machine which will give the best results. This is readily done by slightly darkening the room and noticing on which collecting comb is the brush, or which the luminous points. The difference is very marked. Having done this, then see that the larger ball is in connection with that comb which has the brushes on its points.

To reverse the current, where this is necessary, the better course is to charge a Leyden jar from, say, the right-hand comb. Then close the discharging balls, and with them closed turn the discs a few revolutions in the opposite direction; then separate the discharging balls, and touch the left-hand comb with the charged Leyden jar. The current will then be found reversed.

Leyden jar connections. To produce the greatest length of spark the inside coating of the two jars should be connected to the combs, and the outside coatings of the two jars must be connected together—say, for instance, let the jars stand upon a strip of tinfoil; of course, the inner coating of each jar is in connection with only the one comb. Good stout smooth wire forms the best connection, and great attention must be given to make sure that there are no points left open. To leave the sharp ends of the wire exposed is very damaging to the results, for nearly all the electricity would escape from it into the atmosphere. Try this as an experiment: Put your Leyden jars in circuit, and notice the results. Then get a pin or a needle, tie it on one of the wires so that its point projects away from the wire and from the machine, then endeavour to get the results which the machine formerly gave, and you will find the difference very marked. Next fasten a pin in similar way to the other wire or Leyden jar, and try the result; you will find almost nothing visible. It is a most useful experiment for amateurs, because it will so firmly fix in their minds the great importance of leaving no points exposed, and on the contrary, will show the value of smooth surfaces.

Dust.—Always keep your electrical machine free from dust; each atom constitutes in some degree a point, and moreover, it forms in some degree a conductor of electricity.

The foregoing points may each and all be as indicated; nevertheless, the charge will not remain in the Leyden jars. This condition is produced by a crack probably in one or more of the Leyden jars, and each one should be separately tested for insulation.

If the machine be made up with vulcanite supports for the combs, each of them should be separately tested, for sometimes the vulcanite has a brown-coloured surface left upon it, which freely conducts away the electricity.

Oil. Never work a machine without first knowing that it has oil in all the working parts. A little sperm oil will keep liquid and last for some weeks; but when using the oil-can be careful and don't put too much oil—it messes everything.

Sparkling Plates.—With forty or more sectors, and leaving the spaces between them about a ¼in., very pretty results may be obtained: the sparks jump from sector to sector, and show quite a shower; but for this the discharging terminals and the combs are best removed. Adding the combs and the Leyden jars, and allowing the discharges to take place from sector to sector, gives fewer, but very much brighter, sparks.

The foregoing remarks apply chiefly to the earlier forms of the machine, which were not furnished with four Leyden jars to make the supports for the combs; nevertheless, they equally apply to the newer form of machine. But to obtain the brush discharge, and for several other purposes, it will be necessary with the newer form of machine to break the circuit between the outer coatings of the Leyden jars. This is readily done by removing the wire, which is fitted between the terminals upon the base or stand.

The Bosses working too loosely upon the Spindle.—When this occurs, you will probably find that a brass spindle, instead of an steel spindle, has been used. A brass spindle, with brass bushes inside, soon chafes loose the bosses. The only cure for this is to get a suitable length of steel wire, just a little larger than the old spindle, and then put it in place of the smaller brass one.

Having attended all these points, some one is pretty sure to say: There is an abundance of electricity, but it is all at the top and the bottom of the glass discs, and none at the combs. To him may be said: You have not strictly attended. Turn the handle of the machine in the opposite direction, and you will then see that the electricity leaves the top and the bottom, and seats itself at the combs. The cure for this is to see that the driving band at the back of the machine is crossed, and the front band the straight one, or the neutralising rods and their brushes are wrongly placed. The lower brush to the front plate should be under the right-hand comb, and the others in relation to it, as earlier described.

The newer form of machine: some may say it does not give so long a spark or so good a brush as some other machines do; but it must always be remembered that it is designed as a compact machine of great power to give good average results of every kind.

I think every essential feature has now come under notice, but there may still be others in the minds of some of your readers; if so, let them be stated in your query column, and I will do my best to give an explanation.

James Wimshurst.

WIMSHURST'S CONTINUOUS ELECTROPHORUS.

[24972.]—IN the two earlier communications upon electrical influence machines, your readers have been furnished with enough information to set them to work; and now it may be as well to direct their attention to the earliest machines of this order, and also to the outlines of a theory which is probably worth their consideration; then to finish the paper portion of this interesting subject, it may be well to describe the construction of the simplest and most perfect form of self-exciting influence machine which can be made.

In the year 1753 John Canton was the first to discover electrical induction, and a few years later, in 1782, Volta made an electrophorus (see *Phil. Trans.*, Vol. LXXII. The next step appears, by the *Phil. Trans.*, Vol. LXXVII., page 32, and Vol. LXXVIII., page 8, to have been made by Bennet, who then found that by using an apparatus practically consisting of one electrophorus placed on a second, and by varying their positions relatively to each other, &c., he could multiply the first induced charge.

From the *Phil. Trans.*, Vol. LXXVIII., page 405, we find that the next step was immensely in advance of all previous efforts. Both the electrophorus and the condenser involved the tedious operations of raising and touching the plates by hand; but in the Nicholson's revolving doubler the principle of rotation, and the contact of wires took the place of these elementary processes.

He multiplied the charge by using three metal plates, two of which were held in a horizontal position at the ends of insulating arms, while the third plate was made to revolve in the face of the two fixed plates, the atmosphere answering for the dielectric, and each of the three plates being touched at proper times during each revolution by metallic brushes or contacts, by these means he obtained considerable charges of electricity, and produced the first self-exciting electrical influence machine.

Since then a century has passed away, and the infant of Nicholson has grown to the giant, the difference, however, between the Nicholson revolving doubler and the modern influence machine consisting merely in the mechanical developments.

Scientists and students formerly were satisfied with small discharges, to obtain which the greatest attention had to be paid to the atmosphere and to the temperature of the machine; while now, with the modern influence machines, the temperature and the atmospheric condition are scarcely a consideration, and instead of a small discharge with long intervals between, the modern machines will display torrents of sparks, apparently in a continuous stream. To confirm this last statement, I may add that two machines stand in my laboratory—either of which, when turned by a lad, will furnish discharges from Leyden jars so rapidly as to light the room sufficiently to enable me to write or to read.

The theory which, perhaps, is most worthy of acceptance is that, even when at rest, each of the sectors is in some degree differently electrified to its neighbours; that when the machine is put in motion each pair of sectors in their turn touch the metallic brushes at such points or places, that the equalisation of their charges, and the corresponding changes of the electrical condition between the plates or discs, may produce the most useful effect upon the plate and its sectors at the back of the machine, which plate, it will be remembered. revolves in the opposite direction to the front plate. When the machine is working, it may be supposed that an electrical wave is set in motion, the depression (or −) being seated on the one half of the plate, the crest (or +) being seated on the other half of the plate, the normal condition extending in straight line from brush to brush.

The sectors seem to occupy the position of reservoirs, and contain the larger part of the electricity which is produced upon the adjacent surfaces of the plates or discs, for being of metal they readily accept, and deliver, their acquired electrical charges.

The above remarks contain the early history of these machines, and the outline of perhaps the best theory respecting them. To attempt further developments of the machines, and to complete the above outline of the theory, will form very useful occupation for the younger and newer minds of your many readers during the ensuing winter evenings.

But now to describe the simple form of a continuous self-exciting electrophorus, which is, of course, only reducing the influence machine to its least complicated form, and bringing it within the reach of every school student who chooses to give a few hours to its construction.

First, then, get a large sized knitting-needle, then two large-sized cotton reels, the holes through which nicely fit upon the needle; then obtain two smaller reels, fitting equally well upon the needle; next buy two discs of glass of about 12in. diameter, and having a small hole through their centres, varnish the glasses on both sides with shellac, and when dry stick upon one side of each disc about thirty sectors of tinfoil, the spaces between each of the sectors should be about one eighth of an inch at the outer ends, and perhaps three-sixteenth of an inch at the inner or small ends; then with a little tricycle cement stick the glasses upon the ends of the large cotton reels, in such manner that the cotton reel is upon the face, or sector side of the glass, care being paid to see that the glasses run truly when revolving upon the needle or spindle. A small ring, made of cardboard, and placed between the centres of the two glasses, will give about the proper space between them, to allow them to revolve without touching one another.

The neutralising rods are made by boring a hole through each of the two smaller cotton reels at right angles to the axis, or needle, and through each pass and tightly fasten a brass wire, sufficiently long to bend to a curve, and terminate about half an inch from the glasses. On both ends of each rod tie three or four small strips of fine wire (or the gilt strips used amongst the firegrate shavings will do), and the machine is complete. To work it will need just a little practice, for the smaller cotton reels will need to be held by the fingers in such a manner that the two neutralising rods are at right angles to one another, while with the thumbs the large reels with the glass discs have to be turned in opposite directions. Very little practice will make this part become easy, and with each revolution the discs will exhibit masses of electrical sparks leaping from sector to sector.

Of course, more perfectly-finished instruments may be made, properly-turned bosses being used instead of the cotton reels, and the neutralising rods and brushes being made wholly of metal in the manner described in your earlier issue. The machines also may he better held by making up a simple stand having two stanchions properly shaped to carry the spindle; and in this latter shape the electricity may be collected from the plates by attaching a wire point to a Leyden jar, and then standing the jar with the point near to the revolving discs. For educational purposes, and for illustrating induction, these simply-made instruments are very useful; but the student or the tutor must use his own judgment in adapting the instrument and its attachments to the purpose required of it.

12th October. **James Wimshurst.**

MICROSCOPICAL—PODURA SCALE.

[24973.]—WITH regard to "E. H. W.'s" observations on Podura scale (24917), let me assure him that the method of illumination employed by him—viz., that of placing a diaphragm above the condenser, is not new. It has lapsed into disuse, however, because precisely the same result is obtained when the diaphragm is placed below the condenser. The diaphragm, too, is much more get-at-able when it is below the condenser than when it is above.

Let us suppose that the hole in the centring cap of "E. H. W.'s" condenser allows a solid cone of 20° of light to emerge: it would be quite easy to make a diaphragm with an aperture of such a size, which, when placed at the back of the condenser, would only allow a cone of similar size to pass out of the front of the lens. If "E. H. W.'s" Podura scale is of the right kind, and mounted dry on cover, and if he is obliged to reduce the aperture of his illuminating cone to, say, 20°, in order to blacken the exclamation marks, it follows that his objective cannot be in adjustment. I should not think anything of an immersion $\frac{1}{10}$, which would break down on a Podura scale, illuminated by a solid cone of light 50° in angle.

London, Oct. 26. **Edward M. Nelson.**

FIG. 1.

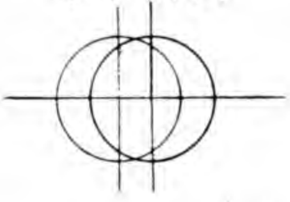


FIG. 2.

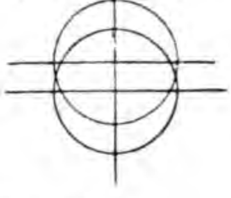


FIG. 3.

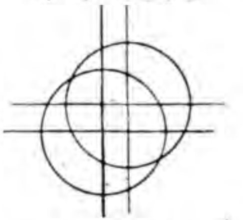


FIG. 4.

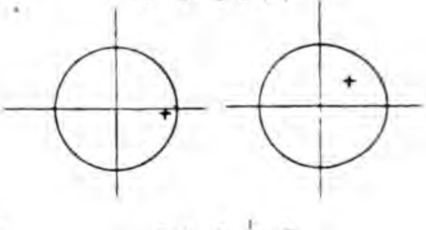


FIG. 5.

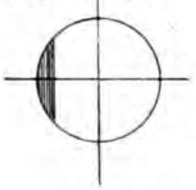
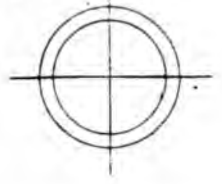


FIG 6



MICROSCOPICAL BINOCULARS.

[24974.]—IT gives me much pleasure to reply to "E. P. G." (57852), as it is a great treat to find some one who is really going in for critical images. The following remarks refer solely to Wenham's binocular, which is, I think, the most practical form that has ever been introduced. The binocular may be readily adapted to any inequality in the focus of the eyes by an adjustment of one of the eyepieces. The eyepieces should be marked R and L, to show which tube they belong to. Binoculars give less critical pictures than monoculars, for the very good reason that half an objective will not perform so well as a whole one. All prisms are defective; therefore the image in the left tube is worse than that in the right. The image in the binocular, therefore, consists of an indifferent picture in the right-hand tube, and a worse one in the left. Observers put up with this for the sake of the stereoscopic effect, which is gained at the cost of a critical image.

I am much pleased with the notice of the "*difference of amplification*." It shows that "E. P. G." has gone into the matter with great care, and wishes to get the instrument perfect, as it should be, and is not going to content himself with one which is deemed to be "good enough for histological purposes." Opticians know very well that the eye will accommodate itself, and combine almost anything; therefore, little or no pains are taken to send out binoculars in perfect adjustment. I will mention a fault which is frequently seen in binoculars exhibited at the societies.

1. The axis of the left-hand tube does not make the proper inclination with the other; this causes the field of the left-hand tube not to coincide laterally with that of the right-hand (Fig. 1).

2. If the axes of the eyepieces are not in the same plane, the field of our tube will be either above or below the other (Fig. 2).

Fig. 3 shows what is often found—viz., Nos. 1 and 2 combined.

3. The focus of each tube should be carefully adjusted, either by the tube or by the eyepiece. I have my own done by collars round the eyepieces; but the tube-length method is preferred by some, and is just as efficient.

4. The eyepieces should be matched in power.

5. The position of the prism in its carrier should be correctly adjusted. One would think that a very trifling movement in the prism would make a very great difference in the position of the image of the field, but such is not the case. The plane of the base of the prism should be at right angles to the axis of the objective; if, however, this is tilted through an angle of 20°, one will be surprised at the small difference it makes. Any twist in the prism would make a very serious fault; in other words, the planes of the reflecting surfaces of the prism must be at right angles to the plane of the axes of the tubes. See Fig. 4, which shows that when the prism is out of adjustment an object will not occupy the same position in each field. (In making this test, it is as well to use the same eyepiece on each tube).

6. When the carrier of the prism is pushed home, the edge of the prism should exactly bisect the back of the objective. Fig. 5 shows the picture in the left-hand tube, when the prism is not pushed in far enough. When the prism is pushed in too far, the dark patch would be seen on the opposite side of the right-hand tube.

7. The diaphragms in the eyepieces should be of the same size, Fig. 6.

I have omitted to mention that the best way to find out if the fields are exactly superimposed is to blink or wink rapidly with each eye alternately.

In conclusion, let me note a few points on the stereoscopic effect of the Wenham binocular, which I do not think are generally known, and which I had the honour to bring before the Quekett Microscopical Club in the spring.

I have found by repeated experiments that stereoscopic effect depends largely on the position of the object in the field.

Example.—The ray of Heliopelta, which lies horizontally, or east or west in the fields, is seen in much stronger stereoscopic relief than one lying north and south or vertically.

I have an object which has a delicate membrane, with a slight oval depression in it. This depression cannot be perceived with a monocular, neither can it by a binocular, if the major axis of the oval is placed in a vertical position in the field. But let the object be turned round 90°, to bring the major axis of the oval into a horizontal or east and west position, then the stereoscopic effect will be strong enough to make the depression apparent. I wish that every possessor of a binocular would try the following experiment.

Place the proboscis of the blow-fly, squeezed flat in balsam, in a vertical position, and examine it binocularly with, say, a $\frac{2}{3}$in. objective, and let the attention be concentrated solely on the two main vertical cut suctorial pipes. Now let the observer carefully examine those with a view to determine the amount of stereoscopic effect the binocular gives to them. Let me warn him against letting his eye cheat him by giving those suctorial pipes a stereoscopic effect which they do not possess, derived by contrast with other parts of the field. He must, to make this experiment correctly, resolutely shut his eyes to everything else in the field except those suctorial pipes. I feel sure that no candid observer correctly performing this experiment will b able to detect any more stereoscopic effect on t object than if it were examined monocularly. course, there will be stere degree, as there will be al it must be admitted tha decided idea of solidity. any difference in the st the binocular and monocular on that object when it is placed in the position I have pointed out, although I have repeatedly gone over the experiment with great care, and with a perfectly unbiassed mind. Now turn the object round, so that the cut suctorial pipes lie in a horizontal or east and west position: the stereoscopic effect is so marked that you might easily fancy you could crawl along the pipes. When the object is in a vertical position, I would call the attention of the observer to the loss of definition of all fine details which lie in a vertical position. I allude to the minute hairs on the delicate membrane, which is stretched across the two cut suctorial pipes. When the object is turned round, notice how sharp they become.

To sum up, every exhibitor should be careful to *place his object so as to secure the largest amount of stereoscopic effect*. It is, of course, immaterial which way some objects are placed, such as a coscinodiscus; but isthmia, pleurosigma, navicula, &c., should be placed with their major axes east and west, as well as objects such as scales on butterflies' wings, and many others.

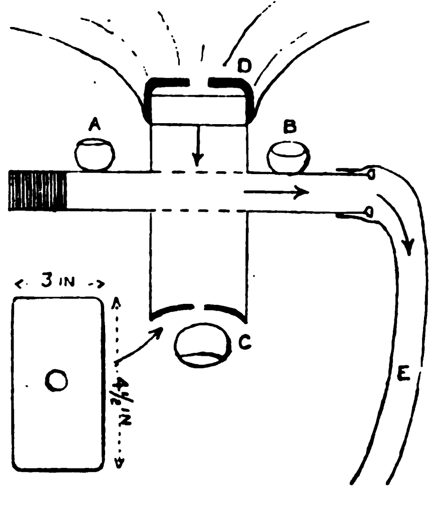
Edward M. Nelson.

London, October 28.

DIPHTHERIA AND DOCTORS' RISKS.

[24975.]—THE inclosed is a diagram of a suction apparatus, constructed from two portions of gaspipe.

A large tube 2½in. long, or small three; they are cross-bored and soldered at right-angles; one end of the smaller tube is filled up with a plug; over the other is passed the tube of a stomach-pump; a ring of indiarubber inside and an oblong of wash-leather 4½in. by 3in. outside the tube form the "artificial mouth" at one end of the larger tube, the other end being rounded out to receive the top of the thumb, so as to act as a valve. When in use it is held in the right hand between the index and middle fingers, leaving the left hand free to adjust the wash-leather. The stomach-pump is worked continuously by a second person. By placing the thumb on the opening, suction is produced; on removal, the air again enters. This is the suction required—not a vacuum, the return of the air being necessary to produce a current to dislodge the membrane.



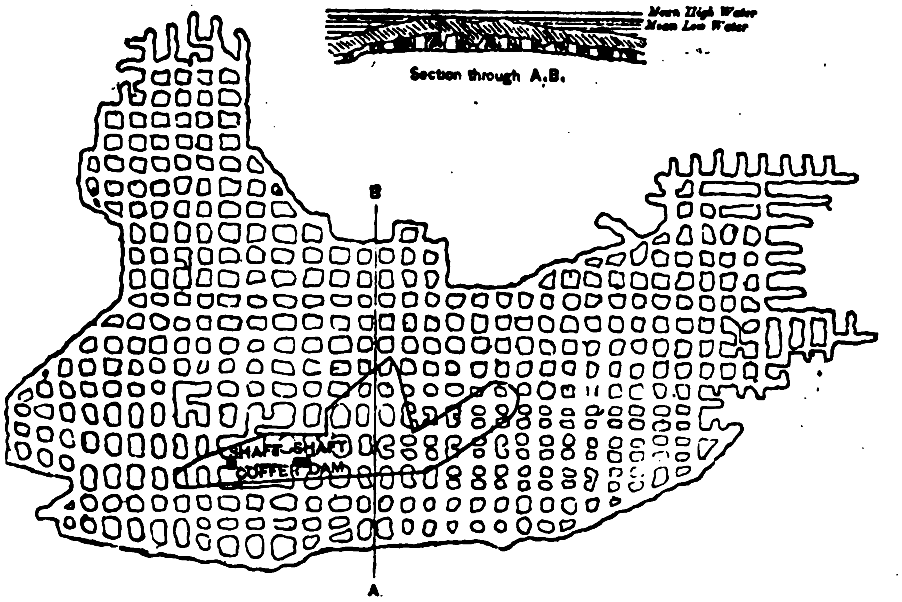
In the diagram, A shows middle finger; B, first finger; C, thumb, to act as valve; D, indiarubber; E, tube to stomach-pump; F, strip of wash-leather.

Wm. W. Brereton, L.K.Q.C.P.I., &c.

A GOOD TONING BATH.

[24976.]—R. A. R. BENNETT expresses a wish, in your last issue, to hear of a good toning bath which could be depended upon. As I was for some time in quest of the same thing, I am pleased to give a formula which I have for the past few months adopted, and which has given me every satisfaction:—

Place the 15-grain tube of gold in 15oz. of water, and keep as stock solution. For toning, take 90 grains of refined borax, and pour on 2oz. or 3oz. of hot water to dissolve it, and make up with cold water to 14oz.; then add 1oz. from gold solution, and put sufficient hot water to make the bath [illegible] warm to work with. It is ready for use at [illegible] will not keep; but for one like myself, [illegible] to [illegible] [illegible]lar in- [illegible] better [illegible] bath [illegible]



THE GREAT SUBMARINE EXPLOSION AT NEW YORK ON OCTOBER 10th, 1885.

[24977.]—THE successful removal of Flood Rock to-day is the crowning act of 35 years' work in clearing the narrow strait called (ever since the days when it was so named by the Netherlanders) Hell Gate, which has been a scene of wreck and disaster, owing to its numerous reefs, from the time of the loss of the *Hussar* frigate (sunk in 1780 with the pay of the British troops on board—upwards of £100,000 sterling) to recent years.

All vessels entering the port of New York from the east save about 45 miles sail, to say nothing of the innumerable fleet of lesser craft, from the small coaster to the magnificent "Sound steamer," going to and fro every day, must pass through this narrow gap, where the tide often runs so violently as to make the best seamanship nugatory, and it is no wonder that even the phlegmatic Dutchmen held the voyage in such horror that they gave it so unsavoury a name.

It is a narrow navigable channel, between Long Island on the south, and the islands of New York and "Wards" on the north, the enormous sweep of the tide being sufficient to prevent silting-up, and its natural depth permitting the passage of the largest ships, were it not for the numerous reefs and the violent and uncertain eddies caused by their presence.

In 1848 the first survey was made by Admiral (then Lieut.) Porter, U.S.N., who proposed to blow up Pot Rock, Frying-pan, and Way's Reef, besides cutting away a part of Hallett's Point—a reef on the Long Island side, projecting far into the channel.

In 1851 the N. Y. merchants spent 14,000 dols. on the reefs, in "surface blasting," but only a few projecting points were removed. The following year (1852) Congress appropriated 20,000 dols., all but 2,000 dols. being spent on Pot Rock, which was lowered 2ft. only.

Little was done, after this, until the suppression of the rebellion, when Major-General Newton, U.S. Corps of Engineers, was detailed in 1866, to make a survey and report concerning Hell Gate. In 1868 Congress approved his plans, and provided 85,000 dols. to carry them out.

In 1870 he began work, drilling the smaller reefs by means of a steam scow of his own device, through whose open centre an iron cupola, 30ft. in diameter, was lowered upon the rock. This carried 21 drills, 10ft. long, and 600lb. in weight; these drill a 5½in. hole by a stroke of 18in. The cupola stands on adjustable legs (two), and is held in place by its own weight. Holes are 6ft. to 8ft. apart, and hold 50lb. to 60lb. of nitro-glycerine. Drilling began May '71, and the Frying-pan was destroyed in July, 1872.

Pot Rock was then attacked and demolished. Way's Reef was removed to a depth of 26ft. at mean low-water in 1874. This rock was 285ft. by 115ft., and 262 drill holes were made, of an average depth of 8·1ft., or an aggregate depth of 2,130ft. Average depth of drill hole per cubic yard of rock was 0·7ft.; average charge of nitro-glycerine per cubic yard of rock removed was 5·54lb.; average depth of hole drilled in a day of eight hours was 6·5ft.; average cost per foot of hole, including running machine and scow, cost of drilling and sharpening drills, and loss of steel was 2·05dols.; cost of dredging and dumping débris per cubic yard was 4·29dols. These details, though uninteresting to the general reader, are useful as data to civil engineers.

The larger reefs were attacked by tunnelling, after the plan proposed by G. C. Reitheimer, of the Holyhead breakwater engineering corps.

Hallett's Point was dangerous, as it left too little room for the channel between itself and Flood Rock by projecting, as it did, 300ft. from the shore. It was semi-circular, 720ft. long, and ran out about 300ft. into the channel.

In July '69 a coffer-dam was built on it, above low-water mark, 145ft. long, and extending out on the rock 95ft.; a shaft, 105ft. by 95ft., and 38ft. deep below mean low-water. From the bottom of this huge pit ten tunnels were cut out into the rock, diverging from each other like the sticks of a fan, and communicating by means of ten concentric galleries, at an average distance of 20ft., centre to centre. The longest tunnel was 126ft. long; the shortest 51ft. The area covered by shaft and tunnels was 2⅝ acres. Tunnels were 13ft. to 22ft. high at shaft (averaging 19½ft.), and 9ft. to 12¾ft. wide (average 10¾ft.) The inner gallery was 12ft. high, and 9ft. wide; the outer much smaller. There were left untouched 172 piers of solid rock, and the total length of tunnels was 4,857ft.; the galleries were 2,568ft. long, making a total length of excavated passages of 7,425ft.

Owing to the shelly nature of the rock, the advance of the work was necessarily slow, as only light charges of the explosive could be used—as a rule, not more than 8oz. of nitro-glycerine. From July, 1872, the Burleigh drill was used, capable of drilling 30ft. of hole in eight hours, at a cost of about 36 cents per foot, while hand-drilling cost 95 cents per foot. Owing to local peculiarities in the rock, the use of the diamond drill was impracticable for general work.

In 1871 more than 16,000 soundings were taken, and from these the plan of the rock was made, the tunnels being so inclined as to allow a roof of 6ft. to 15ft. in thickness between the miners and the water overhead. Constant pumping was a *sine quâ non*, owing to the seamy rock—a very hard "hornblende-gneiss," with many intersecting cross-veins of quartz.

The total mass of rock composing Hallett's Point reef is estimated at 110,461 cubic yards, of which 47,461 cubic yards were excavated and hoisted up the shaft, the blasting costing 46 per cent. of total expenses, and the cartage to the shaft 17 per cent. thereof.

On completing the excavation, the pillars and roof were filled with a multitude of small charges equally distributed, each one primed with a fine wire and fulminate, all thoroughly waterproof.

On Sept. 23rd, 1876, the mine was flooded, and on the following day, Sunday, the 24th, the rock was blown to fragments, as it was deemed unsafe to allow the mine to remain loaded an hour longer than was absolutely necessary.

The holes were divided into 184 groups of 20 holes each, every eight groups having a separate battery. A bomb-proof, near the shaft, contained the batteries and apparatus, and all the wires came to a plate which was capable of sliding up and down like a sash-window, the wires being in electrical connection with pairs of pins projecting from its lower surface. When all was ready the plate was raised in its grooves, and held up by a wire having a small torpedo so attached to it that the explosion of the torpedo would cause the wire to break, and let the sliding plate fall. Under the plate was now put a board, having a series of indentations in it, to act as "mercury-cups," and thus to make an electrical connection between the various pairs of wires going to the sliding plate.

The last act of preparation was to raise and fasten up the plate, and to fill the cups with mercury; the small torpedo was in electrical connection with a wire running off about 1,000ft. on the shore, and was connected to a small battery and an ordinary telegraphic key. At the last moment the little battery was put in circuit, and at 2h. 51m. p.m., Sept. 24th—the time of high water; the key was depressed by General Newton's baby daughter Mary, aged three years. The shock lasted for three seconds, as the various parts did not explode quite simultaneously, but no damage was done outside of a few panes of glass, and one or two old ceilings that came down. At a distance of a few miles the effect was absolutely that of an earthquake, and even as far as 150 miles away the shock was distinctly felt.

The explosives used were as follows:

	lb.
Dynamite	28,901
"Rend-rock"	9,061½
"Vulcan powder"	14,244
Total explosives	52,206½

in 13,596 cartridges. There were 4,462 separate blasts, and 3,645 primers used.

Of connecting wire in the mine 100,000ft. were used, with 64 batteries of 960 cells in all; there being also 20,000ft. of "leading wire" in use. The reef was broken up quite small, and it was found that, while the "vulcan powder" cost less than half as much as nitro-glycerine, it would break, weight for weight, eight-tenths as much rock. Estimated cost of the work, including dredging up the debris of this blast, about 2,000,000dols. If we include all done and to be done, the total cost of improvements is estimated at about 6,926,000dols., or £1,385,200.

The principal remaining obstruction was Flood Rock, a huge mass of gneiss 1,200ft. from the Long Island shore, covering an area of about eight acres on the bottom, although a small patch, 70ft. by 250ft. was all that showed above water.

On this a platform was built, and a shaft was sunk 67ft. deep; a smaller one near it, 40ft. deep, served for ventilation and hoisting. Tunnels were pushed out in all directions at 40ft. from the surface, and a second series from the bottom of the deep shaft, so that the tunnels were two-storied, so to speak, being directly over each other. The tunnels branch at right angles every 20ft., and there were 60 galleries in each tier, so that the total length of tunnels was four miles. As shown on the plan, 24 galleries ran north and south, and 46 east and west. The longest gallery was 1,200ft. long, 6ft. wide, and 10ft. high, a roof varying from 10ft. to 25ft. thick being carefully preserved, sustained by 467 stone pillars, each 15ft. square.

About 80,000 cubic yards of rock were removed to the surface by the elevator shaft; 13,286 drill holes were made, each 3in. wide by 9ft. deep, from 4ft. to 5ft. apart in the pillars. (See sketch, p. 203.)

The "rack-a-rock" was in 47,000 cartridges, 2ft. long by 2¼in., thick, each 6lb. in weight. These were exploded by dynamite torpedoes, primed with fulminate, and ignited by electricity. In all, nearly 300,000lb. of explosives were used, connected by 500,000ft. of wire.

To-day, Oct. 10th. the reef was blown up, at 11h. 14m. a.m. (Standard "75th meridian" time, or 4h. 14m. G.M.T.), the circuit being again closed by Mary Newton, now a staid young lady of twelve years.

Beyond a huge mass of water, raised 200ft. in the air, little was to be seen, but the earth trembled like an earthquake. Thus ends a most stupendous operation in sub-aqueous engineering, which will wonderfully enlarge the facilities of this port, as soon as the broken rock can be removed by dredging. **Roi ne Puis, Souza je Suis.**

Brooklyn, N. Y., October 10th.

MUSICAL SCALE.

[24978.]—It is unwise on the part of Mr. N. E. Child not to recognise that "it is the duty (of himself as well as) of anyone who quotes a writer to endeavour at least to understand what that writer meant," especially as a reference was given to Mr. Hardie's last letter, and it would have been very little trouble to have looked it up. However, information is preferable to badinage, so I will put Mr. Hardie's melodic scale in a nutshell (please refer to No. 1036 "E. M.," p. 477-8, for his full exposition], and it will be seen that it has even as great a right to be called a perfect fifth scale as the natural scale has, so that these two terms are not necessarily synonymous as Mr. Child assumes.

$$F\,\tfrac{3}{4}\quad C\,1\quad G\,\tfrac{2}{3}\text{—}D\,\tfrac{8}{9}\text{—}A\,\tfrac{16}{27}\quad E\,\tfrac{64}{81}\quad B\,\tfrac{128}{243}$$

are the six successive perfect fifths on which Mr. Hardie builds his melodic scale, and it will, therefore, consist of the following intervals $\frac{8}{9}$ $\frac{8}{9}$ $\frac{243}{256}$ $\frac{8}{9}$ $\frac{8}{9}$ $\frac{8}{9}$ $\frac{243}{256}$. But, while stoutly defending this as the one he finds most to his taste for the performance of pure melodies, he admits that it is of no use for the purposes of harmony, for which he concedes the use of the natural scale to be correct.

This natural scale is also constructed of perfect fifths; but the central note D in the system of fifths is therein duplicated a comma lower, thus admitting simpler proportions for the latter three notes, thus—

$$F\,\tfrac{3}{4}\quad C\,1\quad G\,\tfrac{2}{3}\text{—}D\,\tfrac{8}{9}\quad D\,\tfrac{9}{10}\text{—}A\,\tfrac{3}{5}\quad E\,\tfrac{4}{5}\quad B\,\tfrac{8}{15},$$

and the well-known scale intervals $\frac{8}{9}$ $\frac{9}{10}$ $\frac{15}{16}$ $\frac{8}{9}$ $\frac{9}{10}$ $\frac{8}{9}$ $\frac{15}{16}$ follow. Whether perfect intervals must invariably be made by selecting the most consonant form of the central note, I am not yet clear; but the $\frac{9}{10}$ D certainly appears to hold a natural place in the system, yet equally certain is it that in the dominant seventh chord, G B D F, the top interval must always be the imperfect minor third of $\frac{27}{32}$, and if it is right here, why may it not be equally correct to employ this and other imperfect intervals under certain other circumstances?

The arguments advanced against Mr. Hardie's melodic scale, are they not written in "Ours?"—but being of a theoretical nature, he meets them by saying he has practically tested his scale, and found it satisfactory, and recommending others to do likewise, will not let theory outweigh practice. This is all very good; but to what does it point? As I and others cannot agree with his scale theoretically or practically, it must either be assumed that Mr. Hardie is misleading us by the results of experiments conducted with insufficient care, or we are forced to the conclusion that he has a natural taste for a different scale from ours, and as we have not yet reached the limits of knowledge in this direction, it will be as well to avoid hastily-formed conclusions.

Now, when I visited the "Inventions," I determined to try this melodic scale on Colin Brown's voice harmonium, in order to be able to say I had heard it, and with what result. As it is composed of five major tones, $\frac{8}{9}$ and two imperfect diatonic semitones $\frac{243}{256}$, the way to play it is to use all white keys, thus C D E′ F G A′ B′ C, or similarly commencing on any other major or white keynote, the third, sixth, and seventh being a comma sharper than in the natural scale. I am well aware that the third, sixth, and seventh of the natural scale are played with black digitals, as Mr. Child says, and I find these intervals very pleasing; but the imperfect diatonic semitones of Mr. Hardie's melodic scale have a very wailing effect, and the melodic major thirds sound strained. These are the best terms I can use to express the mental effects which I designated as being, "as I expected, worse than with equal temperament," for the simple reason that they are further removed from the natural scale than the same intervals are in the equal temperament.

Here is chapter and verse for my quotation from Mr. Ellis, and it will be seen that I have endeavoured to understand him. In No. 1046, page 118, will be found a short sketch of a paper read by him on the "Musical Scales of various Nations," and he winds up by saying that "The final conclusion is that the musical scale is not one, not natural, not even founded necessarily on the laws of the constitution of musical sounds so beautifully worked out by Helmholtz, but very diverse, very artificial, and very capricious."

Now, the knowledge of, and acquaintance with, musical scales possessed by Mr. Ellis is, perhaps, surpassed by that of no other individual, and he is consequently in a position to deliver an opinion which naturally carries great weight with it; but, duly admitting all this, I find myself unable to believe in his conclusion. But if the ears of other nations rejoice in musical proportions other than those our musical ears select as the correct ones, then it would not be a surprising matter to find differences among ourselves, as most probably the acceptance of some and the rejection of other sounds for musical purposes lies in the natural construction of the ear.

I would like to see the voice harmonium more generally known and used. I can find scarcely anyone, in an ordinary way, who has heard of it.

Swindon. **S. E. Hunt.**

[We cannot spare more space for this subject.—Ed.]

HYDRAULIC RAMS.

[24979.]—In reply to "W. A. S." (24944) I have to say that the ram with which I experimented was such that the only means of stopping it working was by laying hold of the rod of the outer valve and drawing it towards the face of the outlet, when, at the first recoil, the downward pull of the valve (a 4in. one) was so great that it was impossible to hold it there. But the pull became less at the next stroke, still there was an oscillation going on in the water in the pipe, at each of which a fresh pull of the valve was felt. I think there could not have been less than six of these pulls, gradually diminishing in force, before everything came to rest, and the valve was held in its place by the weight of the column of the supply water. Now it was this oscillation which I alluded to, and which "W. A. S." says he does not quite understand, and which I scarcely see is compatible with the incompressibility of water.

The above also will show that the valve does not fall entirely by its own weight, for the drag or pull downwards must have been five or six times its weight, showing that a vacuum or partial vacuum was present in the pipe at each recoil. This is why I suggested endeavouring to determine the force with which the valve starts to fall.

"W. A. S.'s" experiments with the American ram are highly instructive; but they show also that the elasticity of the metal pipes is only one factor in the action, and the full explanation of it is still incomplete. I shall, however, look forward with great interest to the future contributions which "W. A. S." promises on this subject. **J. N.**

THE BLOWPIPE AND COMMERCIAL SCIENCE.

[24980.]—I am very pleased to see a new writer taking up the subject of Anhydrous Analysis in the "E. M." for I had hoped that ere this Mr. W. H. Furlonge, of Thunder Bay, Lake Superior, who is an enthusiastic, and will probably be a distinguished, votary of this science, would have taken the matter up.

"B. C. R.'s" letter (24957, p. 184, "E. M."), is workmanlike, practical, and ingenious; but I would briefly remark concerning it (1) that a beautifully-constructed sp. gr. balance on the principle described and figured, was some years ago brought to me by the late Mr. W. Griffin; and he (I believe unconsciously) had taken the design from Faraday's "Chemical Manipulation." The beam and pans were made of aluminium.

(2) "B. C. R." does not give us the results he has obtained from his apparatus in the way of Al plate sublimates; but I cannot believe he will get correct ones with a Herapath blowpipe (blast pipe inside of gas tube) such as he figures in "E. M." because the delicate effects of oxidation, pyroxidation, and reduction obtainable with the common blowpipe on Al sublimates, cannot, in my experience, be thus realised.

(3) The Al plate, for the same reason, is better held in the left hand than on a fixed support, which, by the way, has also been designed by Mr. J. T. Letcher, of Truro. "B. C. R." "commends the fixed support, as it leaves the (left) hand free for other work"; but, as Berzelius says, "You do not know what else to do with your hand when it is 'free.'"

(4) If "B. C. R." had added to his picture of foot-blower, blowpipe, and Al plate stand, one of the operator, he would have explained what appears at present (to me) a difficulty; viz., how he proposes to sit so as to work this apparatus, which seems to be on the level of the floor. Is the operator to sit on the bellows?

(5) The bellows itself seems simple; cheap, and effective. Mr. Letcher has devised a new form of foot-blower, which I have not tried yet; but will report upon in "E. M." as soon as I can get time. However, "B. C. R." surely deserves every encouragement from your readers, and I trust he will continue his articles periodically.

W. A. Ross.

SODA SULPHATE AND POLARISATION IN BATTERIES.

[24981.]—I acknowledge, and wish to reciprocate, the friendliness of "Sigma's" tone, but must remonstrate against his repeating the charge that I fancied the facts I mentioned were "new additions to knowledge," when I stated in every letter that I expected to find myself anticipated. I remonstrate also against the remark, which I think my narration disproved, that I acted "without a guiding principle." As to the "time and money" spent in my so-called "experiments" on page 522, I still hope the time was not wasted, and the actual expenditure of money could hardly have come to sixpence.

Next, as to the result being mere "chaff winnowed away by earlier workers," "Sigma" himself shows as clearly as possible that the use of neutral salts, to which I called attention (and which he admits not to be mentioned in the descriptions of Daniell's cell in ordinary textbooks), possesses two important advantages. It prevents not merely the slight action of acid upon a well-amalgamated zinc plate, but the deposition of copper from the copper sulphate which, when acid is used, soaks through the earthenware. I call both of these advantages important, for I hardly suppose he will deny that the "very small action" of the acid becomes a very serious matter (even independently of the deposition of copper which must fatally aggravate it) if the rod has to be left in the cell where the circuit is interrupted, and if the amalgam and zinc are somewhat worn. In my own practice I must con
that though I use soda su
which the
cannot decompose, still
sulphate works through
way my own fault, bu
a single Daniell's ele

quite satisfactorily, if I wipe the zinc rod once in a few weeks or so.

"Sigma" appears to have understood me to apply the term "polarisation," in my first letter, to the hydrogen bubbles which I spoke of as produced by the acid upon the surface of the zinc. I cannot find that I anywhere so used the word; nor was I likely to do so, for I always took it to mean properly what "Sigma" defines it—viz., a "counter E.M.F. set up by the products of the decomposition of the electrolyte." But I certainly did speak of the partial coating of the zinc with copper on p. 522 as "permanent polarisation"; and I maintain that is so exactly in the sense of the above definition, because it creates a new galvanic "pair," consisting of the zinc still exposed and the contiguous deposit of copper, thus furnishing the electric current, which accompanies the chemical action upon the zinc with a shorter course than that through the wire and the outer cell. And this is surely a "counter E.M.F." to all intents and purposes. The rod, now partly copper and partly zinc, is polarised, for it embraces both the positive and the negative pole of the combination, whereas one of those poles ought to be elsewhere.

I had supposed "Sigma" to be anonymous, but this seems hardly compatible with his mentioning his own work on electricity. I do not know whether his reference to "p. 189" of that work is intended to warrant my identifying him with Prof. Thompson, to whose "Elementary Lessons in Electricity and Magnetism" I referred in a previous letter, and whose chapter on Two-fluid Batteries (by, at all events, a singular coincidence) begins on p. 189. But I am quite at a loss to discover anything there incompatible with the remark which I am "never again" to be allowed to make—viz., that "it is purely in order to get rid of these bubbles of hydrogen" on the negative plate, as my previous sentence showed, "that copper sulphate is used in Daniell's cell, and concentrated nitric acid in Grove's and Bunsen's. In speaking of the negative plate I mean the copper, towards which the current is supposed to flow through the liquid, and not the zinc, towards which it flows back through the wire. Well, surely this is quite compatible with the view I stated, or at least clearly implied, on p. 522, and which "Sigma" endorses, that, as a matter of fact, the copper sulphate is the sole exciting fluid, and to which my attention was really drawn first of all (before I began my "experiments") by Prof. Thompson's explanation, on p. 382, of the reason that a single Daniell's cell cannot decompose water. What I said about the bubbles of hydrogen comes simply to this, that, were it not for those bubbles, sulphuric acid, the action of which upon zinc gives an E.M.F. of 2·4 volts, would be a far preferable exciting fluid to copper sulphate, the action of which upon zinc gives an E.M.F. of less than 1·2 volt.

When I said, on p. 121, that I found no allusion to the use of neutral salts in Prof. Thompson's book I had certainly overlooked p. 149, where he says that, in telegraph batteries, "water only is supplied at the outset in the cells containing the zincs; and the E.M.F. of these is less than if acid or a solution of sulphate of zinc were added to the water." But there is no comparison made here between the zinc sulphate and the acid, nor anything to imply that the former has any special advantages, theoretical or practical. I venture therefore to repeat my question in this form. If, as "Sigma" appears to admit, soda sulphate or "salt cake" is a better conductor than zinc sulphate, and does not lead to the same wear and tear as dilute acid, what are the "practical advantages" in favour of sulphate of zinc?

A. E. B.

BALL-BEARINGS.

[24982.]—"ROI NE PUIS" uses the knife-edge as an argument against the use of plain bearings for bicycles. The case of a bicycle and that of a balance are not in any way parallel. In one there is revolution, and consequently rubbing motion and friction. In the other there is only reciprocating motion through a very small arc, and if the knife-edge and plane on which it rests are theoretically perfect, no friction at all. Such a thing as revolution on a knife edge is impossible.

There can be no doubt that friction is reduced by the use of well-constructed ball-bearings; but I am persuaded that the gain is not worth the cost. If a suspended bicycle wheel, with good bearings, is set in motion at such a speed that it would travel a mile in four minutes, it may be kept going at that speed by the merest touch—a fraction of a horse-power so small as to be difficult to conceive. If the bicycle be mounted and driven on a level road at the same speed, the power expended is out of all comparison with that expended in merely [illegible] the machine in motion.

[illegible] the rider has to do is made up mainly [illegible] of the air to his [illegible] through [illegible] of the road [illegible] the air alone.

named (on the authority of Molesworth) would be 1lb. per square foot of surface, and taking the rider and machine to represent an area of five superficial feet, we have an effort equal to 5lb. lifted 1,320ft. per minute, or 6,600lb. lifted 1ft. per minute—about a fifth of a horse power. The friction of a well-constructed machine would add to this resistance such an exceedingly small quantity that the gain of ball-bearings would be quite imperceptible.

In order to illustrate my meaning more fully, I will suppose that the power required to overcome the friction only of a machine with good plain bearings is one-hundredth of a horse-power, and two-thirds of that power for ball-bearings. If we take the resistance of the air as stated at ·20 h.p., we have the whole effect of resistance of the air and friction of the machine for plain bearings ·21 h.p., and for ball-bearings ·2066 h.p.

The resistance offered by the irregularities of the road and other minor causes would reduce the difference to a still more insignificant quantity.

I have been concerned in bicycle making and riding for some years, and have now in my possession a 58in. machine with plain hard steel bearings which has run 20,000 miles, carrying a man of nearly 11 stone without any repairs to the bearings.

W. Wyatt.

THE CONSTRUCTION OF OBJECT-GLASSES.

[24983.]—IN reply to "Orderic Vital's" letter on my two articles on the "Construction of Object-Glasses," on page 547, and Nos. 568 and 577, Vol. XXIII.; and, as that gentleman says he does not understand the numerical calculations on page 549, I will endeavour to explain. Now R = 38·1, the radii of the flint lens, and that number, multiplied by four and divided by $38 = \frac{40}{2} = 20$—the inner surface of the flint. And by the same rule R = $38{\cdot}1 \times 80$, and divided by $38 = \frac{800}{2}, = 400$, the outer surface of the flint lens, which he will see and understand now, which is quite in accord with my intentions when I wrote those two articles; the proportion of its surfaces being as 20 : 1, or, as I put it, 40 : 2, which I have quoted from known data, and I gave it as a simple method for amateurs to enable them easily to calculate a set of curves from for an o.-g. of any focus they might require or purpose making. The flint lens has a refractive focus of 29·77, and the crown lens a refractive focus of 18·86, with a dispersive ratio 655, which will make an o.-g., when well worked, fit for anything. Some years back I compiled a complete list of indices of all the various kinds of flint and crown discs, and in sheets that Chance's and other makers were dealing in and manufacturing, along with their specific gravities to each index of refraction and dispersion, and adapted them to practice to the greatest nicety, and calculated a complete table, so that I need scarcely ever go further than calculate the curves from the radii required for an o.-g. of the required focus; and, by merely getting the radii or geometrical focus of crown lens and flint, and multiplying and dividing from the corresponding number in the table, gives me the refractive focus of each lens sought in about a couple of minutes, and it is from that form I gave those curves, as stated in my two articles, which will work well in practice. The figures 19·5 and 38·1 are in reality the radii or geometric focus of flint and crown lens. In the second paragraph of the article on page 112, Vol. XXIII., No. 577, it is stated that the radii of the crown lens should be 15in., which is quite correct as stated, for this reason—that the curves $12 \times 20 = 15$ radii or geometric focus of the crown lens, and, I now add, with a refractive focus of 14·51. And with reference to the flint lens, $18 + 36 = 24$ radii or geometric of that lens (and not 36, as stated), and a refractive focus of 20·6; consequently $\frac{20{\cdot}6 \times 14{\cdot}5}{20{\cdot}6 - 14{\cdot}5} = 49$in., which is the exact focus, measured accurately, the o.-g. will be when worked to the exact curves, and so we have it $\frac{206}{155} = : 704$. And I now think "Orderic Vital" will see the subject in its full meaning. And, I may say, not to receive the remarks of "Orderic Vital" in a friendly manner would be want of courtesy on my part, more particularly when the intent and purpose in view is to simplify matters for all to understand.

I see, on page 316, Vol. XXIV., that "Orderic Vital" has been examining Barlow's formula with a view of determining whether the equation for finding the value of aberration would admit of any reduction, and as "O. V." has long wished to make the posterior surface of the flint lens equal to the focal length of the o.-g., and "Orderic Vital's" views are not without hope of success, I have made o.-g.'s of that kind many a time, and they work well when made from suitable glass. I can assure him it is an accomplished fact. They can be made with the flint, plus or minus, but I prefer the concave and convex flint form the best. It is this one form and the calculating of the tabular values, which has cost me countless nights' rest in perfecting them, instead of being in bed. If that gentleman would like to try it himself, he will be able to get good results from glass with dispersive index, flint, ·605 dispersive, 1·631 refractive. With crown lens refractive index 1·522 good results may be obtained. And, by way of correction, the form of o.-g. calculated by "Orderic Vital," in reply to "J. M.'s" data, and I believe of Shields, page 408, Vol. XXIV., I may just tell him that the dispersion is too high for glass now made, and too low in other respects, and to commence to work on that data would end in failure as regards real good results; which I fancy many flint discs have been ground too thin by repeated alteration, and the blame has been put on the crown by amateurs in that district. And I may inform "Orderic Vital" that, as I am regaining my usual health again, after seven years' illness and suffering, I intend shortly to fulfil my promise on object-glass grinding, and if it be of much use to amateurs and "Orderic Vital," my only desire is may it answer the purpose of our general readers.

Wm. Oldfield.

LATHE FLYWHEELS.

[24984.]—"A. Liverpool," says, in reply to my query, that "the nature and diameter of materials oftenest turned by the operator ought to decide what weight is handiest for a foot lathe." That is all very well, provided one has a number of wheels to choose from. In building a new lathe, how is one to decide the weight of the flywheel? One maker says 30lb. is heavy enough for a 4½in. screw-cutting lathe, the diameter to be 22in.; others will ridicule the idea. There seems to be no rule on the subject. Wheels of 80lb. or 90lb. wear down the centres quickly, and as yet I have not met with anything equal to centres. The so-called anti-friction rollers run on pins, which cause more friction than the centres. Personally, I am in favour of large, light wheels, and I think that for metal-turning no wheel should be lighter than 30lb., or heavier than 80lb., the diameter to range from 20in. to 21in. Many lathes are made to run heavily from the weight of the flywheel being too great. Counter-weights are an abomination; the treadling is suggestive of riding on a lame horse. It is impossible to get a balanced lathe to run backwards without pulling the wheel round. In some lathes where the wheel is outside the standard one can't use one's knees as a brake when one wants to stop at a certain point.

The gear-cutting arrangement shown by "F. A. M." is in use throughout Germany, but the slide is usually omitted. The treadles of German lathes are always made of wood, though for what reason I can never make out; one maker said that they were lighter, but that is impossible. Overhead gear seems almost unknown, being only used for grinding with emery.

A. F. Shakespeare.

Lüttichaustrasse 14 III., Dresden.

THE BINEGAR ACCIDENT.

[24985.]—IN Vol. XLI., p. 542, and Vol. XLII., p. 14-36, I directed the attention of your readers to the facts relating to the recent collision at Binegar, due to the Traffic Inspector neglecting to appoint a man to watch the facing points when the locking was removed, as required by rule No. 149 A. At the Bristol Assizes, on Tuesday, 27th October, the signalman was brought before Mr. Baron Pollock on a charge of manslaughter upon the coroner's inquisition only. It is perfectly well known to criminal authorities, and has been laid down time after time by Judges, that when a man is committed for manslaughter upon the coroner's warrant he must be charged before a magistrate. In this case, knowing that no magistrate could or would think of convicting upon the facts, the signalman was not taken before the magistrates at all, a very great injustice being therefore done to him. The Judge severely criticised the action of the prosecution in not taking the case before the magistrates, and stated "that was not the proper mode of administering the criminal law of this country."

The Grand Jury were not able to obtain evidence enough to even find a true bill, which they therefore ignored, and the prosecuting counsel, finding he had not a leg to stand upon, decided to offer no evidence on the coroner's inquisition, and the signalman was discharged. Justice has, therefore, in the end been done, but this does not alter the fact that the signalman was unjustly committed, arrested, suspended from duty, and put to the expense of legal defence when the really guilty party was the Traffic Inspector, who neglected to appoint a man to watch the facing points as directed by Rule 149 A.

I trust this case may lead coroners, juries, and police authorities to be more careful in future.

Clement E. Stretton,
Vice-President and Consulting
Engineer A. S. R. S.
40, Saxe-Coburg-street, Leicester, 2nd Nov.

COMPOUND LOCOMOTIVES.

[24986.]—ON page 124, a correspondent, who signs himself "In Favour of an Old Racer," directs attention to the important question of compound locomotives, and asks, Are they a success? For a long time I have obtained all available details with reference to the practical working of Mr. Webb's three-cylinder compound express engines on the London and North-Western Railway. I do not condemn the compound principle, and possibly improvements will be made, but at present I can say without fear of contradiction that Mr. Webb's engines *are not a success*.

In the first place, a compound engine costs more money to build than an ordinary engine; secondly, it requires more repairs, as there are three sets of machinery to be kept in order in place of two. Statements have been put forward to try to prove that there is a great saving of fuel; these are in many cases misleading and false. If Mr. Webb's engines are to be successful they must save enough coal to pay interest on the extra original cost and for extra cost of repairs; this the figures before me clearly show they do not, and cannot do.

They have proved such failures when running between Crewe and Carlisle that it has been necessary to take them off that road and keep them for working between London and Crewe upon very good gradients.

It is to be regretted that the true facts have not been able to be published on account of the results which would follow. Drivers who dare to tell the truth and say the engines are unsatisfactory are reduced to shunting engines. Compounding is excellent for stationary engines and for steamships, and may perhaps be of use in goods engines for heavy slow work, but for express traffic Mr. Webb's three-cylinder engines are like the chain brake—an expensive failure.

Leicester, Nov. 2. **Clement E. Stretton.**

RAILWAY COUPLINGS.

[24987.]—IN answer to letter 24935, I suggest for a coupling a staple, as at Fig. 1, fastened through beam, entering freely a slot, Fig. 2. through which a bolt freely falls, worked by a light handle, Fig. 3, to drop or raise the same as required. This would preclude the necessity of men getting between the trucks. A hook could in the same way be raised or dropped; but for security I should prefer the bolt to a hook. Coupling for passenger carriages requires some thinking out. **W. Hosken.**

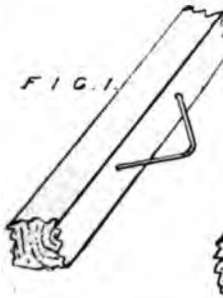


FIG. 1.

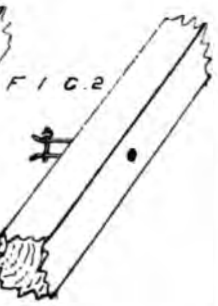


FIG. 2

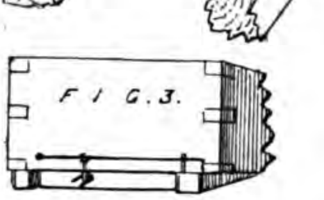


FIG. 3.

HYDRAULIC RAMS.

[24988.]—I HAVE watched the letters which have appeared from time to time in the "E. M." upon the above subject, and as I think they are nearly exhausted, I would like to say a few words with reference to the waste valve of which so much has been said, and for this I must go back to the time of Montgolfier, Bolton, and downwards to Blake.

In the first place, Montgolfier made his ram with the waste valve heavy enough to fall against the *statical power* of the water within the trunk, and there can be no doubt that he intended it to be so, and I can prove that such rams will work, and will never under any circumstances stop, which was one of the great points which Montgolfier prided himself upon. Some five or six years after Montgolfier's ram was made, Bolton's momentum machine was made, and it so happens that Bolton also made his "waste valve" in weight to balance the *statical power* within the trunk of the ram, and Bolton's machine worked very well in this manner, and which can to this day be proved from one of Bolton's own make machines, which has a weight on the end of a lever to the waste valve to balance the before-mentioned statical pressure of water within the trunk of the ram.

"W. A. S." has no doubt been reading up Morin's works, and seems to discard all other authorities upon the subject, and even goes so far as to say that "It is, indeed, marvellous that so admirable a machine should have been so far neglected by our writers on hydraulics," thereby inferring that there is no English authority on the subject, which I protest against, for Bolton unquestionably did make his ram with weighted waste-valves, and which works exceedingly well. More than this, we have an English author who, more than seventy years ago, wrote the following words: "And the water, by its impetus or momentum, opens the exit valve (the air-chamber valve is referred to), and a *portion* of it rises in the ascending pipe; after which the last-mentioned valve shuts, the water in the main pipe recoils, the weight descends and opens the stop-valve (meaning the waste-valve), and the water in the main pipe regains its velocity." From the above it is quite certain that this author knew all about the regurgitation or recoil.

I will also quote another author who, over forty years ago, when writing on the action of the hydraulic ram, used the following words: "Thus when the flow of the water through B (meaning the trunk) is suddenly stopped by the valve E (meaning the waste-valve), a partial vacuum is produced immediately below the air-chamber by the recoil of the water, at which instant the small valve opens (he here is referring to the snift-valve) and a portion of air enters and supplies that which the water absorbs."

Here the author undoubtedly knew about the recoil forming a partial vacuum which allows light waste-valves to fall.

I could name many more who have properly described the action of rams working with loaded and also light waste-valves.

I would like "W. A. S." to tell his readers how he would make a ram that should *start itself*, and keep *continuously* at work, say, for one year *certain* under the following circumstances:—Firstly, in the morning I want the ram to *start itself* when a mill stream begins to flow, and I want to draw off *all* the water that the ram can supply at a height of 10ft. above the top of the air-chamber; also, at noon I close the first supply or draw-off cock, and then want all that it can supply at a height of 25ft., and at other times all that it can supply at 40ft., the 25ft. draw-off being then closed.

Of course all the draw-off pipes are to have simply plain cocks, and branches with full-way openings into the rising main pipe. The ram to be used as illustrated by him, with light waste-valves.

Whilst I am about this letter, I may say that I, when writing my articles on the ram, tried to explain to my readers the action of the old self-acting and *starting* rams working with loaded valves; and I also afterwards wrote these words:—

"Suppose the water to be running down the trunk A, and the valve C to give one pulse against the seating Q; the water will then urge itself forwards through the body D, and strike against E and up into the air chamber F; at the same instant the momentum of the water causes a *partial vacuum* to take place at R, and to draw in air at the passage or capillary tube P." This I thought sufficient, and, moreover, when explaining the next figure, I wrote these words: "Now that I have explained the real action of the ram," referring to one with the light waste valve, Fig. 369, I concluded that my readers would, from the drawing, detect the difference in the waste valves in figs. 368 and 369. Then by referring to my description of Blake's ram, which also works with a light waste valve (see Fig. 377), it will be seen that I have illustrated a ram fitted with a spring plunger to assist the recoil, to make more certain that the ram shall be less liable to stop; and further on I have shown my readers rams made to work entirely without air chambers (see Figs. 374 and 375), which proves that the waste valve will work independently, or even if the air chamber be plugged up.

Of course I am only human, and it is quite possible to err, and when so am pleased to receive a kindly notice; but I do not like to see Morin's, whose works are in French, and not at all perfect so far as the ram is concerned, pushed forward, especially as an authority above all others on this particular machine, for the simple reason that he has done nothing more than what Englishmen have done and practised. **P. J. Davies.**

[24989.]—"J. N." (letter 24929) speaks about the light-made pulse or waste valve working, notwithstanding the snift valve and delivery-pipe are closed, and wishes for an explanation of what then goes on, finding the waste-valve will not cease beating, and that the water is, when within the trunk, said to be inelastic, but if he will consider that the water in the trunk drives the valve outward and towards an elastic force—namely, the atmosphere, he will see that when the valve is by the valve seating suddenly arrested that the outward elastic pressure above the valve is in motion, and that it is not suddenly arrested, but which momentarily leaves the valve and then returns with accelerated force against the valve face, and with greater force than it stopped at when proceeding from the valve; at the same time he must not forget that the water is not inelastic, nor is the material which comprises the valve and valve-seating, any more than a hammer on an anvil.

There is, we all know, 15lb. atmospheric pressure pressing upon the water within the tank at the mouth of the trunk, as is also the case at the waste valve, but the length of the trunk being considerable, the atmosphere does not affect the water so readily at its mouth as it does at the waste valve. This is partially the reason why the valve opens: but there is another cause which at times is even greater than the above, but which is more noticeable with rams working under high heads of water than otherwise, and which can be proved simply by suddenly shutting off a stop cock on a long water main—viz., by instantly arresting a column of water under pressure that it rebounds, and for a moment creates a vacuum near the affected point, and which, taking place in the body of a ram together with the before-explained reason, causes the valve to open.

I will write further upon this subject, and send an explanatory diagram should it be required; but I cannot see its use to the ordinary plumber, it being simply a philosophical question.

P. J. Davies.

USEFUL AND SCIENTIFIC NOTES.

The Current in Paralysis.—Dr. Di Fede reported to the Royal Medical Academy of Rome (May 24th last) the case of a lieutenant in a cavalry regiment, who had paralysis of the right forearm, in consequence of a sword wound received in a duel. The cutaneous sensibility on the outer part of the wasted forearm was much impaired, so it was on the dorsum of the hand and of the first three fingers, and there was complete loss of power in the hand. Two months and a half after the injury, Dr. di Fede cut down upon the divided radial nerve, revivified the extremities, and united them with two fine catgut sutures. Sensibility returned the fourth day, but mobility only a month after the operation. Under the alternate use of the induced and constant current the limb regained shape and power, so that the patient could write and do sword exercises with the injured limb. With the closed fist, extension and supination were perfect; but the movements of extension of the fingers and abduction of the thumb were not so complete. The patient was presented to the Academy, and the case is said to be the first of nerve suture practised in Italy.

The Need of a Portable Sanitary Stove.—There is great need for a portable stove which might be used in a sick room, without either poisoning the atmosphere with the fumes of paraffin or the products of combustion, or consuming a large proportion of the available oxygen. The apparatus should be of moderate size, give out a fair amount of heat, be capable of boiling a small kettle of water, and be provided with a flexible tube, which might be conducted into the chimney. Moreover, the stove must, of course, be perfectly safe. There ought to be no great difficulty in devising a heating appliance of the nature required. It would be invaluable for use in cases in which, no nurse being in attendance to keep up an ordinary fire, a moderate temperature might be maintained.—*Lancet.*

IN a paper on the sulphurous anhydride in the air of towns, by G. Witz—*Compt. Rend.*, 100—the existence of sulphurous anhydride as a normal constituent of the air of towns is shown, as described by the *Journal of the Chemical Society*, by the fact that placards coloured with red lead, posted in situations where they are protected from the sun and rain, become gradually decolourised, whereas similar placards exposed under similar conditions in country air retain their colour unimpaired. The decolourised placard are found to contain lead sulphate and lead sulphite, the lead dioxide in the red lead having been converted into the former, and the monoxide into the latter. This decolourisation of the red lead takes place much more rapidly in shop windows where gas is burnt. The author has also frequently been able to recognise sulphurous acid in hail, snow, and especially hoar frosts, in the neighbourhood of towns.

PROF. A. LANDMARK, chief director of the Norwegian Fisheries, finds that under favour
conditions a salmon may
perpendicularly, and that whe
foot or two short of the he
often succeeds in compl
dexterous use of the tail.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[57328.]—**Sprained Elbow.**—Truly the innocence of Mr. W. Rowland Hart is refreshing. It is delightful to find that even in these days of general information on scientific subjects, one of "ours" can be found so unsophisticated as to believe that American kill-pain and Russian tallow rubbed on the outside of his throat increases the "flexibility" of his vocal chords—by greasing them no doubt. Did Mr. W. Rowland Hart ever try his application of kill-pain and Russian tallow to the outside of a steam cylinder in order to make the piston work freely and to "increase its flexibility"? —it would be quite as reasonable as his proposal. Mr. W. Rowland Hart's suggestion reminds me of a testimonial attached to the advertisement of a celebrated plaster some years ago. The writer stated that, having observed the beneficial effects of this plaster when applied to the throat of a child with whooping cough, he being troubled with cold feet, stuck a plaster on each, and (need it be added?) obtained instant and permanent relief. Truly the gullibility of the educated British public in matters medical is one of the greatest marvels of the age! If "Earache" does not get relief from the sensible advice given him, let him try a drop or two of liquor atropiæ dropped in the painful ear. It will give him temporary relief.—MEDICINÆ DOCTOR.

[57475.] — **Family Clothes-Washing Machine.**—Is the reply (?) on p. 186 intended for an advertisement, or a rejoinder to the reply on p. 166? It certainly does not answer "Turk's" query. Possibly, though, Mr. W. R. H. intends to send the drawings asked for by "Turk," as he is evidently confident he owns a machine which answers the requirements.—NUN. DOR.

[57557.]—**Oysters.**—I want a non-poisonous wire to stake on a foreshore, half an inch from the ground, to prevent oysters, &c., being washed away in gales of wind. About the size of a telegraph wire.—OYSTER.

[57575.]—**Amount of Oil used in Engines.** —It is almost impossible to answer this question unless one has access to the "sheets" of the railway companies and steamship owners. Some of our readers could, however, give the amount actually used per 100 miles, say, on a given engine. —NUN. DOR.

[57579.]—**Invalids' Tricycles.**—Invalids' tricycles are made by all the great makers; but whether anyone makes a design like that briefly described by Mr. Colby I cannot say. Has he applied to headquarters. Makers are usually willing to tell inquirers what kind of machines they have on sale.—ESSAR.

[57581.]—**Wax Castings.**—Has "Busy Bee" tried adding stearine?—S. R.

[57582.] — **Steam - Jacketed Cylinders.** — These are generally cast in one, unless the cylinder is very large.—J. T. M.

[57600.]—**Copper Bronze.**—Does this query mean copper in the state of powder for bronzing, or what? If the so-called bronze powder, I believe the copper is dissolved in nitric acid, and precipitated by means of pieces of iron placed in the solution. The precipitate is collected, carefully washed, dried, and levigated.—S. R.

[57602.]—**Waggonette.**—I would suggest the use of iron gas-tubing, which could be made light and strong, and be readily taken to pieces if desired by unscrewing a few unions.—S. R.

[57606.]—**Lathe.**—Might I suggest to Mr. A. Ramsay that back volumes will probably provide him with the sketch desired; but if not, makers' lists are available, if he will take the trouble to send for them.—J. T. M.

[57610.]—**Telephone Transmitter.**—I should imagine the fault was in the tin-plate diaphragm, about $\frac{1}{24}$in. thick. Why not use ferrotype plate, or even chip-wood varnished.—U. T. C.

[57628.]—**Case-Hardening Long Iron Rods.** —These are not very long, and can be case-hardened by placing them in a bit of iron tube, ramming fine animal charcoal between each tightly, and stopping the ends of the tubes. Raise to a red heat slowly, let soak for a couple of hours, and knock out into a cask of water so that the rods enter vertically.— THE VILLAGE B.

[57724.]—**Soapstone or Steatite.**—This can be tained in any quantity almost at our own doors, bout £4 per ton.—GEO. G. BLACKWELL, eet, Liverpool.

-Engine Fo

n" for his

accordi

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tion, as the log. index will be 7 instead of 5. I, therefore, inclose Rankine's formulæ, which is—

$$V^1 = a \,.\, \text{hyp. log.}\ \frac{t^1}{t^2} - b\,(t^1 - t^2) + v^2\,(p^2 - p^3).$$

a = 1109550ft.-lb.

b = 540·4ft.-lb. per degree of Fahr.

t^1 and t^2 absolute temperatures.

p^2 = terminal pressure per sq. ft.

p^3 = back pressure per sq. ft.

v^2 = vol. of 1lb of steam at terminal pressure, the latent heat of evaporation being assumed to be $a - b\,t$.—UNGENANNT.

[57784.]—**Lathe Flywheels.**—In reading the reply by "A., Liverpool" to A. F. Shakespeare, I could not but think that "A." had not read the excellent article on the Lathe Treadle and Balanced Wheel, by "D. H. G." I should strongly recommend A. F. Shakespeare to read carefully through the whole of "D. H. G.'s" remarks and experiments. He will find them in Vol. XXVII., and if he has not the volume by him, I dare say some of our subscribers would be kind enough to lend it to him. It is a matter of surprise to me that none of our lathe makers has thought it worth their while to improve the treadle action and balance of the flywheels of lathes. I mention this from having been refused an estimate for a lathe with flywheel overhung and the improved treadle of "D. H. G." by an eminent maker. If you would care to engrave it, I shall be pleased to send a sketch of my improved arrangement.—H. C. B.

[Please send.—ED.]

[57747.]—**Power Required.**—Observing the reply given to this query by G. Pinnington, I should be glad if he would show how he obtains his results. I am unable to agree with him. I append my calculation, which is as follows:—200lb. pressure per square = 465ft. head, to which must be added 6ft. 6in., the height of the tank, making 471·5ft. head, say 471. The discharge through a 2in. pipe will therefore be $8\sqrt{471} \times {\cdot}68$ as a coefficient multiplied by area of the pipe in feet, which will give the cubic feet discharged per second = 2·46, which, multiplied by 60 and by 62·5 gives pounds of water discharged per minute = 922·5lb. The H.P. through a 2in. pipe will therefore be $\frac{9225 \times 471}{33{,}000}$ = 131 H.P., similarly the discharge through a 4in. pipe would be 38,055lb., and through a 1in. pipe = 2,411lb. Then $\frac{9{,}225}{2{,}411} = 3{\cdot}82$, as the discharges would all require to be made in the same time, also the supply; the H.P. through 1in. pipe will be $131 \times 3{\cdot}82 = 500$ H.P. for a 1in. pipe and $\frac{9{,}225}{38{,}055}$ $= {\cdot}24$ and $131 \times {\cdot}24 = 31$ H.P. for a 4in. pipe.— M. A.

[57756.]—**From Mr. Wimshurst to "C. P. C."** —You clearly have something wrong beyond the metal bosses. Try whether your varnish is good as a non-conductor. Are the terminal balls of unequal size. If so, the electrical brushes ought to be upon the points of the collecting combs, which are in metallic contact with the larger ball. Are the sectors too long? About one-fifth the diameter of the plate is the most useful length. Have you fine wire for the brushes, or have you that wretched material sometimes used (a kind of leaden tinsel with no spring)? Don't condemn your metal bosses; simply face the metal back and add a vulcanite washer between the metal boss and the glass disc. I have not, however, seen the frosty day this autumn.—J. W.

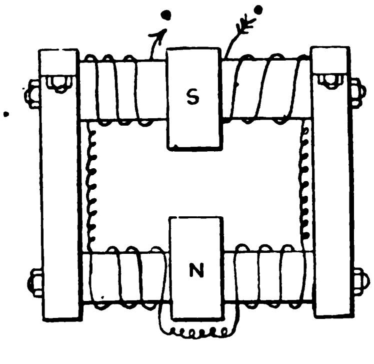
[57767.]—**Adhering Photographs to Glass.** —I find the best way of fixing photographs to glass is to use a thick paste made from starch, which should be well rubbed on both to the glass and to the face of the picture. The photograph must be soaked first in water, and the surplus wet removed by placing it between sheets of blotting paper. It should be pressed lightly to the glass, and then a piece of blotting paper and another of strong paper placed over it, and then, with a rubbing tool made of bone or hard wood, all the paste must be squeezed out, and any air-bubbles or glistening places rubbed out. I have used a liquid cement called *Colle blanche à froid*, manufactured by S. Dumoulin, of Paris, which answers the purpose. In order next to render the photograph transparent, I tried a mixture sold for the purpose, which I fancy contains castor oil, and although it makes the paper beautifully clear, I have not found it to be durable, and after a few weeks the photographs became faded and spotted, and a number of pictures that I painted are completely spoilt. In the "E. M." directions were given (No. 936) for rendering photographs transparent for crystoleum painting, by oiling them with poppy oil, and I should be glad if some correspondent would give his experience as to obtaining good and permanent results by the method therein described. I find the best way to obtain a transparency is to grind away the paper thin as possible without injury to the photo- h with sandpaper, then to heat the glass over t lamp and then to rub it well with a piece of white wax (has any correspondent used paraffin wax?), and if any parts are not perfectly clean, to re-heat, and grind away with sand paper until these cloudy spots disappear and the picture is perfectly transparent. Can any correspondent give his experience as to the process described recently on Enamelling and Colouring Photographs?—DUILO.

[57771.]—**Commonplace Book.**—Some years ago I sketched out an approximately exhaustive series of commonplace books, in six volumes. This appeared in No. 414 of "Ours," p. 583, No. of reply 14027. Supplemented by a series of some three or four hundred small and inexpensive portfolios—old book covers would answer the purpose. It is possible with ease to arrange, classify, and refer to some half-million of notes, references, reviews, articles, maps, plans, drawings, and newspaper cuttings, on all or any conceivable subject.— A. T. F.

[57789.]—**Propelling Ships by Air.**—This system is very old, and was patented and tried thirty years ago. I superintended most of the experiments. We made about 20 models about 3ft. long; these were named after principal emperors and kings, and were sent on to them. We had a long boat built, about 40ft. long, and fitted a tubular boiler in same and a Scheele's fan. The speed was very slow, not more than about 3 miles an hour—this on the Serpentine. The inclined plane was 9ft. long and 4ft. 6in. wide. This was hinged at the bottom, with a long screw fitted to same so as to raise or depress the top end to try the different angles. The patentee tried to form a company to try further experiments; but as there was nothing in it to recommend it, it was not taken up. The utility of such a mode of propelling was to suit the different foreign rivers that were clogged up with weeds, &c., which rendered paddles and propellers useless.—A. C. BELL, Metallurgic, Main-road, Bexley Heath.

[57810.]—**Dynamo.**—TO MR. BOTTONE.— Kindly accept my thanks for reply to my query. The reason that I wanted to use a shunt is, that I sometimes only want two or three lamps burning at a time; so, if I will not be asking too much from you, would you kindly tell me how much, and size of, wire to use, so that I can convert it into a compound wound machine, and if you will give me a sketch of the way to connect it up? I want to use the No. 16 wire as the series coils, and I am going to use a Pacinotti armature instead of the present one. —W. H. H.

[57813.]—**Gramme Dynamos.**—TO W. H. EAVES.—The clearance between the armature and the pole-piece should be, in a dynamo, of the size you give, about $\frac{1}{16}$in.; but much must depend on the workmanship in the armature. The magnetism ought to be evenly distributed; but in practice it never is. The cause of your failure is because the current is not running round the F.M.'s in the right direction. I send sketch of the proper course of the current, from which you can easily correct the fault in your dynamo.—W. H. EAVES, Coventry.

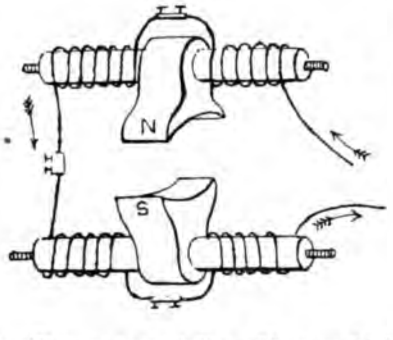


[57826.]—**"Genesta."**—The length of this vessel is 80ft. on load water-line, and *Puritan* about the same; the width of *Genesta* 15ft., and draught of water 13; width of *Puritan* 23ft., and draught of water 8·3, besides centre board. The yachts are thus of very different form, but English has most displacement, having 30 tons more ballast; sail area 7,000 to 8,000ft. each, but *Puritan* the greater extent. See recent numbers of *Field* newspaper.—H. Y. POWELL.

[57832.]—**Railway-Carriage Wheels.**—I do not know the size of the wheels mentioned in the query. There is no opinion about the relation of diameter to circumference, and any textbook gives it. Engineers generally content themselves with as 1 is to 3·1416 which is less than ·00000735 too much.—LIBRA.

[57843.]—**The Sodic Sulphite Developer.**— The formula I use is the one given in Marion's "Guide to Photography." I generally make up half the quantity given at a time—pyrogallic acid, ¼oz.; ammonium bromide, 150 grains; sodic sulphite, 1oz.; citric acid, 15 grains; water up to 3oz. The sodic sulphite and citric acid are first dissolved in 2oz. of hot water. This solution is poured over the pyrogallic acid and ammonium bromide, and is then made up to 3oz. with cold water. I generally put in five drops of nitric acid, which seems to me to improve the quality of the negatives. I hear that the same developer, used with potassium carbonate as an "accelerator," is known as the "potash developer." This last arrangement seems to prevent fog; but I have not generally had any tendency to fog, even when ammonia solution is used for an "accelerator." See "Correspondence" columns for more details.—R. A. R. BENNETT.

[57842.] — **Gramme Dynamo.** — To MR. BOTTONE.—Kindly refer to No. 1050 for sketch of commutator, with sizes, &c. Annexed is sketch



for guiding you as to winding. If you use binding screws to connect the ends, as shown, you can, if needs be, diminish the resistance by coupling up in parallel.—S. BOTTONE.

[57845.] — **Storage Cells.** — Would "Voltlacker" expect an infant to do a man's work? His battery is a mere toy: it might give an E.M.F. of 4 volts, but its capacity for production of current is a mere nothing. He also appears to have put the red lead on the outside of the pair of plates instead of on the two inner or facing surfaces. If he wants any work he must enlarge his plates; and if he wants good work he will have to get rid both of the felt and the paste of red lead.—SIGMA.

[57846.] — **Chamber-Organ.**— If "Mechanic" wishes for a satisfactory result, he should have pedals, and divide his few stops into great and swell organs, two manuals, stopt diapason through and the dulciana, making great organ, and gamba with flute making swell—a coupler uniting the whole. A clarionet added to great or swell would be a great addition. Keep the wind down to 2½in. —W. HOSKEN.

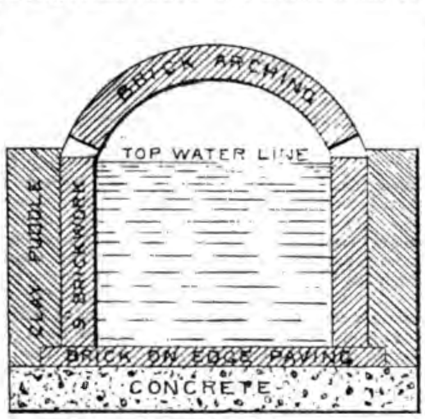
[57863.]—**Boiler.**—I would advise "Belgian," for a small tubular boiler, to have it fixed horizontal and not vertical. I have had a deal of trouble with a copper tubular boiler being fixed vertical, and I am now having it laid in brickwork horizontal, as it was when first set; but it did not draw well, owing to tubes choking with coal; but I have been using coke, and now the tubes keep well clean and it steams all right; but the heat passed too rapidly through and unbrazed the tubes, and they were constantly leaking steam. I believe, in using coke instead of coal my trouble with draught and tubes choking will be over. I shall be pleased to reply to any further inquiry about the same. What size engine do you propose using with the size of boiler you name, and of iron or copper?—L. W. D.

[57867.]—**Engine at I.I.E.**—150 h.p. (nominal). Fixed on the crank shaft of the engine is a rope pulley, with eight rope grooves. Diameter, 20ft., and weighs 16 tons. The engine is a high-pressure horizontal, with a cylinder 20in. diameter, and a stroke of 4ft. It is fitted with Hargreaves and Inglis' patent automatic valve gear, which works very smoothly and noiselessly. The valves are of the Corliss type, and are specially arranged at the ends of the cylinder. The valve spindles have levers keyed on, these levers being connected with upright spindles fixed in suitable frames arranged at the side of the cylinder, but independent of it. Each spindle is lifted by means of a tappet or cam, fixed on a shaft made to revolve directly from the crank shaft, and the lower end of the spindle is attached to the dash pot. The tripping block, which regulates the cut-off, is suitably arranged in contact with the upright spindle, the requisite regulation to the block being given by means of an eccentric shaft, the position of which is regulated directly by the action of the governor. The whole of the shafts, spindle, and tripping-gear is carried by the frames referred to, a very compact and complete arrangement. One notable feature in this valve gear is that the cams and trip blocks employed are wide, and give good wearing surfaces, which, combined with the general strength of the gear, should give a long life to it without the necessity of many repairs. The exhaust valves are worked independently of the steam valve—a very good arrangement. It is claimed for this gear that, however the cut-off is arranged, the steam is always admitted through a full port, and we are informed that the gear admits of a range of cut-off up to three-quarter stroke. It is also fitted with W. Knowles' patent automatic supplementary governor for regulating the main governor, and for giving an exact and unvarying speed.—GAS ENGINEER, Chelsea.

[57868.]—**Gas.**—As cannel coal, from which rich gas is made, is found in Scotland and the North of England, it comes cheaper to use. It is a little more costly; but there is no heavy carriage to pay, and they get a better quality gas. The Houses of Parliament and some parts of Piccadilly are supplied with cannel gas of 21-candle power; but it is dearer per 1,000 feet than the ordinary 16-candle gas.—GAS ENGINEER, Chelsea.

[57871.]—**Bookbinding.**—To fillet and letter cloth-bound books, the usual way is to give one coat of glâir only, no other size being necessary. Let the books stand overnight previous to lettering, so that the glue used in covering may be thoroughly dry. Be sure that the glair used is thin; if it is new and thick, you will be sure to have a mucky appearance on your books. Experience is a very necessary qualification.—PRACTICAL BOOKBINDER.

[57874.]—**Zinc Tank for Rain Water.**—I would advise "J. W. E." to abandon his idea of making a tank by soldering sheets of zinc together, and covering it with a brick dome; and, in preference, let his tank have walls, floor, and roof of good, sound, well-burnt bricks laid in cement mortar (2 of clean sand to 1 of Portland cement), the walls being backed with clay puddle. If the floor is not to rest on strong, watertight material, a layer of concrete would be necessary, and, in any case, would be advisable. If possible, let the tank be square, or oblong, so that no radiating or well bricks will be required. Such a tank should not cost more than the one "J. W. E." describes, while it would keep the water in better condition, and would last longer than the combination of zinc and mortar. Soft water kept for months in a zinc tank would, in my opinion, be unfit for drinking. The accompanying sketch shows a cross section of the kind



of tank I suggest. A manhole should be left in the brick arching.—SILEX SEADRIFT.

[57876.]—**Luminous Paint for Signboard.**—Wouldn't it be possible to cover the signboard with glass to protect the paint from the air? If this was done, it would last for four or, probably, five years. I have painting done with it which was done three years ago, the brilliancy of which is the same as it was when new; but it is covered with glass, though I don't believe it would be at all necessary. If you want it to shine well, you must give it at least three coats of paint. If only the letters of the signboard are wanted, it surely would not take more than three bottles of "Judson's luminous paint" at 1s. 6d. per bottle.—R. A. R. BENNETT.

[57879.]—**To W. H. Eaves, Coventry.**—I do not think it would be advisable for you to put the magnets on a wooden bedplate, as it would not be strong enough. You had better build the machine as you originally intended, putting from 2½in. to 3in. of zinc between the ends of F.M.'s and cast-iron bedplate. Wind the armature with No. 18 double s.c., and the F.M.'s with 25lb. of No. 20 for shunt coils, and one layer of No. 14 for the series. The size of flywheel for dynamo shaft will depend, to some extent, on the make of the gas-engine. You may make it 12in. diameter, with a rim 1½in. by 2½in. depth. Have the flywheel perfectly true, or the vibration will be very disagreeable. The machine will require a speed of 1,700 per minute. Pulley on dynamo shaft 4in. by 2½in. If the flywheel of the gas-engine is larg you may drive direct by a 2in. strap.—W. Coventry.

[57883.] — **Steam Pressure.** — D weight by the area of the valve in inches case given the area is ·5185in. nearly pressure required to blow off the 7lb. 13·5lb. per square inch.—LIBRA.

[57886.]—**Jewel Hole.**—Take jewel press into potence sufficiently tight to ho filing (not too tight), then with first a and then with a three-square, file to shap endstone slip.—JNO. BRADLEY.

[57892.]—**Diagnosis.**—I am sorry to not diagnose this case with any certaint seeing "W. B." Erysipelas does not ap out either diffuse cellular inflammation o It is not hereditary, but there are a g predisposing causes.—MEDICUS.

[57892.]—**Diagnosis.**—To "PRO. Would "Pro. W. B." be kind enough me why he concludes that "W. B." is from weakness of the vaso-motor centr sequently of the nerves supplying the How he reconciles an increased blood-pre dilation of the arteries? This last state correct; because it would be apparent to a dilation of the arteries would cause a decr blood-pressure, and consequently the puls slow and feeble, and not "beating quick How that the vaso-motor nerves could elasticity of the arteries? The elastic arteries is due to the elastic tissue in media, and is consequently possessed o rather than vital properties. The nerve influence the muscular coat of the arteries prescribes Easton's Syrup and 5 to 10 quinine?—MEDICUS.

[57894.]—**To Mr. W. H. Eaves.**—Th ought certainly to give better results have obtained. It should light four 10 easily enough; but, from your query, see anything very wrong. When it is as a series, the magnet coils should be so as to have a res. of about 1 ohm. I res. of A. more than you give. I cou better idea of the capabilities of the n you gave particulars of armature core. if they are not made of malleable cast too small. If you will try the above s and report results, I will again try to hel of your difficulty.—W. H. EAVES, Cover

[57897.]—**Indigo Dye.**—Dilute sulp turns vegetable blues and blacks red; indigo is an exception to this rule. I ha that acid is used in the trade for testi Os.

[57899.]—**Weak Coil.**—You do not gi of wire, primary and secondary, you h therefore, it is hardly possible to say wh wrong. The numbers best suited for are—Primary, No. 16 c.c.; secondary, No S. SUTTON.

[57899.]—**Weak Coil.**—This coil ha much primary wire, 14oz. being entirely question. Two layers will be found suffi long spark depends on a long secon thorough insulation. Try again with tw primary and 6oz. or more of secondary size, say No. 36.—BOBADIL.

[57899.]—**Weak Coil.**—You have o mention size of core and number of primary coil. It seems to me to be al and if that is the case, you would not spark. Two, or at most three, layers of p sufficient. You have not given the si used. The insulation between the layers as thin as possible. A coil may contai quantity of wire, but so disposed that it little use, and it is hardly possible to d errors in the absence of the informati to.—Os.

[57901.]—**Dynamo.**—Such a dynamo, wound with No. 22 wire throughout, F.M in parallel, would light six tens easily, b get hot after twenty minutes' run. If ticular dynamo is wound with coarser w run fewer lamps, but not heat so quickly. tions are right.—S. BOTTONE.

[57901.]—**Dynamo.** — The machine, proper order, should light six 20-volt 10 well. I understand from your note that lit one 10c.p. lamp, but that it would several. Now, if you were driving the yourself, there is a good reason for it, as lamp is as much as one man can convenie going. The connections seem correct. thing I can advise you to do with the dy send it to a competent person to stipulating that no charge be provement be effected.—

[57902.]—**Bunsen B** MR. BOTTONE.—To ligh about 20 ohms resistance, you will require about 30 such Bunsens. Cruikshank's would be of no use, it polarises so quickly. Probable cost per lamp per hour, 3d., exclusive of plant and labour.—S. BOTTONE.

[57904.]—**Legal.**—Does not the querist perceive that he is asking advice how to behave dishonestly and dishonourably? He has had the money under agreement to pay interest for its use. Because, by his own neglect and the oversight of the lender, he has paid no interest for a number of years, he thinks he need not pay it at all. He should ask advice of that kind from some pettifogging hanger-on of the county courts; not in the pages of a paper like this, which is intended to assist the honourable desires of its readers.—SIGMA.

[57908.]—**A Gravity Question.**—If the earth be supposed a homogeneous sphere, there is no point below the surface at which the number of vibrations of the seconds pendulum would be the same as at the surface. It is a mistake to say that the number of beats at the bottom of a deep mine would be greater than at the top. For within the earth the force of gravity varies *directly* as the distance from the centre, and since for the same pendulum the number of vibrations in the same time varies *directly* as the square root of gravity, therefore, the square of the number of vibrations will vary *directly* as the distance from the centre. Hence the number of vibrations in the same time at points nearer the centre will be less than the number at a greater distance. To put this in numbers. Suppose N to represent the number of vibrations of the seconds pendulum at a point within the earth at a distance from the centre equal to x miles, then the force of gravity at the distance x

$$= \frac{x}{r} \cdot g$$

Where r is the radius of the earth, and $g = 32{\cdot}2$ is the force of gravity. We should then have for the number of vibrations of the seconds pendulum in one minute—

$$N = 60 \left(\frac{x}{r}\right)^{\frac{1}{2}}$$

or

$$N^2 = 60^2 \cdot \frac{x}{r}.$$

But for a point within the earth, x is always less than r, therefore, N is always less than 60. If the question had been required the distance from the centre of a point below the surface at which the vibrations of a pendulum would be the same as at a given point above the surface, at a distance R from the centre, we could then have a solution. For let N be the number of oscillations of the seconds pendulum in one minute, at this last point. Now, above the surface the force of gravity varies inversely as the square of the distance from the centre, and it would be equal to

$$\frac{r^2}{R^2} \cdot g$$

We should then have

$$N_1{}^2 = 602 \cdot \frac{r^2}{R^2}.$$

If, now, we suppose $N_1 = N$, we have

$$60^2 \cdot \frac{r^2}{R^2} = 60^2 . \frac{x}{r},$$

or

$$x = \frac{r^3}{R^2}.$$

Therefore, for any point above the surface there will always be a corresponding point below the surface, at which the time of vibration would be the same. Thus, if we take the given point at the moon, then

$$R = 60r$$

and

$$x = \frac{r^3}{60^2 r^2} = \frac{r}{3600}$$

When

$$r = 4000 \text{ miles}$$

$$x = 1\frac{1}{9} \text{ mile.}$$

Also at each of these points the pendulum would vibrate about 7¾ times in one minute.—MILVERTON.

[57911.]—**Accumulator.**—TO MR. BOTTONE.—About 10 cells, exposing 72in. in each cell. Perforated plates hold the red lead better.—S. BOTTONE.

[57912.]—**Potential of Static and Induction Spark.**—First, there is no such thing as a static spark. The spark, or, for that matter, any electric phenomenon whatever, is a dynamic effect; but he spark from a so-called static machine (which oduces a series of charges and discharges per-tly analogous to those of an induction coil) is of same potential as that of a spark of the same and under the same conditions from any There is no exact knowledge as to ponding to the different lengths varies with diff proportional t

[57916.]—**Mechanics.**—You have left out a 2 in your formula. It should be—

$$R = \sqrt{15^2 + 20^2 + 2\,(15 \times 20 \cos. 120^\circ}.$$

Or which is the same thing—

$$R = \sqrt{15^2 + 20^2 - 2\,(15 \times 20 \cos. 60^\circ)}$$

—W. A. S. $= 18{\cdot}0277$ nearly.

[57916.]—**Mechanics.**—"Private Student" states the "law" incorrectly. It should be

$$R = \sqrt{15^2 + 20^2 + 2 \times 15 \times 20 \cos. 120^\circ};$$

and as $\cos. 120^\circ = -\frac{1}{2}$.

$$R = \sqrt{15^2 + 20^2 - 2 \times 15 \times 20 \times \tfrac{1}{2}}.$$

$$R = \sqrt{325}.$$

$R = 18{\cdot}028$, which agrees with the graphical method.—J. E. GORE.

[57922.]—**Photography.**—Paraffin. Dry the wood carefully in a cool oven. Place inside a few lumps of paraffin wax. Allow the heat to increase just sufficient to melt the wax, which will soak in and fill the pores.—S. BOTTONE.

[57922.]—**Photography.**—Paraffin will answer perfectly well; simply put the dish into the oven to get hot, and rub a lump of paraffin all over it, inclining the dish so that the melted wax runs into all the crevices, &c., and soaks thoroughly into the pores of the wood. There will be no fear of its leaking if you do this, as the paraffin will set quite hard, and fill up all the cracks in the wood.—R. A. R. BENNETT.

[57926.]—**Wimshurst Machine.**—W. Rowland Hart will find Rockhill's tricycle cement very good for attaching the glass disc to its boss; other cements or glues are too brittle for the purpose when cold, and many of them get too soft with very little increase in temperature. He should also, as an additional attachment, fit a thin washer of vulcanised fibre to the inner surface of the disc, and screw same to the boss, so as to tightly press upon the disc; the washer should not exceed 1-16in. in thickness, nor the diameter of the boss.—J. W.

[57927.]—**Pacinotti Dynamo.**—Your armature is certainly too small for the F.M.'s. Perhaps the magnet coils touching each other prevent the two halves of F.M.'s from properly closing. This, if it is so, would cause a considerable diminution in the power of the machine. I do not like the way you have connected the wires to the commutator. Connect them in the ordinary manner—viz., the beginning of one coil to the end of the next, and so the twisted ends are then connected one to each commutator bar. The armature deflecting the needle shows no fault. If the machine has the excessive clearance you state, it is the fault of the maker of the castings, to whom they should be sent for examination.—W. H. EAVES, Coventry.

[57928.]—**Cruikshank's Trough Battery.**—Retort carbon is extremely difficult to cut, more especially when it is of the best electrical quality, which is very hard. The most important elements in the operation are time and labour, a thin strip of iron, silver sand, and water. For the iron a bit of the blade of an old scythe will answer admirably. Bent zincs are easily flattened by holding them before a fire till too hot to be held in the naked hand, and then bent straight. Hard and brittle as the metal is, a moderate heat makes it soft.—BOBADIL.

[57928.]—**Cruikshank's Battery.**—Do not waste time upon worthless work. If you do what you want to do, you will heartily regret it when you find that the working is several times more costly, and the trouble involved incomparably greater than if you had gone to work properly at first. It is a very natural thing to do, but a great mistake, to use up existing things to attain a middling result; but it is bad economy. If you want to cut your carbon plates, and have plenty of time at your disposal, and a patient, persevering nature, cut them with an iron hoop, silver sand, and water. If time and patience are not abundant, buy your plates; but, made or bought, do not fix them in a trough, but make the zinc and carbons so as to lift out of the liquid.—SIGMA.

[57928.]—**Cruikshank's Trough Bichromate Battery.**—With reference to the former part of your query, a correspondent on page 607, Vol. XXXVII., says that the best way to cut carbons is to use a piece of an old saw (without teeth) and keep it covered with moistened sand or emery "like a mason would do it." A piece of wood is to be put on the top of the steel to prevent it from hurting your hands. Another correspondent advises the use of an old saw-plate, "using plenty of coarse grit and water." After they are off they are to be rubbed down to required shape, using a York stone and coarse grit, afterwards fine sand, to get them smooth. It is unfortunate that the ENGLISH MECHANIC is bound to keep repeating itself, inasmuch as one cannot find so much information anywhere else; so the only thing to be done to refer to back volumes.—R. A. R. BENNETT.

[57930.]—**Dynamo.**—TO MR. W. H. EAVES.—I have not had much experience in running arc lamps in the same circuit with incandescent lamps, and what little I have had has not tended to enhance my opinion of the system. The sizes given for the 30-lighter will answer your purpose; for, as I said in my letters, the dynamo might have considerably more than 30 lights put on without any danger to the machine. I am afraid you will have some trouble with arc lights of only 500 c.p.; an arc is seldom very steady under 50 volts and 10 ampères, and that amount of current and E.M.F. gives about 200 c.p. The power used by the machine when driving 30 Swans and the four arcs would be about 6 h.p.—W. H. EAVES, Coventry.

[57933.]—**Leclanche Battery Work.**—TO "SIGMA."—Eighteen cells in series will not ring a bell any longer than one cell would, if it is able to ring it properly at all. The number of cells in series is adjusted solely to overcoming the resistance. To maintain the current steadily for a length of time, the cells must be coupled in multiple arc, not in series.—SIGMA.

[57935.]—**Induction Coil.**—The wire mentioned is utterly useless for the purpose; it is only fit for the purpose it is made for, as a conductor of current to its work.—SIGMA.

[57935.]—**Induction Coil.**—Don't use your double wire for a coil: it is not a suitable size for either primary or secondary, and if that is all you have towards it, I would suggest a reference to back numbers, where you will find dozens.—OS.

[57935.]—**Induction Coil.**—It is questionable if an induction coil made as "B. W. G." proposes would be a success. It would be better to put the 55 yards of No. 25 double wire to some other use, where it could fulfil the purpose for which it was made, and save disappointment after labour. Other reasons for discarding it are that, used as a secondary, it would be too thick to give "the best results" asked for; and, besides, all secondary wire should be covered with silk.—BOBADIL.

[57936.]—**Electro-Magnets.**—TO MR. BOTTONE.—Lay on sufficient No. 20 silk-covered wire to bring the diameter of the electro-magnets to three times that of the core at present—viz., to $4\frac{5}{12}$in. Now carefully test the resistance of the quarter-mile telegraph circuit; note also the number of cells in parallel required to give best effect near (in your case about six Daniells); test the internal resistance of your cells. Now couple up a few more cells in series, so as to render the current the same through the longer distance—say, about four sets in parallel of two in series.—S. BOTTONE.

[57937.]—**Egg Albumen**—is the white of eggs merely dried; but it is not dried by heat, as that would spoil it. The temperature of boiling water coagulates albumen, and renders it insoluble in water. A large quantity of albumen is also made from blood. I do not think egg albumen is made in this country. It is, I believe, all imported.—OS.

[57937.]—**Egg Albumen.**—The substance described by querist is dry albumen prepared by evaporating the white of egg in a water bath at 40° C. It is a yellow, transparent, glassy mass, soluble in water, and is readily pulverised. It is best to evaporate the egg albumen in a water bath. Its cost would be that of the eggs and the heating apparatus. It can be obtained from most large manufacturing chemists.—MEDICUS.

[57938.]—**Linseed Oil.**—Should try Mosses and Mitchell's vulcanised fibre valves. They are one-third the cost of rubber, and will outlast three sets of the best rubber valves yet produced; are quite impervious to oil and noiseless in working.—J. G. M.

[57938.]—**Linseed Oil.**—There is no doubt that grease and oil do destroy indiarubber. It lasts longer when vulcanised, which I expect is the kind you use; but still, if the valves are small, a shillingsworth of indiarubber will go a long way, as you seem to have used it successfully so far. There is hardly anything else but leather; perhaps that would suit you.—OS.

[57945.]—**Galvanometer Resistance.**—I cannot refer the querist to my former reply; but I suppose the plan given was to place the two galvanometers in one circuit with a Daniell cell, and note the deflection; then remove the one whose resistance is required, and replacing it by a resistance instrument, reproduce the deflection. The resistance thus used will be that of the galvanometer. I doubt if his second instrument, as described, will answer the purpose, as not being sensitive enough.—SIGMA.

[57945.]—**Galvanometer.**—Shunt the galvanometer whose resistance is to be found with a known resistance S, then test the joint resistance of the galvanometer, and shunt on the arm x of a bridge and call that resistance R, then R = the joint resistance of galvanometer and shunt.

$$R = \frac{GS}{G+S}$$

$$RG + RS = GS$$
$$RS = G(S - R)$$

$$\frac{RS}{S-R} = G$$

Or use this method for testing the resistance of the galvanometer by its own deflection. Take a battery with E M F = E, and whose internal resistance is small, and, therefore, may be neglected. Now shunt your galvanometer with shunt of resistance (preferably of low resistance); now connect up your shunted galvanometer in series with a resistance *r*, and mark the deflection on the galvanometer. Call C the total current—

$$C = \frac{F}{r + \frac{GS}{G+S}}$$

Call C_1 the current in the galvanometer, in terms of the total current.

$$C_1 = \frac{E}{r + \frac{GS}{G+S}} \times \frac{S}{G+S} = \frac{ES}{S(G+r) + rG}$$

Now take off the shunt, and increase the resistance *r* until you get the same deflection as in first case, and call this new resistance R. Now, as there is no shunt on the galvanometer, the total current will go through the galvanometer,

$\therefore C = \frac{E}{R+G}$, but as there were equal deflections, therefore the current in the galvanometer in both cases was equal; that is, C_1 in first case is equal to C in second case—

$$\therefore \frac{ES}{S(G+r) + rG} = \frac{E}{R+G}$$

$$SR + SG = GS + rS + rG$$

$$S(R - r) = G(S - S + r)$$

$$s\frac{R-r}{r} = G.$$

—C. L.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

57320. Model Dynamo, p. 573.
57321. Webster Condenser, 573.
57334. Heinrich Dynamo, 573.
57336. Eccentric for Loco. Engine, 573.
57345. Electrical Weather-Vane, 573.
57346. Jewellery, 573.
57350. Butter Fat in Cream, 573.
57351. Ascent of Bullet, 573.
57353. Skewer-Making Machine, 573.
57358. Putting Bars in Lancashire Boiler, 573.
57360. Chronometer Balance, 573.
57362. Engine, 573.
57364. Electrical Veterinary Oil, 573.
57365. Phosphor Tin, 573.
57366. Chewalla, 573.
57370. To "Sigma," 574.
57371. Extra Currents, 574.
57374. Portland Cement, 574.

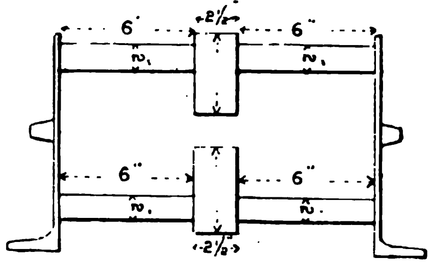
57573. Label Turning by Machinery, p. 88.
57578. G. W. Engine, 88.
57588. Engine, 89.
57601. Mounting Horses' Hoofs, 89.
57604. Construction of Magic-Lantern, 89.
57612. Locomotives, 89.
57614. Hydropathy, 89.
57616. Damp in Underground Workshop, 89.
57617. Lathe Wheels, 89.
57619. Compressing Air, 89.
57620. Printing Machine, 89.
57621. Chasing Screws, 89.
57622. Centring Cylinder, 89.
57627. Bicycle Race, 89.
57628. Watch Work, 89.

Influence of Light on the Bacillus Anthracis.—The alterability, both functional and structural, to which the lowest forms of organisms are liable under the influence of transient changes in their environment, no doubt led M. Arloing to investigate the influence of light on the vegetative and pathological functions of Bacillus anthracis. The presence or absence of artificial light, whether white or coloured, appears to cause no profound alteration in the mode of vegetation of the bacillus. The formation of sporules, however, is asserted to be more rapid and abundant in the dark and in the presence of the least refracting rays of the spectrum. With regard to the pathogenic properties, it appears that no change was caused by the calorific rays, though the actinic rays rather increased than lessened the pathological activities of the microorganism.

QUERIES.

[57946.]—**Tractive Force of Compound Locos.**—Will someone with a knowledge of the subject kindly show how to find the tractive force of a compound locomotive? Also of an ordinary working one? Kindly use dimensions of Mr. Webb's, if possible.—EXPERIMENT.

[57947.]—**Small Compound Wound Dynamo.**—TO W. H. EAVES.—I have a small dynamo, which I wish to wind so as to get a constant E.M.F. at the terminals, but am at a loss how to get proportions of series and shunt coils. The armature is 6in. across (outside measurement), and of the cog pattern, with 12 cogs. I think I can get about 2lb. of 20 gauge wire on it. The size of magnets will be seen from sketch. Would "W. H. E." say what quantity and gauge of wire would be best for shunt and series coils, supposing the armature to be wound with 2lb. of 20 wire? I want to light ten lamps of 10 candle-power, requiring an E.M.F. of 30 volts each, and propose connecting the shunt across the terminals. Is this the best method?—F. C. A.



[57948.]—**Cone Pulleys.**—The cone pulleys (3-speed) of my lathe are not well graduated—that is to say, the belt runs tight on the small step of mandrel pulley and large one of treadle pulley, half-tight on medium step, and quite loose on large step or slow-speed pulley. How can I remedy this? I tried to glue some thicknesses of paper on the pulleys, which are not of sufficient diameter, but it won't stick to iron. The pulleys are flat. No use answering that I should shorten the belt. If I do that, it will run all right if I only use it for slow speed, and if I put it on the quick pulley it will be too tight, and get longer after a little while.—BELGIAN.

[57949.]—**Electrical Units.**—I have had numerous books to learn the values of these, but a few clear words, as Mr. Bottone could write them, would be of more use to me, and, no doubt, many of "ours" would benefit by his information also. Suppose I want a battery (bichromate) of 25 volts, 5 ampères, as an example, which, of the volts or ampères, is influenced by the number of cells, or size of carbons, or zinc plates? Will the use of two zinc plates, or two carbons, for one carbon or one zinc double the volts or the ampères?—BELGIAN.

[57950.]—**Chemical Reaction in Wall Paper.**—Can any of the chemical authorities of "Ours," explain the reaction which takes place under the following circumstances? When a certain kind of bright blue paper is hung with paste containing alum in the usual way, a most offensive odour is emitted from it, which sometimes renders it necessary to take the paper down again. When the alum is omitted by way of experiment, the smell is entirely absent. The paper is a fine blue colour, the basis of which is copper, and it is certified by the makers to be free from arsenic.—CUPRAMMONIUM.

[57951.]—**Figured Foil.**—TO MR. WIMSHURST.—Kindly say how the figuring is produced on the tinfoil on your influence machine at the International Exhibition, as it makes so much handsomer an appearance than the plain foil? If the foil is to be bought ready-figured, perhaps the Editor will allow you to say where it may be procured?—BETA.

[57952.]—**Electro-Motor.**—TO "SIGMA."—I am much obliged to "Sigma," and others, for their answers to a former query. Will "Sigma" kindly give me a little information on the following questions? I am designing a motor, and primary battery to drive it. I am restricted to, say, 144 sq. in. of battery plate surface. How am I to tell the best combination of resistances to get the most power out of my motor? Is it the combination which gives the greatest number of ampère turns? which I take to be the ampères × the turns of wire in the machine ÷ the number of circuits through the machine that the wire is joined up in. If this is so, I find I should get the best effect when my battery was made of one large cell of very small resistance, and having an E.M.F. of about two volts, using very large wire on the machine connected up, so as to give the same resistance as the battery. I shall be very glad if "Sigma" will say whether I am going on correctly. The motor I think of making will be something after the Reckenzaun pattern, but with a Gramme ring, 9in. diam. and 1in. square in section, made of iron ribbon. I propose to make the battery (Bunsen) in the form of a long trough, with narrow porous cells, so as to get the plates very close together, leaving room at the end of cells for plenty of solution. I should be glad to know how long I may expect 1lb. of nitric acid in a battery of this sort to keep my motor going? and whether there is any reason why I should not use a wooden trough for a large Bunsen cell?—H. B.

[57953.]—**Clearing Smoke-box of Loco.**—Will some kind reader give me information how to clear the smoke-box of a loco. of ashes without taking the door off, for we find after a run of five or six miles her smoke-box gets hot? Could we erect a cinder tosser? A sketch of one would greatly oblige—LOCO.

[57954.]—**Piano.**—I have a Broadwood grand piano, and the wrest pin-plank is slightly split. Will someone kindly say the best thing to be done with it? I thought of having an iron frame put in it myself.—NEMO.

[57955.]—**Organ Pedal Pipes.**—Will some reader of the ENGLISH MECHANIC kindly give the size of pedal-pipes, 16ft. tone stopt, for chamber organ to produce a good full tone? Also, on what scale the radiating and concave pedal boards are made?—AMATEUR ORGAN BUILDER.

[57956.]—**Arc Lamps.**—We have had, lately, most excellent practical letters on dynamo-making from W. H. Eaves and others, and, strange to say, little or nothing on arc lamps. We had, of course, ten years or so ago, a full supply of lamps of a toy class, one of which is before me now, and I am always reminded of the hauling-up gear of a coal-pit when I look at it, and it was made by a good maker of other apparatus in Birmingham; but a lamp to give you light it was not. Since then many improvements have been made in lamps, and now and then we read of some new lamp: the sale price will be very low in consequence of the simplicity of construction, &c.; but £10 to £8 stg. don't seem to me low. Last winter I saw one that cost £8 (Brockie is, I think, the make), that ought not, in all fairness, to have cost over 30s. The lamp I refer to has been at work this past nine years. Will any reader tell me if the patent of this lamp is still in force, or of any other simple working lamp that I should be free to make during these long evenings?—LEVER.

[57957.]—**Electro-Motor.**—I am making a small electro-motor. The A. is of the Siemens type, and has about 2lb. of No. 16 c.-c. copper wire wound on it; the F.M.'s are wound with 8lb. of same size. What kind of cell, and how many should I use to get the best results? And, supposing I was to use it as a dynamo, how many c.-p. might I expect? I would also like to know what constitutes a 1 man-power, with electro-motors, and how ascertained?—MOTOR.

[57958.]—**Faulty Dynamo.**—Having made a small dynamo, 20 c.-p., laminated armature, 3½lb. No. 20 wire on fields, and ½lb on armature, shunt wound, I find it will not give any current, but acts as a motor with battery. What is the fault?—J. B.

[57959.]—**Brass Mixture.**—Will one of our readers kindly answer the following? What is the best mixture of brass to make screws and bolts of, as I want some to stand a great twisting strain?—ROMANIA.

[57960.]—**Dynamo.**—TO MR. BOTTONE.—I have put together one of Mr. Jones's 30-light dynamos, H pattern, with laminated H armature. The weight of iron in the castings is 1¼cwt. It is series wound, with 37lb. of No. 18 d.c.c. wire on F.M.'s, and about 6¾lb. of No. 16 d.c.c. on the armature. The armature is in two parts, and commutator in four segments. At a speed of 1,027 revolutions per minute, it gives 40 volts, 40 ampères, when a number of lamps are placed in circuit. The commutator sparks terribly, so much so as to considerably decrease the power of light. What is the cause of this? Is it because I have not sufficient wire on armature, although it is now crammed? Can I now convert it into a compound machine by winding another 20lb. of wire on F.M.'s? Can I wind armature, which is 4½in. in dia., in four separate sections and couple it up the same as a Gramme, by making the commutator in eight sections? My circuit for the lamps extends over 250 yards.—C. R. G.

[57961.]—**Small Dynamo.**—I have made a small dynamo with Siemens H armature, 10in. long and 2½in. diam., pole-pieces 10in. long, bored out to 2 5-16in.; the amount of wire required is 9lb. of 16 d.c.c. The armature I filled first, which takes 1¼lb., and the remainder 7¾lb. I put on F.M. coils, two in number. It is made after the No. 3 Patrick dynamo, so gauge of wire and amount is according to maker, and should light six 10 c.-p. Swan lamps, which is about 24 volts each. Now if I put one of Opperman Bro.'s 10 c.-p. lamps of 24 volts in circuit, it is not lit to its full power, and when I put two in it is worse; so I got one of 16 volts made, and it lights it splendidly. The speed required is 3,000 revs. to light the six 10 c.-p. lamps; but the results I give was at a speed of 1,500 revs. If I turn the machine and the outer circuit is broken, there is a heavy drag on armature; but when I put a secondary battery in circuit it runs very light, and seems to give no current at all, and still it works an electro-magnet on a Cuttriss motor well. Will any of our readers give me some information of the above working: whether it is right or wrong, and if there is any remedy? I want it for lighting incandescent lamps and charging storage batteries. Also I would like to know what such a machine will give in volts and ampères if properly constructed?—J. S. P.

[57962.]—**Material to Stand Intense Heat.**—Wanted, a material that will best withstand intense heat in limekilns, which heat at one part of kiln is equal to, if not greater, than a blast furnace?—PROGRESS.

[57963.]—**Lamp Query.**—What is the cause of the wick of a lamp running dry and burning red? The lamp is of the sort known as a "kosmos," with an annular burner, and the lamp maker informs me it is in perfect order. I use only best rock oil, and the reservoir is filled. I tried putting in a new wick, and it worked well for two nights, but is now as bad as the old one.—DEMETRIUS.

[57964.]—**Boiler Query.**—I have a boiler, 4ft. 6in. long and 20in. diam., with a dome 2ft. by 1ft., with a fire-hole 2ft. long by 1ft. wide; height, 14in. Would such a boiler drive an engine with cylinder 4in. by 5in. stroke?—REVIT.

[57965.]—**Carbon in Ferro-Manganese—Eggertz's Method.**—Would Mr. Grey, or any of our chemical readers, kindly answer the following, with explanation? Say 3 grains of standard steel, 0·40 per cent. carbon, are dissolved in dilute HNO_3, boiled, &c., and the solution taken to 16cc. on carbon tube; 1½ grains of the ferro are treated precisely the same as the standard, the solution is then taken to 20cc. on tube: when the colour is found too dark; the solution cannot be carried higher, as the tube is only graduated to that height; 10 cc.'s of the solution are then thrown away, leaving 10cc. in the tube, which is again taken up to 20cc. when it is again found too dark; 10cc. are again thrown away, and the remaining 10cc. taken up once again to 20cc. when the precise colour is obtained. Kindly say the percentage of c. in the ferro-manganese?—L. J.

[57966.]—**Refractor.**—My 4in. refrac , by C
defines stars perfectly when used with pow
With powers of 230 upwards the star disc
and irregular appearance, even in cl
under the impression that a telescope
of 100 per inch of aperture, I should b
someone conversant with telescopes wh

nine is at all normal, or whether some defect in
dicated, and, if so, whether it can be remedied?—
ER.

]—**Electric Boat.**—I have a boat about 3ft
h a beam of about 5in. or 6in. I am making a
escribed by Mr. Chaster in Vol. XL. of the ENGLISH
IC, for it. Would some kind reader tell me how
tteries it would take to drive the motor to make
go, and what batteries are best to use, and whether
ulator would be better? If so, what kind would
—A BEGINNER.

]—**Length of Musical Strings.**—Will any
f the "E. M." give lengths and gauge of wire
t three octaves from C, below the stave, upwards
s, giving the length of each string, as I am going
a small harp and fairy bells with chromatic scale?
o use as fine thicknesses as possible, but I would
ood tone.—A POOR LAD.

]—**Eclipses of Satellites.**—Have any eclipses
ne's satellite been observed, or of those of Uranus,
hom? All popular books tell us the motions of both
tems are retrograde; but this fact seem sone hardly
to ascertain till some of their eclipses have been
d in the case of Neptune there must be intervals
rs, and in that of Uranus of nearly 40, in which no
occur.—E. L. G.

]—**Walnut Oil.**—In last week's *Graphic* there
n made of this oil being used by artists and dis-
d by them for its quickly-drying properties.
nyone who has tried this oil in any way inform me
icker in drying than raw linseed oil without the
ny dryers? Under what name is it sold?—
S.

]—**Extracting Dye.**—How is the red dye
l from the bark of the maple? Is the bark sold by
? If so, under what name? It is referred to in
"Botany," 1882 ed., p. 478.—A. H. SMITH.

]—**Glaze.**—Can any of our correspondents
e what is the composition of the glaze which
lossy surface to the cloth in use for bookbinding?
ALE.

]—**Winding Engine.**—Having a winding
ith single cylinder of a given diameter, to find
eter of cylinders of a pair of coupled engines of
wer, steam pressure, size of drum, and speed of
e the same in both cases. Example: What will be
of cylinders of coupled engines to be of equal
the following? Single cylinder = 24in. dia.
roke; pressure on piston = 40lb. per square inch;
um = 10ft.; speed of rope = 20ft. per second, or
ing in 30 seconds from a depth of 100 fathoms.
eone of our able correspondents kindly favour me
formulæ for above?—E. P.

]—**Cleaning Prism of Binocular Micro-**
—How can I wipe off the dust from the prism of
ular microscope, and should I attempt to do it
I find two spots on the right-hand side of the
n I use a small pencil of light with the least hole
phragm (with a more brightly illuminated field
ppear), which are not due either to the object-
the eyepieces. Hence, it appears to me they
lue to small specks of dust on the prism; but I do
how to get at the prism to clean it. Can any of
lers advise me?—TRITON.

]—**Centre Seconds Watch.**—Will some
ease say whether centre seconds watches are as
as regards daily rate as a watch of same grade of
t with the seconds hand in the ordinary position?
the old key-winding watches more accurate than
rn keyless watch, other things being the same?
ght the daily rate of a good watch (not chronome-
I mean, what daily rate could one count on,
6 secs. + or − daily?—CLOCK STAR.

]—**Elliptical Firebox.**—TO "BOSWELL,"
N," OR OTHERS.—I wish to calculate the col-
ressure of an elliptical flue, 12½ft. long, 3ft. wide,
p, and ½in. thick; no supports in the flue. In
p on this subject in Mallet's work, I came upon
ula $D = \frac{2\ M^2}{m}$. Where D equals mean diameter
major axis and *m* equals minor axis. In apply-
o the above case D comes out 7·2, which surely is
Mallet then says: D bear found work as for
. Is not this wrong too, for I am of opinion that
ical tube is far stronger than an elliptical tube
an diameter is equal to that of the cylinder?—
N.

]—**Compressed Air, or Water Pressure.**
a small, but constant, stream of water on my
running day and night. I now use a half-horse-
gine about two hours per day. Could I not store
by a small water-wheel always working, either
water up in a tank about 16ft. high (this is the
height I could get); or would it be better to have
boiler to compress air in and use it instead of
d by passing the air through a coiled pipe, and
ther by gas or a small fire? Which of the two
most economical in using my small available
L. W. D.

]—**Extracting Silver.**—Will any reader of
M." be so kind as to inform me how to extract
m stones? The stones are of a soft nature. I
following the fissures or openings of the stones in
f small grains; the clusters vary in size from 1in.
diam., mixed with other bruss, and I find it
in the solid stone in squares of ⅛in. to ¼in.?—
ATUM.

—**Cuttriss Motor.**—TO MR. BOTTONE.—Will
y give me the size of wires and quantity required
or of the Cuttriss pattern, with H armature?
nature, 3⅝in. by 1¼in.; web, ¼in. thick; space on
ets, 2¼in. by 2¼in. by ¼in. thick.—J. A. P.

—**[illegible] Clay.**—From what clay is the best
[illegible] re can it be obtained? Wh[illegible]
of fireclay?—SOUTH

Lens.—Wha
tter, any kind

scope) is said to magnify, say, 10 diameters? Does it mean that a circle 1-100in. diameter should appear to be 1-10th when viewed through the glass, or what? Would the same rule apply to a telescope?—X.

[57982.]—**Coke Scrubber.**—I should be much obliged to any gas manager who would inform me how long an ordinary coke scrubber may be used to advantage? It is about 9ft. by 3ft. I may state there is no washer in use. The make is about four millions, and I fancy the tar must gather on the coke and make it non-effective.—A COUNTRYMAN.

[57983.]—**Electrical.**—TO MR. BOTTONE.—I have an engine, 3½in. stroke, 1⅝in. bore, run at 250 revs. p. m., with pressure of 30lb. per sq. in., which could be increased to 45 or 60. Wanted to know what sized dynamo this engine would drive (size of dynamo required, not power of engine)—i.e., length and diameter of armature, F.M.'s wire required, &c. Would it light 20 c.-p. lamp, or four 5 c.-p. lamps; or would it do anything at all worth the trouble of constructing the dynamo? I have done nothing in the electric department, so I am quite at sea. Engine is strongly made, and drives 3½ centre lathe for metal-work well.—AMATEUR DRIVER.

[57984.]—**To Mr. W. H. Eaves, or Mr. Bottone.**—I require to make a dynamo to give a current sufficient to fuse a piece of steel wire 4in. long and 26 B.W.G. What current shall I require for this purpose, what size of H armature (laminated) would be necessary, and what size, and how much c.c. wire would be required? Would it be best to use permanent steel magnets, and make a magneto machine, or should I make an ordinary series-wound dynamo? I want the machine to be as slow-running as possible, and very compact.—W. O. E.

[57985.]—**To Mr. Wimshurst.**—Could you kindly state what is the relative efficiency of your electrical machine when constructed with glass plates and with vulcanite plates? Would any combination of plates of glass and plates of vulcanite give better effects than either material alone? If plates were coated with vitreous material and with resinous material, could higher charges be procured by the opposition of these? Many thanks for useful information already given in "Ours."—NO SIG.

[57986.]—**Dynamo.**—TO MR. BOTTONE.—I have a dynamo, Jones's 100 candle-power castings, cog armature, F.M.'s 8½lb. of 16 d.c.c. wire, armature 2lb. 6oz. of d.c.c. wire 20 gauge, with a flywheel 31in. dia. on a pulley 3⅝in. dia. I can succeed in making 9in. of 33 gauge iron wire red hot by hand power. How many 20 candle lamps can I succeed in lighting? Also what size of carbon for arc lamp, and will same form of arc lamp as described by you in "Experiments with Dynamo" do for the same? Please state power required and revolutions of dynamo per min.—LES DENTS.

[57987.]—**To Mr. S. Bottone.**—I am making a small dynamo with H armature, 2in. by 4in., F.M. wound with 8lb. of No. 16 d.c.c. How much and what size ought I to put on armature, and how many 10 c.-p. lamps might I expect to light well?—E. A. W.

[57988.]—**Screw-Cutting.**—I have got some taps to make for cutting dies for screwing. Should they be cut and finished with the tool or finished with the chaser? Would they be right if they were finished to a nut that has been tapped, or to a templet on top of thread?—SCREW-CUTTER.

[57989.]—**Entomological.**—While hunting along a railway fence for caterpillars, I came across a mass of yellow, silky, egg-like looking bodies, and, assuming them to be lepidopterous eggs, I at once cut them off and boxed them up. A yard or two farther on, I found two caterpillars, hair short, bodies black, yellow stripes along back and sides. I took them home and put them in the rearing box, covering over with a sheet of glass. A day or two afterwards I found one of the caterpillars had changed into a black-spotted angular chrysalis, suspended around the middle by a silken thread. The other had, to my surprise, deposited on the underside of the glass a mass of yellow egg-like looking bodies—in fact, in every respect identical with those I found sticking on the railway fence. The caterpillar remained with, and continued covering, the eggs (at least, I presume them to be such) with silk—at last falling off dead. Do any of your readers know of such a thing happening before? If so, in what genera? All books on entomology say that the perfect insect, moth or butterfly, deposits the eggs. Would this be a case of parthenogenesis? Any information will oblige—ANTIOPA.

[57990.]—**Limelight and Lantern.**—Will someone who has had experience with limelight burners kindly tell an old subscriber the best way to manage the lime turning arrangement? Also the best way to get the sliding telescopic tubes for the fronts of a pair of lanterns, four sizes, about 4in. diam.? I have tried "Invicta's" plan of casting and boring them, but have failed to get them a good fit.—R. LINSEY.

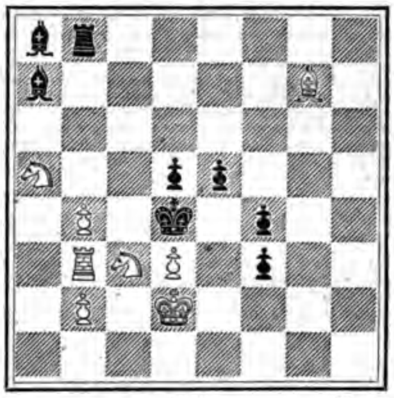
Colour Tests for Strychnia.—Some very delicate tests for strychnia have been published in the *Pharmaceutical Record* by Mr. Hinsdale. Cerosoceric oxide is a powerful oxidising agent, and was introduced by Sonnenschein as a test for alkaloids. It is easily prepared by igniting cerous oxalate in an open crucible. Mr. Hinsdale prepares it for testing by mixing about one-tenth of a grain with five or six drops of sulphuric acid. The hydrated peroxide of manganese is found also to be much more delicate as a test than the ordinary peroxide in fragments. Wenzell's method of testing with permanganate of potash is to dissolve 1 part in 2,000 parts of sulphuric acid. With the ceroso-[illegible] oxide the purple, pink, and red play of colours [illegible]rychnia produces are very distinct, and the [illegible] lasts a much longer time than when [illegible]ny other reagent.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLXIV.—BY LOUIS WHALLEY.

Black.



White. [8 + 8

White to play and mate in two moves.

SOLUTION TO 962.

White.	*Black.*
1. B-Kt 6	1. P-B 7 (a)
2. Q-K 8 (ch)	2. Q-B sq.
3. B-B 7 (ch)	3. K-Kt 2
4. Q-B 6 (ch)	4. K-R 2
5. B-Kt 6 (ch)	5. K-Kt sq.
6. B-R 7 (ch) and wins.	
	(a) 1. K-R sq.
2. Q-R 5 (ch)	2. K-Kt sq.
3. B-B 7 (ch), &c.	
	If 1. Q-B sq.
2. Q-R 5 (ch), &c.	
	If 1. Q anwhere else
2. B-B 7 (ch), &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 962, by B. Fison; to 961, by E. S. Follwell; to 963, by A. S. Olver.

B. F.—Thanks for problem.

J. P. T.—We shall be pleased to insert corrected version.

ENGLISH MECHANIC Two-move Tourney.

Judge's Report.

IN judging the merits of the many interesting problems in this Tourney, I have mainly taken into consideration the following features:—Variations, Purity of Mates, Utility of White King, Freedom of Black King, and Economy of Force Employed. I have also noted the Solver's criticisms, and it is to be regretted that such were not more general and frequent. Problem No. 933, "Tessie," a very neat problem (7 points); No. 935, "Respice Finem," a novel idea, but easily seen through (3); No. 937, "Væ Victis," pleasing and ingenious (6); No. 939, "Ideen," not attractive and marred by duals (2); No. 941, "Beware of the Dog," rather heavy, with ordinary care the muzzling is soon accomplished; notwithstanding, there is evidence of much care in its construction (6½); No. 943, "Pathfinder," very pretty, a path with roses on either side (6¾); No. 945, "The Four Knights," of average merit, the duals are somewhat detractive (5½); No. 947, "Aut Vincere Aut Mori," an exquisite problem of deep design; the main idea, however, is somewhat stale, and it is a little down the scale as regards economy of force (7¾); No. 949, "Phono," neat and well constructed (6½); No. 951, "The way the Wind Blows," an ill wind whispers, a little above average merit, yet still there should be a greater variety of mates considering the number of pieces engaged (6½); No. 953, "Respice Finem" (2nd), a neat, though simple, stratagem (4); No. 955, "Ianthe," a very cleverly-planned position (7½); No. 957, "Check," sound, but very easy (3); No. 959, "Salutation," not difficult, but very nicely arranged (4); No. 960, "Respice Finem" (3rd), Rachael! an elegantly designed stratagem, "beautiful for ever" (8).

Prize Award.

1st prize, £1, "Respice Finem" (3rd), No. 960; 2nd prize, "Aut Vincere Aut Mori," No. 947, Baxter's "Chess Problems"; 3rd prize, "Ianthe," No. 955, Chess diagram stamp, presented by Mr. Briggs; 4th prize, "Tessie," No. 933, a copy of "Dot," presented by Mr. J. P. Taylor; honourably mentioned, "Pathfinder," No. 943.

Oct. 24th, 1885. FRANCIS CHARLES COLLINS.

WE propose shortly to publish the names of the prize-winners and competitors in the Problem Tourneys.

ALKALOIDS, like dogs, appear to be having their day. M. Tuyagopu has extracted an alkaloid from pickled cabbage. The hydrochlorate of this base does not cause intellectual or sensory disturbances; but it paralyses the vaso-motor centres of the medulla as well as the cardiac fibres of the vagus. M. Tuyagopu asserts that the new alkaloid suppresses the delirium due to prolonged abuse of alcohol. This may point to a new use for pickled cabbage.—*Lancet.*

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Bookbinding : No. 613.
Electric machines : Nos. 1,009, 1,025.
Electro-magnets : Nos. 772.
Lacquers : No. 866.
Pattern Making : Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 969, 974, 978, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,010.
Silver-plating : No. 1,009, 1,010.
Varnishes : Nos. 478, 619, 675, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 4, and unacknowledged elsewhere :—

REV. H. HARRIS.—Crossley Bros.—Pfeil and Co.—Jas. W. Queen and Co.—Rev. R. G. Leigh.—W. Saunders.—W. H. Smith and Son, Dublin.—A. Ireland.—F. A. Moilliet.—G. Morecroft.—J. C. L.—J. J. H.—Hazy.—M. Arkwright.—G. Calver.—F. T. R.—A Plumber.—W. H. Thurlow.—S. R. P.—L. S.—J. R.—E. A. W.—Sand-rat.—T. R. Saxton.—Bowling.—H. A. Wassell.—G. Fryer.

N. V. N. G. (There are so many good works that the reply would be invidious, and also an advertisement.)—AFGHAN BOUNDARY COMMISSION. (Saunier's "Watchmaker's Handbook"—J. Tripplin, Bartlett's-buildings, E.C.—is a fairly complete practical treatise, giving more than you really want, price about 12s. 6d. Britten's "Watch and Clockmaker's Handbook"—the author, Horological Institute, E.C.—is also a practical work, price 5s. There is also a "Watch Repairers' Handbook," by Kemlo, but we do not remember the publisher. 2. Both the Waltham and the Waterbury Company publish illustrated pamphlets, we believe, but they would not be of much use to you in repairing a watch.)—G. R. B. (The Cantor lectures on the Guttapercha and India-rubber Industries, in Vols. XXXI. and XXXII., would give you a good deal of information. They were published in book form by Bell and Son, York-street, Covent-garden, for the Society of Arts.)—RUBBER WORKER. (See previous answer, and look through back volumes.)—NEW SUBSCRIBER, Hertford. (Hospitalier's "Domestic Electricity," by Wharton, and V. Stephen's "Wrinkles in Electric Lighting," both published by E. and F. N. Spon, 125, Strand.)—COCHLEA. (Certainly not, or why should electricians have separate cells. 2. We should think so, as there must be some scientific instrument-makers who keep a battery of that size for experimental purposes. An advertisement in the Wanted Column would no doubt meet with an answer or two, as we presume a storage battery would do for your purpose.)—ALF. ROBERTS. (We do not know the greatest number that *can* be printed, and no one is likely to run any risk of a breakdown in trying; but you may reckon from 12,000 to 14,000 revolutions per hour, and as some machines are large enough (or the papers small enough) to print two copies side by side, you may reckon, say, 26,000 copies per hour from one machine.)—ARCTURUS. (Dip in acid, wash, scour with sharp sand, wash again, and when "clean," immerse in a bath of molten zinc, the top of which is covered with sal ammoniac. The important point is in the word "clean"; but if the pieces are large, they should be heated before immersion in the zinc.)—CREMONESE. (See p. 55, No. 1,043, and the indices generally, for much valuable information on violin-making. There is a book entitled "Violin Making: As it Was and Is," by E. Heron Allen, which may suit you.)—DESIDERATUM. (Either supported by a thimble on a point, or revolving on a ring on the rod.)—I. W. WARD. (Thanks: a slip of the pen.)—X. Y. Z. (We believe you were answered at the time; but at any rate, no room for questions of that kind just now.)—NOVICE. (For Dulcimer, see p. 227, Vol. XXXVII., pp. 97, 168, Vol. XXXVI., and the indices.)—OUTER DARKNESS. (For articles on luminous paint, see back numbers. You can purchase it ready prepared with proper grounding material. Does not require varnishing. Can be washed, but better not. It is used to coat lifebuoys.)—W. B. M. (They are made of the best skins of parchment, called vellum. They are mostly skins of the he and she-goat and wolves. The process of preparation is described in most of the cyclopædias. 2. The articles on Cart and Wheelmaking appeared in Vols. XXXII. to XXXVI., commencing with No. 822.)—AMATEUR. (Use any of the cheap essential oils, singly or together, such as oil of rosemary, sassafras, bergamot, lavender, thyme, cloves, &c.)—GRAMME. (Will none of the many replies to similar queries in the last three or four volumes suit you?)—F. M. (If you have the machines, what more easy than to try which is the better way? If the lamps are in series, it would be best, perhaps, to make two circuits, one for each machine.)—CWRW. (Briefly, it is yeast compressed in hair bags until the liquor is driven out; but see the index to Vol. XXXVII.)—SOLDER. (Must be brazed with spelter and a blowpipe. The edges of the copper should be brought nearly to a red heat. See indices.)—TOBY. (New pins can be put in. See indices. Any of the large musical instrument dealers will undertake such work.)—C. L. TWEEDALE. (No room for such questions just now; besides, the existing arrangements are superior.)—PROBABLE PURCHASER. (Would it not afford an opportunity for gratuitous advertisement?)—THOMAS. (Tampico, we suspect, you mean; but cokernut fibre, broom corn, leaves of date palm, birch twigs, and many other things are used.)—H. O. S. (Such a string of queries is too much. Why not apply direct to the secretary of the company?)—NEL'S POORT. (The best thing is varnish colour: that is, the required pigment ground up and mixed with best hard copal varnish. The gear was illustrated in No. 954, and there is a good deal about it in back volumes.)—J. E. SAINSBURY. (You can engrave glass "without a diamond" by means of anything hard enough to scratch the surface—an ordinary V-pointed graver, for instance, made "dead hard." We presume you really mean etching? That is done with acid, or special fluids, and you will find directions in back numbers. See p. 156, Vol. XXXV.; p. 376, Vol. XXXVI.; p. 162, Vol. XXXIX., and the indices generally.)—MALLEABLE. (There is much about malleable cast iron in back volumes—for instance, Vol. XL., p. 303, Vol. XXXVII., p. 534. There is information on the subject in most of the textbooks of metallurgy.)—ETRURIA. (It is made of glue rendered insoluble by means of a little bichromate of potash. Sometimes treacle is used. The figures are treated with size; when that is dry they are coated with varnish, and as soon as that is tacky the powder is dusted on.)—J. J. HAMMOND. (Given several times. See p. 116, No. 1,019, and the indices of recent volumes.)—INCANDESCENT. (No.)—AMATEUR PHOTOGRAPHER. (If you cannot refer to back numbers, in which all your queries have been answered many times, procure one of the cheap guides to photography.)—AN OLD WET PLATE WORKER. (There are several in back volumes; but none better than those you have tried.)—J. COPCUTT. (What can we do with it? A "matchless artificial light," which was displayed on such an occasion in 1858, must be well known by this time.)—CONSTANT SUBSCRIBER. (Patent size (at any oil-shop) or gelatine dissolved in water. See that the size covers every part of the paper, and when dry give two coats of paper varnish.)—CIVETTA VERE. (Try the aniline dyes. Unless the quantity is large and you already have the requisite plant—proper coppers, vats, and tubs—it would be much cheaper to "give it out" than to attempt to dye by the older processes.)—A COLLIER. (The meaning is plain enough; but as to the "utility," that is another question. Still, a low barometer should suggest extra caution. Not much interest who originated the expression.)—JNO. BRADLEY. (The mercurial process was recently described, and the silvering in many back numbers. 2. To dress sheepskins into mats see p. 431, Vol. XXXVII.)—CETEWAYO. (For so-called self-acting fountains, see Nos. 459, 582, 801, 967, 973, 974.)—H. M. D. (If you use pieces of ordinary steel, the effect produced will be just the same, provided the patient has faith. 2. Pounded quartz mixed with water-glass.)—P. (See an article in No. 927, p. 376, and look through the indices for references to the subject. Several notes on etching and embossing glass have been given in recent volumes.)—SENSITIVE ALARM. (Anything that will keep a spring contact away from its seat and give way when the temperature reaches a certain point will do. One was illustrated in No. 1,063.)—W. D. The time-ball query was answered in No. 1,017, p. 72, and in No. 994, p. 129. 2. Yes, benzine is the material used for "dry cleaning." See indices.)—J. T. Do you mean a refractor or a reflector, and what parts do you intend to buy? There are many articles in back numbers; for instance, "How to make a 2in. Astronomical Telescope," pp. 585, 607, 621, 622, Vol. XXXIV.)—W. BELTON. (It is a bit of inferior mica.)—MURIATE. (Mix tin and mercury together in proportions to form a paste; clean the article thoroughly, rub with a rag moistened with dilute hydrochloric acid, and immediately apply the mixture with a bit of cloth.)—J. W. W. (Bisulphide of carbon. If expense is no object, try chloroform or ether.)—C. A. (In the Address Column—sixpence for the first sixteen words.)—EXPERIMENT. (There are several forms of carbon. Diamond is a pure crystallised carbon, which is, however, by intense heat converted into graphite—another form of carbon. Consult an elementary textbook of chemistry.)—AMATEUR BOOKBINDER. (No. 594 contained the English Mechanic Telephone. It is out of print. Frequently stated that it was specially disclaimed, and is therefore free. Look through recent numbers for the heading "Gillett's Telephone." 2. "The Dynamo," by Mr. Bottone, commenced in No. 960. 3. Several recipes for ebonising wood in back volumes; see p. 371, Vol. XXXVIII.; pp. 16, 64, 136, Vol. XXXVII, and the indices. 4. It is done by using a solution of indiarubber in bisulphide of carbon.)—F. L. BROWN. (If you consult the catalogue issued by Crosby Lockwood and Co., Stationers' Hall-court, E.C., you will find several works of the kind, and can choose the one which will suit best.)—A YOUNG AMATEUR. (The best way is to take a look at some existing constructions of the kind, and modify to suit. You will find some hints in back volumes. Nothing cheaper than glass.)—W. H. BLAND. (Yes to both questions; but it depends on what you mean by a nominal fee (£4 in France). Procure one of the handbooks advertised by patent agents in our columns. An agent is practically the only person who can do the foreign business at all economically.)—T. G. (Do you mean an original essay, to be read as a paper by yourself, or an essay on industry by some well-known author?) H. D. PALMER. (The question is inadequately stated. You will find solutions of the kind in back numbers, but something depends on what you wish to plate, and what battery power you have at disposal.)—TOAST. (Articles of the kind are sold by most ironmongers and tinmen. In the simplest form they are a simple wire fork suspended through a hole in a bar of tinplate, which slides along the top of the sides. A loop at the top of the fork enables it to be turned round.) LEARNER. (Procure Plaidy's "Technical
Studies," published by Breikopf and
(Augener, Newgate-street, most likely)
Bach's two-part "Inventions.")—F. W.
mill revolves because the equilibrium o
stroyed when an aperture allows the
The side opposite to the aperture is pr
tion contrary to that of the issuing jet
is sometimes called the reaction of efflu
mill in a vacuum would settle your do
(We can only suggest that you should
indicated; we know no other means
Ritchie's address.)—H. WILLIAMS. (H
spectable and solvent. There must be
where; write again and say you have
matter, and if you still get no reply we
can do.)—K. M. G. (1. Ask any of the
vertise in these columns. 2. Not neces
but not powerful enough for the work
do. 3. We have neither the space nor t
discuss consanguineous marriages. In
tioned marriage is, in our opinion, una
all anyone could say.)

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AND WORLD OF SCIENCE AND ART.
FRIDAY, NOVEMBER 13, 1885.

NOTES ON NEBULÆ.—I.

IN publishing the following notes, I have done so, not so much that my own observations (made from time to time) may be of any special value; but because the subject seems one rather neglected by amateurs, and (although perhaps difficult) quite suited to those having moderate apertures at command, and a few notes made on coming across a nebula (just mentioning its bearing with regard to faint stars on or near the object) would, in combination with other observations, throw great light on seeming discrepancies of description, and might well be the means of pointing out some interesting change in their bodies.

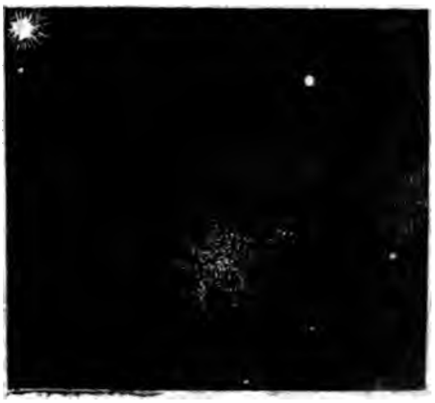
In the observation of nebulæ there are several points which, although perhaps not new to observers accustomed to the subject, I may perhaps be excused in bringing before those less familiar with the same.

First of all, for large and diffused masses of nebulosity, the clearness of the air and size of field of view are of more importance than the *aperture* used, always supposing that the telescope is competent to deal with the object. Thus a luminous night will render the use of a large instrument of very little advantage over a much smaller one, although with the former many small *stars* may be seen not visible with the latter, especially if the *air is steady*. The alleged invisibility of the Merope Nebula in the large instruments of Pulkowa and Washington is no doubt due to want of contrast, and the almost impossibility of getting a sufficiently large field. But I am not aware that any very *special* low eyepieces have been tried on these telescopes? As regards field, one might bring to mind the somewhat analogous case of the tail of a bright comet, the *extent* of which is far more easily fixed with the naked eye than with the telescope; of course this is only the case where the object does not require magnifying to render it visible.

Secondly, as regards magnifying power. In viewing the details of the object, and especially in the detection of minute stars in a nebulosity, this is of extreme importance. If the power is *too low*, the bright ground will be *too bright*, and the difference in brightness of, or the existence of faint points of light in, the nebula will be lost to view. A certain proportion of magnifying to aperture is essential, and thus it may happen that a bright nebula would show detail in structure, and perhaps a small stellar nucleus with a certain power (say 80) on a 5in. aperture, which would only appear a structureless glow with the same power on 10in. Doubtless, a false appearance of small stars, or apparent resolvability, may obtain with an aperture only just sufficient to deal with the object observed, as a very slight difference in brightness of the different parts of the nebula may at times be so uncertain as to be mistaken for a *star just glimpsed*.

Thirdly, some attention must be paid to the manner of using the eye in the observation of *exceedingly faint and difficult objects*. Naturally, the eye must be free from the excitement of a bright light; but, paradoxical as it may seem, I have found that keeping the eye in *utter* darkness is detrimental to its most sensitive condition, a very faint, diffused light, such as one gets from the sky on a dark night, keeps the eye in better condition than no *light at all*. Probably there may be [illegible] constituted as to bear complete [illegible] but it would seem [illegible] the eye strain [illegible] a consequent [illegible] gestion produces a sort of amaurosis in a very mild form, and this especially in wearied states of the mind. Of course, I need not here mention the well-known practice of *oblique* or *averted* vision in rendering a faint object more visible: but I have found that slowly moving the eye all round the field is far better than steady gazing, and frequently will render a very faint object visible when ordinary steady vision has failed to do so.

As regards the size of the instrument suitable for the observation of these objects, of course the larger the aperture the better; but a skilful and intelligent user of even a moderate aperture will by no means be without result, and should the following notes be the means of some of our readers giving more attention to nebulæ, and a desire to follow in the footsteps of such great masters in this field as the Herschels and D'Arrest, I shall feel only too well repaid. No doubt the subject is difficult, the majority of the objects being faint and obscure; but the very obscurity of the subject, and the little we know of these bodies, will be an inducement, I trust, to some zealous young observers to persevere in this line of research. Let me impress on these once more the importance of stating in their notes the aperture and power used. In confirmation of this importance, I may mention that as regards the Andromeda Nebula, I notice that on my 10in. at present, the aspect of the nebula with my lowest power (60) gives very little sign of any star, and looks only, perhaps, a little brighter at the centre than formerly; but with 300 the star and nucleus are seen at once.


NEBULA Nº β ANDROM. (218 G C)

No order is followed in the nebulæ mentioned, and under each I have put together all the observations of the objects I have made. An attempted review of this kind must necessarily be slow, from the few opportunities, as regards absence of moonlight, clear weather, and uncertainty of time at disposal. The sky of late years, too, I have thought not so fine as formerly, irrespective of *weather;* and this I see has been also noticed by the American observers since the red glows of 1883.

I have given, for facility of identification, the number in Sir John Herschel's *General Catalogue* of 1864 (G. C.), and followed this by the more generally-known synonym, where such exists.

G. C. 4,373 (37 H IV. Draconis) 1877, May 15.—It bears power well, and looks bright with 300, with which power its light does not appear equable, apparently mottled: a 13-mag. star at some distance N., and a suspicion of an *excessively* minute point on the preceding *edge* of the nebula; aperture used 7in.

1884, Sept. 13th (aperture 10in.)—Very bright with all powers from 80 to 720: a 14 mag. star a short distance N., about [illegible] diam. of the nebula, suspicion of a very [illegible] star on the *n.p.* edge of neb. Could see no *stellar* nucleus as distinguished from the bright, nearly equal light, of the nebulosity; but fancied with 320 some condensation on centre. The companion star seems nearer than I have *drawn* it in 1877, when I called it 13 mag.

D'Arrest says: "*unica prope inter nebulas.*" Bird, in 1863, with 12in. mirror, nucleus like 10.mag. star. So Knott. Brodie: "Very curious; there is a bright star in the centre of the nebula, which appears to have escaped Smyth." Webb does not mention seeing central star. I certainly saw no star in the centre, although I observed it *carefully* on the two occasions above, but noted the apparent faint point on *p.* edge in both observations.

G. C. 1137 (261 H. I. Aurigæ); 1876, Oct. 16; 7in.—Examined the nebula attentively with high powers. The stars are not easily seen, and appear nebulous. Several excessively faint points of light are scattered about the vicinity of the nebulosity, especially one just *p.* the nebula, also one *n.f.* The nebula is described by H. in the G. C. as *large*. It is certainly not so now, the whole extent of the nebulosity not exceeding 40″, neither is it *bright*. The triangle of small stars giving it the bright aspect. With low powers it looks like 9th mag. star a little out of focus.

1885, Oct. 3 (10in.)—Observed the nebula with various powers. The nebulosity is small in extent, and only moderately bright. It is not easy to see the *triangle* of stars in it. It now appears at first sight as a faint 10 mag. double star in a mist: but with attention the fainter one is made out *n.p.* the others, and making up an equilateral triangle, a suspicion of a very faint star just *s.p.* the more southern one; examined with powers 100, 236, and 600. The diameter of the nebula does not seem more than about 60″.

Described by H as one or two stars in middle, irregular nucleus. H.: Nebula surrounding a triple star. Webb says: "Haze surrounding 4 minute stars" (9½in. speculum). E. of Ross and D'Arrest 5. Brodie remarks: "Very faint: not resolvable in any ordinary telescope."

G.C. 218 (near β Andromedæ). 1874, Nov. 9th (aperture 6⅜in.)—The nebula closely *n.p.* β Andromedæ appeared with a power of 250, to be resolved into glittering mass of minute points of light, very condensed in centre, and running out into curved rays of minute stars in a spiral manner of arrangement.

1876, Oct. 15th (aperture 7¼in.)—I again observed the nebula. It most certainly is a cluster. The stars run out into curved rays; but there appears to be a *second condensation*, a little *n.f.* the principal nucleus. β Andromedæ must be out of the field, as its glare is quite unfitted for the detection of these faint details. Power used, 200.

1882, Sept. 10th (aperture 10in.)—Night not very clear, sky luminous, nebula resolvable. Strong condensation in centre, and a second nucleus *n.f.*, but sometimes appearing like a star; an exceedingly faint star north a little following, which was proceeded by another faint star somewhat as in the Fig. Some still fainter stars in the field. (Power, 300).

1882, Sept. 12-13 (10in.)—In a short view of the nebula (with about 300) the star *n.f.* the nebula was conspicuous: but I did not notice the one preceding it, mentioned on the 10th, although the latter then appeared the more easily seen. The nebula seemed resolvable with this power, although the sky was misty and luminous.

D'Arrest says of this object, with the 11in. Copenhagen refractor, Aug. 27, 1865: "Luminosa, rotunda, majuscula, crasso cum nucleo = ·11 magn. An solubilis sit, necne, penitus examinandum"; also, on Aug. 29, 1862, he mentions a star, "14 magn., 80″ distans, boream versus." I may remark that I knew nothing of these observations till after making my own, so that I resolved the object quite independently. This nebula is not in the "Cycle." The description in the general Catalogue mentions no star, or any evidence of resolvability.

Champion Hill. **Herbert Ingall.**

REVIEWS.

Patent Laws of the World, Collected, Edited, and Indexed. By Alfred Carpmael, Solicitor, and Edward Carpmael, B.A., Patent Agent. London : Clowes and Son.

INVENTORS, patent agents, and all concerned in knowing something of the patent laws of the various civilised countries will thank the Messrs. Carpmael for the volume in which they have carefully digested the patent laws of the world. The texts of colonial laws and translations of foreign laws were formerly published by the Commissioners of Patents ; but some years ago the publication was discontinued, and now many of the most important laws are out of print, while the office continues to sell its old stock of repealed enactments without any warning that they are no longer in force. Abstracts of the patent laws of the principal countries have been issued in book form, and are, as a rule, carefully compiled ; but abstracts are not satisfactory to the patent agent or solicitor who has to advise on points of detail. Messrs. Carpmael are fully aware that their work cannot be considered perfect ; but they have endeavoured to fill up all gaps, and have had all the translations carefully revised, and they promise that if others will assist them with additions and corrections, they will at a future time make the work one step nearer perfection.

Spectrum Analysis. By Dr. H. Schellen. London : Longmans.

The late Dr. H. Schellen's famous work on "Spectrum Analysis" is familiar to most students throughout the world, and in its English dress, as translated by the Misses Jane and Caroline Lassell, has been well read by many in this country. The first English edition was published in 1872, and was edited by Dr. Huggins. It was translated from the second German edition, and at the time was fairly abreast of what is known in connection with spectrum analysis. Since then, however, this fascinating branch of research has progressed apace, and the late Dr. Schellen set himself the task of entirely reconstructing his work. Illness compelled him to call to his assistance Mr. H. J. Klein, and the translators have obtained the help of Capt. Abney as editor, in order to reduce the volume to reasonable limits by the excision of obsolete or unnecessary matter. The editorial notes, appended to the first English edition by Dr. Huggins, have been incorporated into the text by Dr. Schellen, while the new matter, introduced by Capt. Abney so as to bring the work as nearly as possible up to date, is indicated by brackets. It is scarcely necessary to say, then, that the work is the best we have on spectrum analysis in its application to terrestrial substances and the physical constitution of the heavenly bodies. Amongst the plates we may mention the coloured chart of emission and absorption spectra, and the frontispiece, which is an enlarged copy of the Orion Nebula, taken by Mr. Common.

Manual of Telegraphy. By. W. Williams. London : Longmans.

The author of this work is the superintendent of the Indian Government Telegraphs, and has written the manual by order of the Director-General, so that the staff may have a means of self-education in practical telegraphy, and a primer and companion to the departmental "testing instructions" ; that probationers may have a textbook for their instruction, and as a book for ready reference by those engaged in the service. It is based on the substance of papers on technical subjects set by the author at the general examinations of the Indian Telegraph Department, and includes a general description of those batteries, instruments, and circuits with which the telegraph official may have to deal, their faults and the remedies ; the conservancy and modes of testing lines, &c. ; the electrical phenomena which interfere with working, and, in short, the whole art of telegraphy. Unnecessary details are omitted ; but principles are explained fully, and in language which will be found intelligible by all classes of readers.

We have also received *The Mathematical Theory of Electricity and Magnetism*, by H. W. Watson, D.Sc., F.R.S., and S. H. Burbury, M.A. (Oxford : the Clarendon Press), which is Vol. I., dealing with electrostatics, and is intended as an introduction to, or commentary upon, Maxwell's "Electricity and Magnetism." It states the provisionally-accepted two-fluid theory, and develops it into its mathematical consequences, regarding it, however, simply as an hypothesis.——*A Handbook of Practical Telegraphy*, by R. S. Culley (London : Longmans) is the eighth edition of this well-known textbook, which at this period in its life needs no commendation. The author expresses his great obligations to Mr. Graves and Mr. Preece for help in bringing the present edition up to date. ——*Gas Works*, by Samuel Hughes, revised and rewritten by William Richards (London : Crosby Lockwood and Co.) is the seventh edition of the well-known treatise in Weale's series.——*The Boiler-Maker's Assistant*, by John Courtney, revised and edited by D. K. Clark (London : Crosby Lockwood and Co.), is the second edition of a work which is useful to sheet-metal workers generally as well as to boiler-makers.——*Elementary Principles of Carpentry*, by Thomas Tredgold (London : Crosby Lockwood), is the well-known "small Tredgold," to which has been added a treatise on Joinery, the whole edited by E. Wyndham Tarn, M.A., and in this, the fourth edition, revised and extended, the new rules for finding the scantlings of the timbers of floors and roofs have been taken from the larger work.——*On Light*, by G. G. Stokes, M.A., F.R.S. (London : Macmillan and Co.), is the second course of Burnett Lectures delivered at Aberdeen in 1884, and deals with "Light as a means of Investigation." Workers with the polariscope and the spectroscope will be pleased to have Prof. Stokes's lectures in this handy form.——*Arithmetical Physics, Magnetism and Electricity*, by C. J. Woodward, B.Sc. (London : Simpkin, Marshall and Co.), is a useful book to students.——*The Art of Boot and Shoemaking*, by John Bedford Leno (London : Crosby Lockwood and Co.), is a practical handbook, which includes measurement, last fitting, cutting out, closing, and making, together with a description of some of the most approved machines. It will be found interesting even by those who do not wish to learn the art presided over by St. Crispin.——*Illustrated Lectures on Ambulance Work*, by R. Lawton Roberts, M.D. (London : H. K. Lewis), is a collection of lectures delivered at sundry collieries and ironworks, which should be in the office library at all such places, or wherever accidents are not unlikely to occur. If only one person at such places is acquainted with what may be termed "ambulance work," he can often do much to assist in saving life.——*Handicraft for Handy People*, by an Amateur Mechanic (Dublin : Gill and Son), is a useful book for those who wish to do things for themselves.——*Wrinkles in Electric Lighting*, by Vincent Stephen (E. and F. N. Spon), is intended to give engineers on shipboard some idea of the manner in which electricity is produced by mechanical means and converted into light. It will be useful to anyone who wants to understand the main features of electric lighting.——*A Practical Guide to French Polishing*, by a Practical Man (London : Wyman and Sons), is the best work on the subject : it is really practical, and deals with graining, staining, japanning, and other processes which come within the every-day work of the furniture builder. ——*The Marine Steam Engine*, by Richard Sennett, R.N. (London : Longmans), is the second edition of a work which met with a cordial reception when first published three years ago. The demand for the second edition came somewhat unexpectedly upon the author, and he has been unable to revise the work to any great extent ; but he has added information on triple expansion engines, closed stokeholds with forced draught, &c. It is an excellent treatise for engineering students and officers of the royal navy. ——*The Art of Soap-making*, by Alexander Watt (London : Crosby Lockwood), is the second edition, carefully revised, of a work which undoubtedly supplied a want, as is evidenced by the fact that the first edition has so soon been sold. We reviewed it at length in Vol. XXXVIII., p. 527.——*Practical Histology and Pathology*, by Heneage Gibbes, M.D. (London : H. K. Lewis), is the third edition of this well-known manual, which appears with a considerable quantity of new matter. The staining methods given are those most useful for the work of the present day.——*Solutions of the Questions on Magnetism and Electricity*, by F. N. Levander (London : H. K. Lewis), is the second edition of a useful little work, which gives solutions to the questions set during the last quarter of a century at the intermediate and preliminary examinations of the University of London.—*Practical Chemistry*, by W. Ripper (London : W. Isbister, Limited) is the second edition of a textbook for students preparing for the examinations in chemistry.——*The Ocean*, by William Leighton Jordan (London : Longmans) is the second edition, abridged and revised, of the author's treatise on ocean currents and tides and their causes, demonstrating the system of the world. Book X., which formerly professed to offer suggestions only, now contains demonstrations of the subject.——*Interior Decoration*, by Fred Miller (London : Wyman and Sons) is a practical treatise on surface decoration, with notes on colour, stencilling, and panel painting, which will be useful to professional decorators and amateurs).——*Researches on Solar Heat*, by S. P. Langley (Washington : Government Printing Office) is the report of the Mount Whitney Expedition undertaken by the director of the Allegheny Observatory, the principal features of which have already been made known. The official report is a credit to all concerned, and to the U.S. Government, which does not consider that a scientific research has been properly completed until a full report has been published.——*The Organ : its Compass, Tablature, and Short and Incomplete Octaves*, by J. W. Warman, A.C.O. (London : W. Reeves), is the first written of a series of departments, which are designed to form a comprehensive treatise on the construction, &c., of the organ. Our readers are already familiar with Mr. Warman's style of treating his subject, and know how elaborately and exhaustively he deals with every point in the construction of the organ.——*British Cage Birds*, *Book of the Goat*, *Fancy Pigeons*, *Poultry for Prizes and Profit* (London : L. Upcott Gill), are parts of nicely-printed and freely-illustrated handbooks, which cannot fail to be useful to those interested in t subjects named. The "Book of the Go will be especially welcomed, as it gives p cal directions for the ma goat, an animal which h glected.——*The Practi* by Jas. P. Knigh

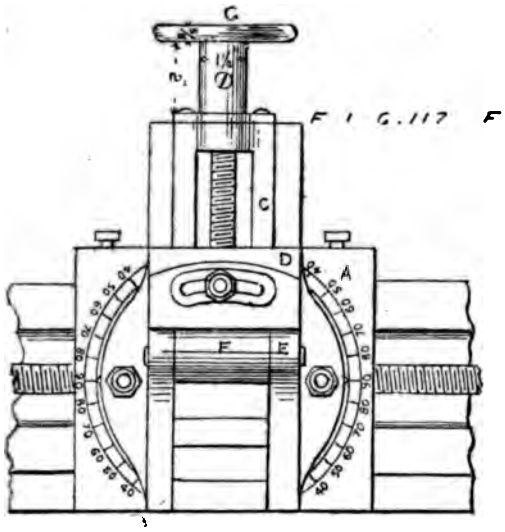


FIG. 117

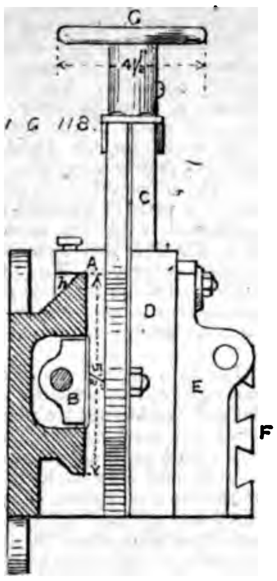


FIG. 118

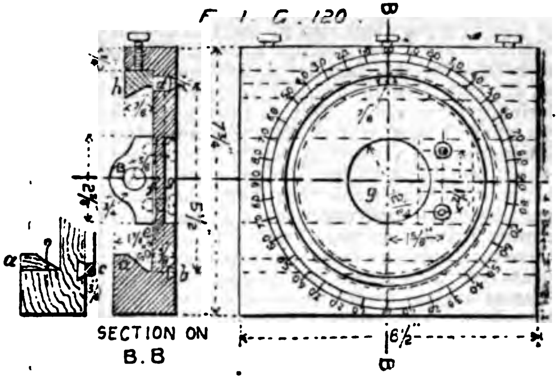


FIG. 120

SECTION ON B.B

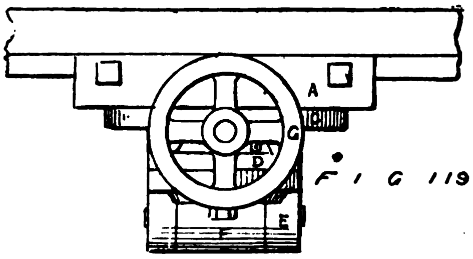


FIG. 119

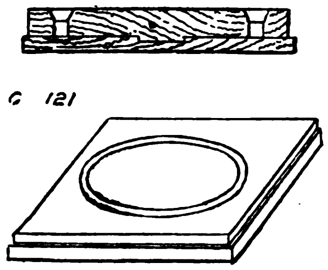


FIG. 121

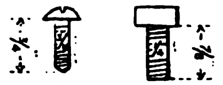


FIG. 134. FIG. 132.

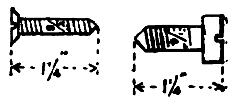


FIG. 131. FIG. 133.

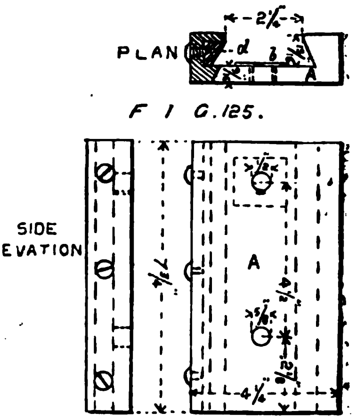


FIG. 125.

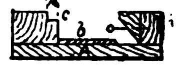


FIG. 126.

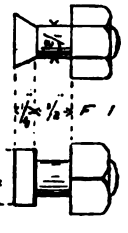


FIG. 122

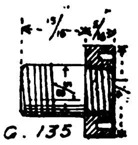


FIG. 135

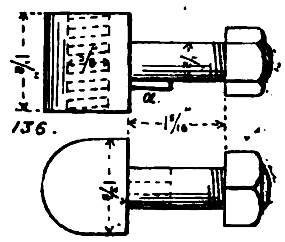


FIG. 136.

FIG. 130

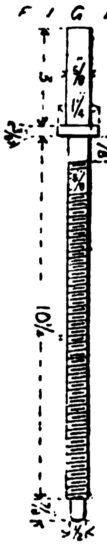


FIG. 137

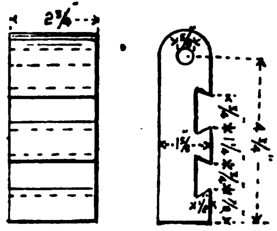


FIG. 129.

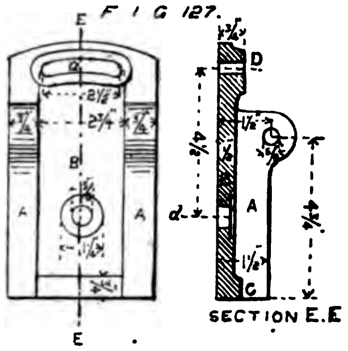


FIG. 127.

SECTION E.E

FIG. 128

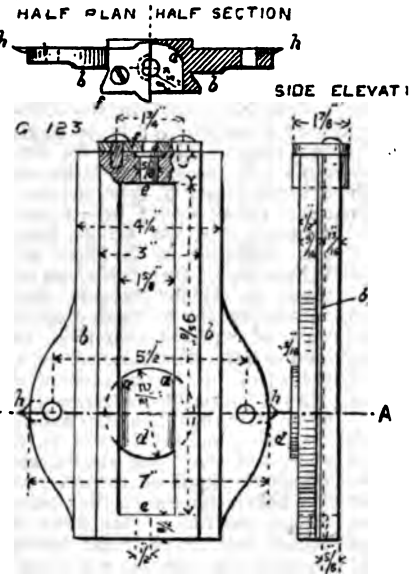


FIG. 123

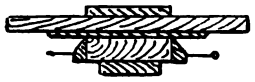


FIG. 124

Marshall, and Co.) is a new edition of a little work which we noticed some years ago. It is now in its 48th thousand, a fact which sufficiently testifies to its merits.——*The Car-Builder's Dictionary*, by M. N. FORNEY (New York: *Railway Gazette* office), is a revised and enlarged edition of a comprehensive manual of car-building, in which every part, to the minutest detail, is illustrated and described.

WE have also to acknowledge *On the Sensa-* [illegible] *of Tone*, by H. L. F. HELMHOLTZ, [illegible] lated by A. J. ELLIS, B.A., F.R.S. [illegible]: *Draught*, by W. PHILIPSON [illegible] Co.); *First Year of Scientific* [illegible] BERT (R[illegible]); [illegible] *Gas Analysis*, by CLEMENS WINKLER, translated by G. LUNGE (John Van Voorst);—most of which will be noticed at greater length than is usual in this column.

THE AMATEUR WORKSHOP.—XII.

Planing Machines—Tool Boxes (*continued*).

THE tool box here figured is the one which I have designed and proportioned for use with our special machine. Here, as, indeed, in most of the other portions of the work, good and clean castings are absolutely essential, not only because there are considerable straining forces at work, but because all parts have to be filed or planed true and bright. The iron-moulder should be informed of the use to which these [illegible] have to be put, so that he may make special provision for casting them free from scabs and blow-holes.

Before making the patterns we must settle whether the bearing-faces are to be planed or filed. If filed, the allowance must be curtailed as much as possible, in order to save unnecessary labour. I should not allow more than $\frac{1}{32}$in on any face for filing, since the work of trueing up a large surface by the aid of a file alone is immense. Also the stuff in the patterns must be taken altogether out of winding, and gauged, and even calipered with the utmost care, since it is vastly easier to manipulate the wood than the metal. But if the parts are to be planed, it is necessary to allow more than the $\frac{1}{32}$in. filing allowance, say $\frac{1}{16}$in., if the metal is to be reduced in a hand machine, a bare $\frac{1}{8}$in. or $\frac{3}{16}$in. if in a power machine.

Having premised thus much, I shall leave my readers to make their own allowances accordingly, for filing or planing, as the case may be, and it will simplify the details to follow if it be understood that all dimensions given in the engravings and also in the text are the *finished sizes* of the castings after they have been fitted together, and not pattern dimensions at all, even though I quote them when describing the patterns. Thus, if I say a plate is ¼in. thick, I mean it is of that thickness after filing or planing, while in reality the pattern would be ^{1}in. or an ⅛in. thicker. And an examination of the views will show what parts must be fitted, and which do not necessarily require fitting allowance. Practically, however, there is no portion whatever of a tool box which is not got up smooth and bright, either for bearing surface or for appearance sake. But the distinction consists in this: that parts which have to fit and slide over one another must be kept to dimensions, while those which are not bearing surfaces, and are only polished for the look of the thing, are not so particular as to size.

Take the saddle-plate which fits the cross-slide (Figs. 117 to 119, A, and Fig. 120) first. Its pattern is made like the casting, with these exceptions:—the bevelled strip, *a a*, is loosely wired on, and the V-shaped slot, *b b*, is cored out. The print *c* for the slot may be ⅝in thick, and its core-box is shown in perspective and in section in Fig. 121. A hole will be put anywhere in the back (Fig. 120, *d*), in the circle of the slot or groove for the sliding in of the bolts, Fig. 122. A plain oblong core box ¼in. by ⅝in. by $\frac{7}{16}$in. will be provided for this core, which will be fastened by the moulder upon the ring core when the latter is dropped in its place.

The object of putting on the thin facings *e e* is to save unnecessary fitting across that portion of the saddle which falls between the faces of the cross slide. A narrow strip, *f*, is allowed to bridge across wide enough only to take the screw nut B, Fig. 118, 120. The stud recess *g* may be bored out in the pattern to nearly the finished size.

The vertical guide, Figs. 117 to 119, C, and Fig. 123, has its vee's skewered on as usual, and moulds with its outer or front face downwards; the print for the coring out of the internal recess for the screw (coring being preferable in this instance to cutting out the pattern) is put upon that face. A section of the pattern, Fig. 124, taken on the line A A; compared with the dimensions on the figures will render description unnecessary. The box is perfectly plain, being rectangular in form, its dimensions being 9⅝in. by 1⅝in. by 1⅞in., plus the thickness given to the print. As the presence of the hollows *a a* behind the stud is desirable, they had better be put either upon a bottom board dowelled to one face of the box, or against the box sides in a position corresponding with that of the stud. The thin strips *b b* beside the Vee's, are for readier fitting of the vertical slide.

The slide, Figs. 117 to 119, D, and Fig. 125, is a plain plate whose pattern is shown in section in Fig. 126. A is the plate; *b*, a facing to take the nut for the vertical screw; *c* a print to carry a plain rectangular core for taking out the space for the loose strip *d*; the method of fitting usually adopted in vertical slides whereby a close fit is obtained without jamming in the angle. The core-box with ¾in overhang of print will measure 7¾in. by 1¼in. by ¼in.

The slewing plate, Figs. 117 to 119, E, and Fig. 127, requires two sides A A, and a back B to the dimensions given. Also a stop strip C, and a facing, D, a print and core-box for the curved slot *a*, for the tightening bolt. The core-box is shown in plan in Fig. 128, and its thickness is, of course, equal to that of the print and pattern together. No other holes are cast in.

The tool box, Figs. 117 to 119, F, and Fig. 129, is cut from a solid bit of stuff, and the vee-shaped slots are made by cores, for which prints and a box, whose sectional shape is that indicated in Fig. 130, is used.

A plain pattern of the hand-wheel, Figs. 117 to 119, G, cut from a solid bit of mahogany, completes this portion of the work. The castings will weigh 49lb., and should cost 15s. or 16s. per cwt.

Let us commence our fitting at the saddle-plate. This can be brought to a fit with the cross slide first, by filing or planing; the trued surfaces being then employed for the purpose of chucking while the front face, the groove, and the stud-hole are turned. Or its face might be turned in the first place, and that bolted then to the table of a planing or shaping machine while the facing strips and Vee's are being planed. Whichever method is adopted, the chief aim is to insure that the two faces shall be quite parallel with each other. Also the groove *b*, and the stud-hole *g*, must be truly circular and concentric, and while in the lathe three lines will be run round for the divisions into degrees (every tenth degree only being marked on the figure). The adjustable strip (Figs. 118, 120, *h h*), made of a piece of wrought iron, for strength, is attached with the countersunk screws shown in Fig. 131, and tightened with the square-headed set screws, Fig. 132. The saddle must be moved along the slide from end to end, and finished to a fit by scraping; as, indeed, must all the bearing surfaces of the tool box.

In the division into degrees the zero point will be at exact right angles with the edges of the cross slide, and is obtained by placing the saddle in position and marking the line down from the edge of a long and true square, checked first from one side, and then from the other. The outer and the top and bottom edges of the slide will be filed and polished with reasonable exactitude for appearance sake. A nut, B, is wanted at the back of the slide to carry the screw. This is attached with two cheese-headed screws, as shown in Figs. 120 and 133. It may be cast in gunmetal. The thread for the transverse screw into which it takes had better not be cut yet.

The vertical guide, Fig. 123, comes next. Here we have parallel, faces, and Vee'd edges to get true, involving even more trouble than the saddle, so that templets and calipers must be brought into constant requisition. The back of the guide, with its stud, must be turned in the lathe, a little extra facing having been allowed there when making the pattern. Two holes will be drilled to 5½ centres, Figs. 117, 123, for the tightening bolts, Figs. 122, with which the stud *d* must be exactly concentric. Holes will be drilled at top and bottom, *e e*, for the screw. These last can be drilled either on the table of a machine when clamped to an angle plate, or, better still, in the lathe, a drill being held in the slide-rest, and the work being attached to an angle plate on the face chuck. The recess for the collar of the screw will also be bored at the same time, with a turning tool if done in the lathe, with a small cutter driven into a cutter-bar whose diameter fits the drilled hole, or with a pin drill, if it is done under a drilling machine. Over this recess comes the cover plate, *f f*, which prevents the screw from moving in the vertical direction. This is a plate of wrought iron (Fig. 123, half-plan), having a ⅝in. hole in its centre, and screwed to the top of the vertical guide with countersunk or with button-headed screws (Fig. 134). The cover plate should not be jammed down upon the collar, but should rest on the top of the slide, and the collar should work freely, but without backlash on the reversal of the screw. The hole in the end of the casting which is to receive the foot of the screw is a plain ⅜in. drilled hole, bored right through from the outer face, and its centre is exactly in line with that at the collar end. This hole could be dispensed with altogether, and the lower end of the screw be without a bearing; but it is better to have it there. The pointers, *h*, *h*, are cut from thin steel, fitted into recesses chipped out of the back of the plate and screwed in place with small stove screws.

The vertical slide is fitted over the guiding vee's with a loose strip tightened with button-headed screws (Fig. 125).

The fit of these parts must be as good as it is possible to attain. The time occupied with this work will well repay itself afterwards. The swing plate (Fig. 127) must bear well and closely against the surface of the vertical slide. The plate will swivel on the slide at the centre *d*, and the two will be connected there with a stud (Fig. 135) screwed tightly into the slide, and passing through the plate to receive a circular nut, which nut is sunk into a recess to a sufficient depth to clear the hinged plate, the nut having a couple of holes drilled in its face to receive a forked spanner. When the plate and slide are pivoted, the centre of the tightening bolt (Figs. 117 to 119 and Fig. 136) may be marked from the slot cast in the hinge plate, and a hole drilled in the slide to receive the steel forging (Fig. 136), which becomes the nut of the elevati and the tightening bolt of the hinged sunk feather, *a*, prevents the nut fro ing the screw when it is tightened up. I in diameter, are drilled in the lugs, wi the hinge pin is to make a moderat fit. This is simply a plain turned rod fitting tightly in the hinge plate and the tool-holder. The latter is made to between the lugs, and after its hole and the pin inserted, look to its beari bottom strip of the hinge plate, and eas where necessary. The elevating screw in Fig. 137. It is made of steel, and square-threaded; but it would ans ciently well if cut V-shaped with an screw-plate. The screwed and plain p their dimensions, are indicated clea figure.

Too much emphasis cannot be lai necessity of constant recourse bein square and calipers during the progr work. If the thicknesses vary, or the at other than exact right angles, the w the machine is intended to produce accurate, and the box itself will furt the eye by its unsightliness. The worl is as great as that in a plain slide-re is, after all, not so difficult as it is ti requiring much patience and care i still a task within the capabilities of are not trained mechanics.

ON SOME MATTERS IN THE

OF MIRRORS.—IV.

By W. BRADBURY.

(*Continued from p.* 423, *Vol.* XI.

§ 6 TO find the aberration of mirror, we may either go calculation similar to that in § 5: suitable alteration in (26): the lat most convenient plan. By an ins Fig. 4, p. 402, it will be seen that th ray D B, the radius, and principal measured in the same direction; t front of the mirror. In the case of mirror, let us suppose the incident measured in a direction from left to thus fall on the convex face A B: it represent the case of the secondary m Cassegrain. By changing the sign of the equation becomes applicable to s of reflection. We have then—

Focal equation for diverging rays cave mirror as in (26), but with v in term as in (27).

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} + \left(\frac{1}{v} - \frac{1}{2f}\right)$$

Corresponding aberration—

$$-\left(\frac{1}{v} - \frac{1}{2f}\right)^2 \frac{v^2y^2}{2f}$$

Focal equation for diverging rays vex mirror—

$$\frac{1}{v} = \frac{1}{f} + \frac{1}{u} + \left(\frac{1}{v} - \frac{1}{2f}\right)$$

Corresponding abberation—

$$-\left(\frac{1}{v} - \frac{1}{2f}\right)^2 \frac{v^2y^2}{2f}\cdots$$

By employing the value of a, as in of these aberrations is expressed by—

$$-\left(\frac{a}{1-a}\right)^2 \cdot \frac{y^2}{2f}$$

The latter formula is not of much u (30) may be further simplified and following result:

$$-\left(2 - \frac{v}{f}\right)^2 \frac{y^2}{8f}\cdots\cdots\cdots$$

To my mind, this is the most usef teresting aberration rule: because t factor represents the error for par while the first part shows the ratio vergent bears to the parallel aberr fraction $\frac{v}{f}$ is, of course, alwa unity; and the less its value, the ratio between the two species of

§ 7. Having now obtained the errors of reflection fo rays may be computed, it study their relation to that an equation may be found, which shall represent a balance of positive and negative errors. This is a very difficult subject, and I cannot hope that my treatment of it will be found anything like satisfactory in practice. It is one thing to calculate an error, due to a certain kind of reflection, but quite another matter to say when two such errors shall effect a mutual compensation; especially when such compensation must take place at a distance from two surfaces, which are themselves at a considerable distance apart. In a paper in one of the back volumes, I have touched upon this subject; and though a result is reached, which has apparently been found satisfactory as a practical ratio of foci, I am far from being convinced that the analysis there given rests on a sound basis. In the present case I have adopted a different course; because, after mature consideration, I look upon it as more clearly representing the actual conditions under which the errors arise.

If the rays are to be finally brought together free from error, it seems clear that the aberration of a ray, considered as travelling back from the final focus to the small mirror, should, after this reflection, have the same amount of error as a parallel ray, reflected by the large mirror on to the small one. In other words, the error of the small mirror for diverging rays coming from the compound focus, must equal the error of the large mirror for parallel rays. If this is not the case, it is difficult to see how the course of a ray traced either way can be the same; which it evidently should be if no error is to arise at their final union. This is the basis on which I rest my present analysis, whether rightly or wrongly must be left for others to decide.

Representing the semi-aperture and focus of the large mirror by Y and F, and those of the small mirror by y and f, and v being the distance C D in Figs. 2 and 3 (thus reversing its value for C D has been previously represented by u), we have for the balance of errors—

$$\frac{Y^2}{8F} = \left(2 - \frac{v}{f}\right)^2 \frac{y^2}{8f} \quad\ldots\ldots\ldots\ldots (32)$$

The first part is the parallel aberration, the second the vergent aberration; but if we choose to disregard their actual values, we may reject the 8 in each denominator, and the y^2 in the numerators may be got rid of as follows. From the diagrams it will be seen that these quantities, which represent the semiapertures of the mirrors, are directly proportional to the distances B C and C D, or F and v. Hence, substituting these in the above equation, we eventually get—

$$F = \left(2 - \frac{v}{f}\right)^2 \frac{v^2}{f} \quad\ldots\ldots\ldots (33)$$

This is an equation which is not likely to be satisfied. In the Gregorian telescope, it is not worth while to pursue the subject further, because the aberrations of both mirrors are similar in character and similarly disposed, and therefore, cannot in any case effect a correction. But with the Cassegrain, the error of the second mirror is of the kind required; let us find whether it can be made powerful enough to balance the error of the great speculum.

§ 8. To do this it is necessary to employ the auxiliary quantity a previously mentioned. We have—

$$\frac{1}{v} = \frac{1}{f} + \frac{1}{u}.$$

$$\text{Let } \frac{1}{v} = \frac{1-a}{2f}; \text{ then } \frac{1}{u} = -\frac{1+a}{2f}.$$

Now, in the Cassegrain arrangements of mirrors, a has certain limiting values, between which it must lie. Thus, when $v = f$, the final rays are parallel, and in this case $a = -1$, which is the lower limit. Next, if $v = \frac{f}{2}$, $a = -3$; this may be taken as the upper limit, because the rays come to a focus at a distance equal f in front of the small convex, which is a position they cannot have to be serviceable as a telescope. Hence, in the final equation, a must have a negative root lying between 1 and 3.

Introducing the value of a in (33), and using ratio $\frac{F}{f}$, we have—

[illegible]

the vertex of the large mirror. This may not be its exact position in practice; but it is not far from it, and no advantage can be gained by removing this point far behind the great mirror. Under these circumstances, we shall have $a + v = F$, therefore—

$$F = \frac{2f}{1-a} - \frac{2f}{1+a} = \frac{4fa}{1-a^2}.$$

This gives another value for x, viz:—

$$x = \frac{4a}{1-a^2}.$$

Comparing the two values of x—

$$\frac{4a}{1-a^2} = \frac{16a^2}{(1-a)^4}.$$

We get a cubic equation,

$$a^3 + a^2 + 7a - 1 = 0.$$

Substitute first -1 and secondly -3 in this equation.

When $a = -1$, value of equation $= -8$
„ $a = -3$, „ „ $= -40$.

Hence it appears that neither of these values, nor any value between them, can satisfy the aberration equation; and we conclude that in no case can two spheric mirrors, arranged as in a Cassegrain, *completely* balance each other's aberrations. The only equation, therefore, that is of any service is (32), from which we may calculate the spheric error of each mirror, and thus determine how much the aberration of one or other of them must be increased, or diminished, to effect a balance.

Let us assume that the large mirror of a Cassegrain has an aperture of 10in. to a focus of 60in., and we desire to compare the spheric errors when convexes of different foci are used. In each case the final focus is understood to be at the vertex of the great mirror.

In this case Y = 5, F = 60. Therefore,

$$\text{Parallel aberration} = \frac{Y^2}{8F} = \frac{25}{480} = \cdot 052.$$

1st. Assume the small convex to be one-third the focus of the large concave, or $f = 20$.

To find C D or v (Fig. 3). By the rules in § 4, when $r = \frac{1}{3}$, $BD = F \times \cdot 7675$,

Hence CD or $v = F(1 - \cdot 7675) = 60 \times \cdot 2325 = 13\cdot 95$.

$$\text{and } y = Y \cdot \frac{v}{F} = \frac{5 \times 13\cdot 95}{60} = 1\cdot 16.$$

$$\therefore \text{Vergent error} = \left(2 - \frac{v}{f}\right)^2 \frac{y^2}{8f}.$$

$$= \left(2 - \frac{13\cdot 95}{20}\right)^2 \frac{1\cdot 34}{160} = 1\cdot 695 \times \cdot 008 = \cdot 0135.$$

Hence it appears that the error is little more than one-fourth of what is requisite to correct the concave.

2nd. Let $r = \frac{1}{4}$, then $v = F(1 - \cdot 809) = 60 \times \cdot 191 = 11\cdot 46$.

$$y = \frac{5 \times 11\cdot 46}{60} = \cdot 955.$$

$$\text{Vergent error} = \cdot 0114.$$

Let $r = \frac{1}{5}$, then $v = F(1 - \cdot 8385)$

$$= 60 \times \cdot 1615 = 9\cdot 690$$

$$y = \frac{5 \times 9\cdot 69}{60} = \cdot 807$$

$$\text{Vergent error} = \cdot 0096.$$

§ 9. These results show that by increasing the ratio of the foci, the less becomes the corrective power of the convex. For the shorter the focus of the convex, the more nearer parallelism must be the state of the rays when they leave it. Equation (32) enables us to infer that the power of the small mirror is very inadequate to compensate the error of the larger one; for the first factor can never be large (always less than two), and even if we suppose $\frac{Y}{F} = \frac{F}{f}$, and make the first factor two, we have:—

Error of 1st mirror : Error of 2nd : : Aperture of 1st : Twice aperture of 2nd.

so that a large margin of positive error must remain in any case.

The fact must not be lost sight of, that the surfaces are supposed to be perfectly spherical in each case, and therefore the errors are those due to spheric aberration. But we may have aberration from surfaces which are not parts of spheres; and it will vary in amount according to the nature of the curvature. Evidently such surfaces must enter into the construction of a reflecting telescope, which shall give perfect definition; for no two spheres can be arranged so as to cause a balance of aberration. But it is well known, that to get a perfect spheric curve, is quite as difficult a task, perhaps more so, as to work to any other definite curvature: so that it is not improbable, that the matching of two mirrors is not so troublesome as it would have been, had they both required to be perfectly spherical.

The foregoing theoretical considerations do not assign any particular ratio of foci as preferable to another, so that it seems practice alone must decide that question. Dr. Royston-Pigott gives 5 as a suitable number; but I notice he mentions the use of other focal proportions as well.

§ 10. I copy from my notebook the following table; but I am not able to say with certainty what book I found it in; most probably it was Dr. Kitchener's book on "Telescopes." Its heading is the following:—

Table of Dimensions of Short's Gregorians and Cassegrains, according to the Computations of Dr. Smith:

GREGORIANS.

Focus of large mirror.	Aperture.	Aperture of small mirror.	Focus.	Distance apart.	Distance of large mirror from plane side of first eye-lens.	Focus of first eye-lens.	Focus of second eye-lens.	Separation of first from second eye-lens.	Distance of second eye-lens from small eye-hole.	Diameter of stop in focus of eye-lens.	Magnifying Power.
5·65	1·55	0·31	1·11	6·78	1·76	2·45	0·81	1·63	0·41	0·27	40
9·60	2·30	0·40	1·50	11·25	3·36	3·13	1·04	2·69	0·52	0·35	60
15·5	3·30	0·50	2·15	17·84	3·95	5·97	1·31	2·63	0·66	0·44	86
36·0	6·26	0·65	3·43	39·72	1·44	5·12	1·71	3·41	0·85	0·57	165
60·0	9·21	0·83	5·01	65·39	2·78	6·43	2·14	4·29	1·07	0·72	243
CASSEGRAINS.											
15·5	3·52	0·40	1·97	13·51	1·41	3·17	1·06	2·11	0·53	0·18	93
36·0	6·57	0·59	3·57	32·75	1·65	4·69	1·56	3·03	0·78	0·26	173
60·	9·61	0·77	3·17	55·21	2·97	6·06	2·02	4·04	1·01	0·34	253

These numbers show a much higher ratio between the foci of the mirrors than is common in the present time. In the shortest foci they are nearly as 5 to 1, and in the longest about 19 to 1 for the Cassegrain.

From the figures in the sixth column, it will be seen that the final focus was kept as close as convenient to the back of the large speculum.

§ 11. Having thus far confined our attention to spherical mirrors, and given rules by which their aberrations may be calculated, we must now proceed to consider the more complex cases of reflection in which conic surfaces are concerned. Calculations connected with these are very complicated and laborious, but, fortunately, it will not be necessary to go very deeply into the subject.

Theory can only form a sort of guide to the attainment of certain results; and so long as the practical man knows what kind of surface to aim at, its exact amount of compensating aberration is of little consequence in a case

FIG 2

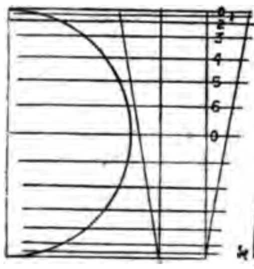


FIG. 1.

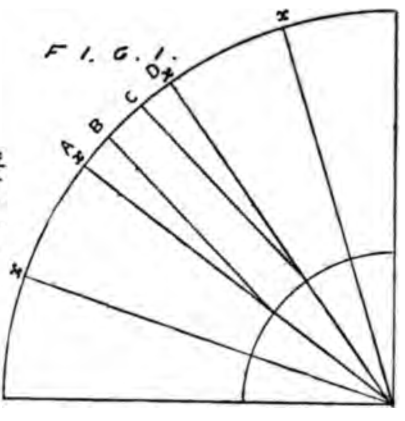
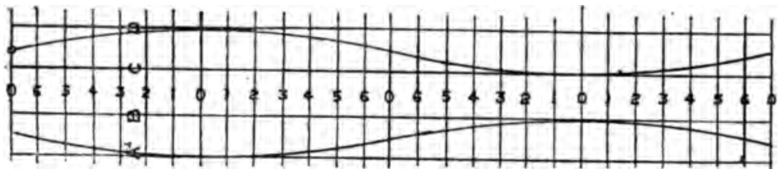


FIG. 3



where progress is ascertained, not by measurement but by frequent testing of focal appearances.

(*To be continued.*)

LAYING OUT SHEET IRON AND BOILER WORK.—V.*

The Goose-neck Elbow.

THIS, like the ordinary elbow, may be made at any angle desired. It requires a full-sized sketch, as shown in Fig. 1, the outer circle of which may be divided into as many equal parts as may be required, bearing in mind that the more pieces there are the nearer you come to a true curve; also bearing in mind that the more pieces you use the greater the cost. In this sketch the elbow is divided into five equal parts, all of which are shown; but in the centre piece we have an illustration of what the goose neck really is—a straight course, bevel on each side. In the central section the straight course is represented by the lines B and C, and the bevels A to B and C to D. In Fig. 2 we have a view of one section, if the same were rolled up and looking at the edge; this is shown in the half-circle which is divided into equal parts. The same figures also show a view of the same piece rolled up and looking at the side. The lines drawn across are identical with the divisions shown on circle.

Fig. 3 is a view of the developed piece, and the lines O, 1, 2, 3, 4, 5, 6, 0, &c., correspond with those shown on Fig. 2; the letters A, B, C, D, shown in each figure, refer to the straight course already referred to, and the bevels on each side. They are used when laying out the work as starting points from which to measure.

The principle used in laying out this piece so closely resembles those already illustrated that many of the readers will be able to develop without instruction, but for such as cannot do so the following explanation is given: The full-sized sketch already referred to having been made and divided, draw a half-circle equal in diameter to the pipe. Divide this into as many equal parts as you desire, as shown in Fig. 2, transfer a section of elbow to the vicinity of half-circle as shown, then draw lines from divisions across the side view of section.

It will be noticed that only one quarter of circle in Fig. 2 is used and numbered. The reason for this is explained by measuring from B to A on any of the lines. At wide end of section transfer your compass to corresponding line on narrow end, measuring from A to B, and the distance you will find is equal. As a consequence of this when your compass is adjusted you can mark off eight spaces with it, as on lines 1, from B to A and C to D, on each side of O, and on same numbers on narrow end from D to C and A to B. The developed piece, to complete, requires allowance for lap, as the lines shown are the centres of holes.

Having advanced as already directed, measure off on straight sheet the circumference measurement; divide into four equal parts, and each fourth into as many spaces as are shown in quarter-circle. Set compass on line 1 from B to A, or C to D, Fig. 2, and transfer distance as already directed to corresponding lines on Fig. 3. Proceed in like manner with other numbers, and your piece will appear as shown in Fig. 3, which is laid out as exactly as though intended to be used for actual work.

Efforts have been made to dispense with large and small courses in the formation of goose-neck elbows, but have not been generally adopted. One of them is based on tapering each piece; this requires too much time at the bench to prove successful. The other is to alter bevels by increasing length on one side and reducing on the other, so that a large and small end may be had on each piece. To an educated eye this elbow looks like a botch job; for this reason, I think, it has not been more generally used. It will be understood that the finished elbow will not have the exact appearance as shown in Fig. 1, from the fact that the pieces will be straight on top and bottom instead of curved as shown, but the utility of the work is only slightly diminished from this fact. This piece shown in Fig. 3 has the seam on the side. Joints are broken by placing seams opposite each other on the finished work. If it is desired to place the seam at any other point than that shown, it may be accomplished by changing the numbers on straight sheet; where 6 now is placed substitute 1, and in like manner with the rest of the figures, and the seam will be on top or bottom as desired.

ON PHOTOGRAPHING THE SPECTRA OF THE STARS AND PLANETS.*

By HENRY DRAPER, M.D.

FOR many years, it has seemed probable that great interest would be attached to photographs of the spectra of the heavenly bodies, because they offer to us conditions of temperature and pressure, that cannot be attained by any means known at present on the earth. The especial point of interest is connected with considerations regarding the probable non-elementary nature of the so-called elementary bodies. There has long been a suspicion in the minds of scientific men, that one or more truly elementary bodies would be found, from which those substances, which have not as yet been decomposed, are formed. The recent publications of Lockyer have attracted particular attention to this topic.

The most promising laboratory process, for accomplishing the dissociation of our present elements. depends upon the action of heat, especially when accompanied by electrical influences and upon relief of pressure. But the temperature we can employ is far below that found in the stars, which is comparable only with the heat of our sun, and when, in addition, the application of heat is restricted by the narrow range of circumstances under which we can also reduce the pressure, complete success seems to be impracticable in the laboratory.

But in the stars, nebulæ, and comets, there is a multitude of experiments all ready performed for us, with a variety of conditions of just the kind we need. It remains for us to observe and interpret these results, and this is the direction I have sought to pursue.

There is but one mode of investigation that can add materially to the knowledge astronomy has given us of the heavenly bodies; that is the spectroscopic. This in its turn is capable of a subdivision into two methods, one by the eye, the other by photography. Each of these has its special advantages and each its defects. The eye sees most easily the middle regions of the spectrum, and can appreciate exceedingly faint spectra; by the aid of micrometers it can map, with precision, the position of the Fraunhofer lines; and by estimation it can with tolerable accuracy approximate to the relative strength, breadth, and character of these lines. The character of the spectrum lines is, however, of great value for the purposes we are now speaking of, and the greatest precision is needed. Photography, on the other hand, as applied to faint spectra, deals mainly with the more refrangible region, and cannot at present be employed in stellar work below the line F. Fortunately, there is no break in the spectrum between the place where the eye leaves off and photography begins, and hence the two methods lend one another mutual assistance. The photograph, when suitably accommodated with a standard reference spectrum from some known source, gives valuable indications as to the positions and all the peculiarities of the lines.

But the application of photography to the taking of stellar spectra is surrounded by obstacles. These are partly due to the small quantity of light to be dealt with; and partly to the fact, that it is necessary to overcome the motion of the earth and other causes, such as atmospheric refraction, which seem to make a star change its place continually. The exposures of the sensitive plate require to be sometimes for two hours, even with a large telescope, and if during that time the image of the star at the focus of the telescope has changed place $\frac{1}{300}$ of an inch, the light no longer falls on the slit of the spectroscope. The changes of the earth's atmosphere in regard to photographic transparency, as well as by fog, offer impediments and promote the chances of failure. There is often a yellow condition of the air, which may increase the length of exposure required forty times or more.

It will, from what has been said above, be readily perceived that a research such as this consumes a great deal of time; in fact, these experiments and the preparations for them have extended over more than twelve years. A large telescope is required, and for many reasons the reflector at first seems most suitable. Recently, however, I have found that the refractor has also some special advantages.

In 1866, I had already constructed a silvered-glass reflector of 15½in. aperture, which was commenced in 1858, and had taken with it many hundreds of photographs of the moon. But as the mounting had been contrived for lunar photography, and to avoid the moon's motion in declination, the instrument was not suitable for the spectroscopic work contemplated. A reflector of 28in. aperture was therefore commenced in 1866, and in 1871 it was ready for use.

On May 29th, 1872, my first photograph of the spectrum of a star was taken, the spectrum of Vega being photographed by the aid of a quartz prism. At this time I did not happen to know that Dr. Huggins, who is so distinguished for his thorough and accurate researches on the visible portion of the spectra of the heavenly bodies, had already made some attempts in this direction, as is shown by the following paragraph from the Transactions of the Royal Society for 1864:—"On the 27th of February, 1863, and on the 3rd of March of the same year, when the spectrum of Sirius was caused to fall upon a sensitive collodion surface, an intense spectrum of the more refrangible part was obtained. From want of accurate adjustment of the focus, or from the motion of the star not being exactly compensated by the clock movement, or from atmospheric tremors, the spectrum, though tolerably defined at the edges, presented no indications of lines. Our other investigations have hitherto prevented us from continuing these experiments further; but we have not abandoned our intention of pursuing them."

During August, 1872, I took several photographs of the spectrum of Vega, and these showed four strong lines at the more refrangible end of the spectrum, the least refrangible being G. On pursuing the subject, and seeking to ascertain what substances gave rise to these lines, it became obvious that a photographic study of this part of the spectrum for the metals and non-metals was necessary to interpret the results. This, of cour opened out a large field for experiment, requi many years for its study, and as physicists were engaging in the of the metals, I concluded to d periments commenced in 18 metals, and to confine the the non-metals. The initi obtain a fine photograph of the normal solar spectrum, so that the wave-lengths of the lines up to O (wave-length 3,440) might be determined with precision.

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* By GEORGE MARSHALL, in *American Machinist*.

* The above paper forms Art. L. of the *American Journal of Science*, to which it was contributed by the late Dr. H. Draper. Though six years have elapsed since it was read before the American National Academy of Sciences (Oct. 28th, 1879), it contains matter which I believe will yet be new and interesting to many readers of the MECHANIC. This is the reason why I have taken the trouble to transcribe it verbatim.—O. V.

In the spring of 1873, I published a paper on the diffraction spectrum of the sun, illustrated by a photograph embracing the region from wave length 4,350 near G to 3,440 near O, and in the fall of the same year, took photographs of the spectra of several non-metals, notably nitrogen, carbon, and oxygen. The experiments were interrupted in the spring of 1874 by going to Washington to superintend the photographic preparations for the United States observations of the Transit of Venus.

Since that time my experiments have been divided into two parts, an astronomical portion occupying principally the summer season, and a laboratory portion during the rest of the year. The former consisted of photographs and observations of the spectra of the stars, planets, and sun; the latter of photographic work on the spectra of the elements, and particularly the non-metals, and has led to the discovery of oxygen in the sun.

In 1876, Dr. Huggins published a note in the Proceedings of the Royal Society, accompanied by a woodcut of the spectrum of Vega, with a comparison solar spectrum. Seven lines were observed in the spectrum of Vega. In the summer and autumn of 1876, I made several photographs of the spectra of Vega, α Aquilæ, and Venus, and sent a note concerning them to this journal *(Am. J. of Science)*.

Since that time, Dr. Huggins has pursued the subject actively in spite of the London atmosphere, and has attained very fine results, which I had the pleasure of seeing at his observatory last spring. These he is preparing to publish shortly. In my observatory photographs have been taken of the spectrum of Vega, Arcturus, Capella, α Aquilæ, Jupiter, Mars, Venus, the moon, etc. Recently the plan has been to have a comparison solar spectrum on every plate, derived either from diffused light of our atmosphere, or from the moon or from Jupiter. In this way no difficulty in determining the wave-lengths of the lines is encountered, and the changes produced by our atmosphere are eliminated. The telescope and spectroscope are now in good working order, but to secure the requisite degree of precision of movement, it has been necessary to make seven different driving clocks before a satisfactory one was attained.

It has been remarked that on account of the faintness of the light of stellar spectra prolonged exposures of the sensitive plate are required. In former times, when the dry processes of photography were much less sensitive than the best wet plates, the exposure was limited by the length of time the plate could be left in the camera, without being stained by drying. But now, since the gelatine bromide process has been introduced, this obstacle has been removed, and a sensitive plate is sometimes exposed two hours to the spectrum of a star, and then almost an hour to Jupiter for the comparison spectrum. The best and most sensitive gelatine plates I have used are those made by Wratten and Wainwright, of London; Dr. Huggins was good enough to call my attention to them.

It is not worth while to describe the various forms of spectroscope that have been employed in the last ten years. Quartz, Iceland spar, hollow prisms, and flint glass have been the materials, and they have been sometimes direct-vision and sometimes on the usual angular plan. Gratings on glass and speculum metal, given to me by Mr. Rutherfurd, have been tried. The length of spectroscope has been sometimes 28ft., and sometimes not as many inches.

The especial spectroscope for stellar work that is now on the telescope, is intended to satisfy the following conditions: (1) To get the greatest practicable dispersion, with the least width of spectrum that will permit the lines to be seen; (2) To use the entire beam of light collected by the 28in. reflector, or 12in. achromatic, without loss by diaphragms; (3) To permit the slit to be easily seen so that the star may be adjusted on it; (4) To avoid flexure, or other causes, that might change the position of the spectrum on the sensitive plate, in pointing the telescope first on one and then on another object; (5) To admit of observing the spectrum on the sensitive plate at any time during an exposure, without risk of shifting or disarrangement. The dispersion is produced by two heavy flint prisms, which are devoid of yellow colour. The telescopes are about 6in. in focal length, and the slit has a movable plate in front of it, enabling the operator to uncover either the upper or the lower portion at will.

During the past summer, this spectroscope has been used with the Clark refractor of 12in. aperture, partly because the 28in. reflector has been [illegible] [illegible]vered, since it was used in taking photo- [illegible] the Transit of Mercury, on account of its [illegible] certain experiments on the sun. [illegible] an advantage possessed by the [illegible] which does not ap[illegible] at [illegible]upposes that a [illegible] which brings all the rays from the star, no matter what their refrangibility, to a focus in one plane, would be the best; because when the slit is put in that plane, it is equally illuminated by rays of all refrangibilities, and the spectrum will be parallel sided in its whole length. On the other hand, a refractor is not achromatic; for the violet end of the spectrum comes to a focus, either inside or outside of the plane of the rays in the middle of the spectrum, and, in observing the spectrum, it is not parallel-sided. This peculiarity was used by Mr. Rutherfurd to enable him to correct a telescope lens for the ultra-red rays. It is easy, therefore, with a refractor so to adjust the position of the slit that you may have a spectrum tolerably wide at F and G, and which gradually diminishes in width towards H, and finally becomes almost linear at M. Now, as the effect of atmospheric absorption on the spectrum increases as you pass from G toward H, and above H by diminishing the width of the spectrum, you can in some measure neutralise the effect, and at one exposure obtain a photograph of nearly uniform intensity from end to end, though it is of variable width. If it were not for this it would be necessary to have the spectrum over-exposed at G in order to be visible above H, or else to resort to an elaborate diaphragming, which is difficult. It is my intention next season to return to the use of the 28in. reflector, because it collects nearly five times as much light as the 12in. does after making allowance for the secondary mirror. Of course, in a large reflector the difficulties of flexure and instability of the optical axis are much increased, and keeping a star on the slit will be troublesome, especially as the magnifying power on the image is about 50. As to the results obtained, it has already been mentioned that the spectra of several stars and planets have been photographed. The subject of planetary spectra will be reserved for a future communication. A preliminary examination at once shows that these stellar spectra are divisible into two groups—first, those closely resembling the solar spectrum, and, second, those in which there are relatively but few lines, and these of great breadth and intensity. The photographs of the spectra of Arcturus and Capella are so similar to the solar spectrum that I have not up to the present detected any material differences. But, on the other hand, the spectra of Vega and α Aquilæ are totally different, and it is not easy without prolonged study and the assistance of laboratory experiments, to interpret the results, and even then it will be necessary to speak with diffidence. I have not as yet obtained any stellar spectrum photographs belonging to the third and fourth groups of stellar spectra as described by Secchi. These, if obtainable, will aid materially in discussing the whole subject, but unless a star passes near the zenith, it is hard to make a fair study of its spectrum by photography, because atmospheric absorption in the ultra-violet region increases rapidly as the altitude decreases. In the case of the sun, I have found that at sunset the exposure necessary to photograph the spectrum above H is often 200 times as long as at mid-day.

In the case of the spectrum of Vega when examined by the eye, the lines C, F, and G and *h* are readily visible; but lines such as D and *b* are relatively faint. It is clear, then, that hydrogen exists to a large extent in the atmosphere of that star. But on examining the photograph of its spectrum, it is evident that other lines just as conspicuous as the hydrogen lines are present. One of these corresponds in position and character to H, and seems to coincide with a calcium line. It appears to me, however, that the evidence of this coincidence is not complete.

In attempting to reason from these photographs as the matter now stands, it is necessary to try at every step farther experiments in order to find out whether the facts agree with hypothesis, and it is this very condition of affairs that gives hopes of results valuable in their bearing on terrestrial chemistry and physics.

In the photographs of the spectrum of Vega there are eleven lines, only two of which are certainly accounted for, two more may be calcium, the remaining seven, though bearing a most suspicious resemblance to the hydrogen lines in their general characters, are as yet not identified. It would be worth while to subject hydrogen to a more intense incandescence than any yet attained, to see whether in photographs of its spectrum under those circumstances any trace of those lines which extend to wave-length 3,700 could be found.

It is to be hoped that before long we may be able to investigate photographically the spectra of the gaseous nebulæ, for in them the most elementary condition of matter and the simplest spectra are doubtless found.

BOLTS AND SCREW THREADS.

In a recent communication to the American Institute of Mining Engineers, Major King, of the Government Corps, again calls attention to the evident weakening of bolts by cutting coarse "standard" threads upon them, and gives some experimental proof of the great advantage to be derived from the use of a finer standard. As a rule, bolts are the weakest part of a structure, and they are at present further weakened by cutting away too much metal for the screw threads. When the thread is cut deeper than is required to prevent stripping, the bolt is weakened by precisely the same method that the blacksmith employs when he wishes to break a bar of iron or steel, only it is to be noted that the standard thread is cut even deeper than the blacksmith nicks his bars. The standard sizes for V-shaped threads are much too coarse for nearly all purposes, and the nuts themselves are out of all proportion to the strains put upon them, as the bolt invariably breaks long before the thread or nut would yield. In order to thoroughly verify these statements, Major King had three pairs of bolts made, having 6, 12, and 18 threads to the inch respectively. In all other respects they were entirely alike, being turned from bar iron 1¼ by 2in. square, so that no forging was required. When broken in a hydrostatic press, not a single nut showed signs of weakness, and the bolts with 18 threads to the inch showed unmistakably that they were the strongest, although they finally yielded by pulling out of the nut—not by stripping the threads, as is generally understood, but by drawing down the size of the bolt until the greater part of the threads were disengaged. The standard bolts broke at an average strain of 76,655lb., those with 12 threads at 92,991, and those with 18 threads at 94,248lb.; or, taking the tensile strength in connection with the stretch, they showed a relative work of 1, 2, 9, and 4.

Major King thus sums up the advantages of increasing the number of threads per inch: 1. At least 20 per cent. additional statical strength. 2. Three or four times the strenth to resist impact. 3. The finer lines are easier to cut. 4. They are less liable to work loose. 5. In many cases this practice will take the place of upset or enlarged bolt ends. 6. In such cases it would have the advantage of filling the hole, or, rather, it would avoid the necessity of making the holes larger than the body of the bolts. 7. There will be a saving of 50 to 60 per cent. in weight of heads and nuts, also in cost. 8. Bolts may be placed closer to angles in structures without chipping out for head or nut. He mentions among the disadvantages the cost of changing taps and dies; the additional time required to put on or remove nuts, which, of course, is hardly worthy of notice; and the greater loss in strength from wear and rust of surfaces of thread. In some cases, such as the bolts which secure the cylinder heads of a steam engine, the coarse thread will probably be preferable; but for all other ordinary uses the finer thread seems undoubtedly the more desirable. In establishing a new standard, it is suggested that instead of introducing such complications as fractional threads to the inch, whole numbers be agreed upon for each quarter inch of bolt diameter, and that each of the intermediate sizes of bolts have the same number of threads as the bolt next below it in size.

SCIENTIFIC SOCIETIES.

WESTERN MICROSCOPICAL CLUB.

On Monday week this club met at the house of Dr. J. L. W. Thudichum, F.R.C.P. The subject for the evening was that of "Medico-legal and Chemical Microscopy." To this the host has devoted no small amount of attention. In dealing with suspected bloodstains it was pointed out that the microscope is incapable of distinguishing human corpuscles that have once been dried from those of some domestic animals; it is only capable of saying that the blood is that of a mammal. Chemically, by the production of the hæmin colouring matter, we can diagnose just as much. An instance was given in which a clot of blood 65 years old gave the characteristic reaction. Dr. Thudichum considered that the micro-spectroscope had no advantage over the ordinary spectroscope, since both required the same amount of material to produce definite results. He pointed out that in toxicological cases an "absolute method" should exclude all sources of error; hence, in searching for arsenic or antimony, Marsh's test should be used and not Reinsch's. The microscopical detection of octahedral crystals is merely a confirmation of the presence of arsenic, but not diagnostic, since other substances produce similar crystals. In all cases chemical tests should be relied upon. Crystalline form is not trustworthy evidence, for it frequently happens that these forms are determined by impurities present, so that often the substance in its pure form cannot be made to crystallize at all. Even when substances formed definite crystals, these vary in appearance according to the mass of the substance used, the heat, and other circumstances. That it is not sufficient merely to determine the presence of a poisonous body Dr. Thudichum evidenced by the production of four samples of aconitine, all of different strengths, one being 700 times as powerful as another. The microscope was especially useful in the preliminary stages of an inquiry; thus, in dealing with 1,500 ox brains, he had found it invaluable in preparing phrenosine from these.

Dr. Thudichum's remarks were well illustrated with specimen and microscopical slides, a demonstration with the oxycalcium spectroscope being given at the end. Various slides were exhibited by Messrs. Nelson and Swain. The next meeting of the club will take place on Dec. 7th, at the house of W. Crookes, Esq., F.R.S. To this meeting ladies are invited. The subject will be "Recent Results in Spectrum Analysis."

SCIENTIFIC NEWS.

We regret to announce the death, on Tuesday last, of Dr. William Benjamin Carpenter, M.D., F.R.S., in the 73rd year of his age, from accidental burns occasioned by the overturning of the lamp of a vapour bath. Dr. Carpenter was the son of Dr. Lant Carpenter, an eminent Unitarian Minister at Bristol, and was born at Exeter in 1813. He was educated at the Bristol School of Medicine and University College, London, and practised his profession for a short time in Bristol; but in 1843 was induced to come to London, and to devote himself to the cultivation of physiology, a science of which he may almost be said to have been the founder. A great crisis in Dr. Carpenter's life was his appointment, in 1856, to the office of Registrar of the University of London, an office which he held for 22 years. From this time his leisure was chiefly devoted to the study of the Foraminifera, on which he contributed papers of permanent value to the Royal Society and to the Ray Society; and to an examination of the results of the scientific expeditions, culminating in that of the *Challenger*, which were sent to undertake deep-sea dredging, and to investigate the causes and courses of ocean currents. In the scientific world Dr. Carpenter was held in high honour. He was a Fellow, and had been more than once Vice-President, of the Royal Society, from which he had also received the Royal medal for his physiological researches; was a Fellow of the Geological and Linnean Societies, and a member of many other learned societies. In 1872 he presided over the Brighton meeting of the British Association.

The death of Dr. Henry Greaves Bull, of Hereford, is announced, at the age of sixty-seven years. The deceased practised for many years as a physician in Hereford, and as a distinguished member of the Woolhope Club will be missed. "The Herefordshire Pomona" was completed by him only a few weeks ago; but it will remain as the best monument of his energy and scientific taste. Dr. Bull was an authority on fungi, and did much to teach the use of those which are esculent.

A small planet, registering as No. 252, was discovered by M. Perrotin from the Nice Observatory on the 27th ult.

Such reports of the eclipse of the sun of the 9th of September as have yet been received from New Zealand, state that some remarkable phenomena connected with prominences and protuberances were observed.

The annual report of the Board of Directors of the Chicago Astronomical Society, and of the director of the Dearborn Observatory, for 1885 has been received. Amongst the astronomical work we note the following observation of the companion to Sirius:—

1885·167; P.A. 32·7°; distance 7·96″.

Since 1880 the distance has diminished 2″ of arc, the rate being now a little more than 0·5″ annually. Jupiter was systematically observed, and four drawings are given, the latest bearing date May 15th, 1885, in which the great red spot is conspicuous. Prof. Hough says it could be readily seen with moderate optical power, the outline being the same as when first observed at Dearborn in 1879. He gives the mean rotation period of the planet, deduced from observations made between Sept. 1879, and June 1885 (2,104 days), as 9h. 55m. 37·40s.

We have received a reprint of Prof. S. P. Langley's paper on the Temperature of the Surface of the Moon, deduced from researches made at the Allegheny Observatory, in which he was assisted by F. W. Very and J. E. Keeler. The paper was presented to the National Academy of Sciences; but a note appended to it announces the fact that the authors did succeed in obtaining measures with rock-salt prisms and lenses in a lunar heat spectrum. They must, however, repeat them many times before complete results can be obtained. The inference at present is that the temperature of the lunar soil is, at any rate, below that of boiling water, and in an indefinite degree.

Mr. Latimer Clark has issued (E. and F. N. Spon) his useful "Transit Tables for 1886," which will enable anyone to obtain accurate time in any part of the world without calculation, provided he has a transit instrument, which is supplied in a cheap form in Clark's patent.

It is understood that Prof. G. G. Stokes will succeed Prof. Huxley as president of the Royal Society. The following is the list recommended by the council for election to the new council at the anniversary meeting on the 30th inst.:—Treasurer, Dr. John Evans; secretaries, Prof. Michael Foster and Lord Rayleigh; foreign secretary, Prof. A. W. Williamson; other members of the council, Prof. R. B. Clifton, Prof. J. Dewar, Prof. W. H. Flower, A. Geikie, Sir J. D. Hooker, Prof. T. H. Huxley, Admiral Sir A. Cooper Key, J. Norman Lockyer, Prof. H. N. Moseley, Prof. B. Price, Prof. Pritchard, W. J. Russell, Prof. J. S. Burdon-Sanderson, Prof. A. Schuster, Lieut.-Gen. R. Strachey, and Gen. J. T. Walker.

The Government Grant Committee of the Royal Society will meet in December, and applications for a share of the £4,000 must be sent to the secretaries of the society before the 28th inst., on forms to be obtained from the assistant secretary.

The second part of the Report of the Trinity House Committee on lighthouse illuminants has been issued, and contains a variety of useful information in the reports of the experts engaged in the late experiments. The details given in this part, with the charts, diagrams, plans, and tables, complete a work which is of scientific value. In one of the sections there is a table showing the duration of fog at lighthouse and light-vessel stations around the coasts, compiled from the records of four years; the average annual duration is 431h. 34m. (nearly 18 days).

The Royal Meteorological Society have appointed a committee to consider the question of the supposed diminution of water supply, and the suggested increase of floods. The committee is desirous of obtaining as much information as is available, and will be glad to receive any data that may be recorded in the notebooks of private observers. Information is especially requested relating to the period 1825-35, in order that a gap may be filled up in the diagram issued with the *Journal* for July last. All communications should be addressed to Mr. W. Marriott, the assistant secretary, at the offices of the Society, 30, Great George-street, S.W. At the ordinary meeting of the Society, to be held at 25, Great George-street (Institution of Civil Engineers), on the 18th inst. at 7 p.m., a paper, by Mr. W. Marriott, on "The Helm Wind of August 19, 1885," will be read, as will also papers on "The Typhoon Origin of the Weather over the British Isles during the 2nd of October, 1882," by Mr. H. Harries, and "Note on the Principle and Working of Jordan's Improved Sunshine Recorder," by Messrs. J. B. Jordan and F. Gaster.

In the last issue of the *Mineralogical Magazine* Mr. W. Semmons gives an account of a recent discovery of the rare mineral Connellite—a sulphato-chloride of copper, specimens of which are in the national collection at South Kensington and in the museum of Practical Geology. Connell observed this mineral in 1847, and Dana gave it a specific name in 1850, but since then it has not been found.

Two trains, propelled or drawn by electricity, will shortly be at work on the Ninth-avenue Elevated Railroad, New York, the motors being of Daft's make, and similar to those recently tried. It is proposed to lay down a line 12 miles long in Hamilton County, Ohio, and it is probable that electric tramways will shortly be established in Brooklyn and Pittsburg.

There is now approaching completion in a Brooklyn shipyard a launch or boat 100ft. in length, which is to be propelled by the explosive energy of compressed air charged with vapourised petroleum. The air is to be compressed to 500lb. on the square inch, and is to be stored in steel reservoirs. The mixture of air and hydrocarbon vapour is to be exploded in open-end cylinders running parallel with the vessel's planking, an electric spark being used to effect the discharge. It is calculated that 75 explosions per minute can be made. Steering and stopping are to be effected by exploding the mixture in cylinders placed near the stem, at right angles to the sides of the vessel.

Professor Schaer has found that weak solutions (0·5 per 1,000) of prussic acid and corrosive sublimate prevent the development of seeds, and the exercise of the functions of organised and unorganised ferments.

The brothers G. and A. Bellussi, who own large vineyards at Tezze, have discovered that hydrate of calcium is a remedy for the peronospora of the vine, known as oïdium or mildew. This season they invited viticulturists to come and see for themselves, and exhibited long rows of vines, the leaves of which looked as if sprinkled with brine, but were perfectly healthy, while on the other side of the walk, the foliage had nearly all shrivelled up or dropped off. The vines treated with the calcium hydrate were laden with bunches of ripe grapes, while grapes on the untreated plants were few in number and sour.

A new method of treating sewage has been recently devised, the active agent in which is sulphate of iron. The cost is stated to be about one-fourth that of existing methods.

USEFUL AND SCIENTIFIC NOTES.

A Steam Bicycle.—According to the *New York Turf, Field, and Farm*, of Oct. 23, a steam bicycle is the latest novelty, invented by L. D. Copeland, of Arizona. It is of the star pattern, with a small wheel in front, and attached to the front bar is a vertical brass boiler heated with gasoline. A dainty engine mounted on the bar above the boiler has a stroke of 3in., with a cylinder of $1\frac{1}{16}$in. diameter. Below the engine is a spherical reservoir holding a quart of water, and above it a cylinder holding as much gasoline. A round belt communicates the power of the engine to a 30in. wheel attached to the wheel of the bicycle. The engine, in an exhibition at Newark recently, made 180 revolutions of the 1½in. crank in a minute, and nine of these revolutions turned the large wheel once. A little steam-gauge showed 60lb. pressure a few minutes after the fire had been started, and, leaping into the saddle, Mr. Copeland rode swiftly around the rink for twenty minutes. The inventor said the engine would run for an hour without renewal of water or gasoline, and that engine, boiler, and fuel did not add more than 20lb. to the weight of the bicycle. He has retained the pedals on the machine, and he used them as an auxiliary to the engine when he pleased.

Gold Varnish for Frames.—Take of turmeric and gamboge, of each 1 drachm: spirits of turpentine, 2 pints: shellac and sandarach, of each 5oz.; dragon's blood, 7 drachms; thin mastic varnish, 8oz. Digest with occasional agitation for 14 days in a warm place, then set aside to fine, and pour off the clear liquid. This is to be applied on the frames previously silvered.

Alcohol in Cider.—The results of an investigation commenced in 1882 to ascertain the maximum and minimum percentages of alcohol and acetic acid which genuine apple juice would produce are published by Mr. W. French Smith in the *Journal* of the American Chemical Society. They indicate that a good cider should contain about 5 per cent. of alcohol, and a fair sample ought not to fall below 4 per cent.; and if less than 3½ per cent. the cider must have been diluted or prepared from extremely bad apples. Again, while a genuine cider vinegar may contain less than four per cent. of acetic acid, a good article should contain about five per cent., and vinegar prepared from the better grades of cider will represent from 5½ to seven per cent. of acidity. Apples must be carefully selected to yield a vinegar about seven or eight per cent.

Mr. Burchard, Director of the Mint in the United States, in his annual report gives the production of gold in America in 1884 as 30,800,000 dols. In 1883 the gold produced was valued at 30,000,000 dols.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆

THE "RAPID MOTION" OF THE NOVA IN THE ANDROMEDA NEBULA.

[24990.]—EITHER Mr. Perry had a special copy of the *Times* of September 9th supplied to him at Alnwick, or he was suffering from some extraordinary mental hallucination when he penned letter 29940, p. 178. In it he says: "Mr. Sadler now assumes that my measures (*expressed in seconds of arc*) [the italics are my own] contained in my original letter to the *Times* were also misprinted. This was not the case, and if Mr. Sadler will convert Dr. Copeland's measures expressed in seconds of *time*, into seconds of *arc*, and then compare it with my measures (expressed in seconds of *arc*) he will at once perceive the ground on which the suspicion of 'rapid motion' in the Nova was founded." Mr. Perry here makes a deliberate statement, the truth of which can be proved by anyone interested in the subject, and which will serve as a test of the accuracy of his other allegations.

He says (and he says it twice) that his measures, as printed in the *Times*, were expressed in seconds of *arc*. I most emphatically deny every syllable of this statement. They were expressed in seconds of *time*, and it was the extraordinary discrepancy between Dr. Copeland's and Mr. Perry's measures, both expressed in Mr. Perry's letter in seconds of *time*, which so astounded Mr. Lynn and myself. Mr. Perry's letter to the *Times* runs as follows:—"The new star in the above nebula is apparently in rapid motion. By the Dun Echt *Circular*, No. 98, we learn that Lord Crawford and Dr. Copeland found that it was 'most probably situate some 1·6s. preceding and 5″ south of the old nucleus, which is much overpowered by the light of the star.' I measured it carefully last evening with my 18¼in. silvered-glass 'Culver' reflector, and found that it was some 12·0s. preceding and 2·5″ south of the old nucleus."

Dr. Copeland's measure, 1·6s., converted into seconds of arc, as Mr. Perry requests, is equal to about 18·28″, and Mr. Perry's 12·0s. to 136·87″. This would give the new star a *daily* motion of 39·5″, nearly seven times as much as the *annual* movement of Groombridge 1830, the star having the largest known proper motion! I assure Mr. Perry that I gave him credit for saying what he meant; it was Mr. Lynn who suggested at first that he did not know the difference between seconds of arc and seconds of time; but I was loth to believe that a Fellow of the Royal Astronomical Society who owned, and used, a telescope of 18in. aperture, could have committed so puerile a blunder. However, I shall know better in future. It would seem as if Captain Noble's note "On the Misuse of a Common Symbol," urgently required reprinting in the *Monthly Notices*. Mr. Perry has landed himself on the horns of a dilemma: either he blundered so greatly in his measure as to make the distance of the Nova from the nucleus 118″ greater than it should have been, which would justify his assertion of rapid motion with a vengeance, but does not reflect great credit on either his micrometer or his perspicacity; or he wrote 12·0s. when he meant 12·0″ (not knowing the difference between the two), which, however, would not warrant his assumption of "rapid" or any other motion (except a "motion" of what unkind people might be rude enough to term "premature and indecent haste" in rushing into print with a story of a cock and a bull), as the difference of 6″ between his own and Dr. Copeland's measures was well within the limits of error, considering the difficulty of getting exact measures from such an object as the nucleus of M. 31, and the admitted uncertainty of the Dun-Echt results at the time Mr. Perry first rushed into print. **H. Sadler.**

[24991.]—AS Mr. Perry twice states in his last letter in the ENGLISH MECHANIC (24910) that his measure of the distance of the Nova in the Andromeda nebula from the nucleus was expressed in his letter to the *Times* of Sept. 9, in seconds of arc, I must beg to point out that he cannot have a copy of that letter by him, and that his memory must be at fault.

The distance in right ascension between the star and the nucleus is as clearly expressed in seconds of time (s) as that in declination is in seconds of arc (″). Had this not been the case, I should never have written my letter to the *Times* of Sept. 15. The great discordance thus shown between Mr. Perry's measure and those of Dr. Copeland and other observers being so far exceeding possible error of observation, even when made under the most unfavourable circumstances, convinced me that there was some mistake in the former which it was desirable to have explained. Had Mr. Perry explained that it was a misprint, or *lapsus plumæ*, in his letter (as we now know, and as Mr. Perry will see if he consults the letter as printed), I should have said no more; but in his letter published on Sept. 22, he said that my conjecture was wrong, and hinted that it was unintelligible, without pointing out the nature of the mistake, by himself or his printer, on which it was founded. If it had been explained in a previous unpublished letter (which, of course, I could not have known), it is singular that no allusion was made to this. So I wrote again on Sept. 22 a letter which did not appear until Sept. 29 (with date omitted), again pointing out that the distance in right ascension between the star and the nucleus could not be nearly so great as 12 seconds of time, and requesting Mr. Perry to communicate some further measures. To this letter Mr. Perry made no reply. The fact was simply that I thought those who took all their information on the subject from the *Times* ought to see so important a statement as the star's "rapid motion" withdrawn, as it was so evidently unfounded.

Blackheath, Nov. 8. **W. T. Lynn.**

THE COLOUR OF THE NEW STAR IN ANDROMEDA—OPTICAL MATTERS—NOTES ON SILVERING.

[24992.]—I QUITE agree with Mr. Brooks (letter 24850, p. 121), as to the colour of the new star in Andromeda. My first observation of this star was made on the night of Sept. 6th, with my 6½in. reflector, the colour then being recorded as "white, slightly tinged with green," and the magnitude estimated to be about 6½.

Since then I have seen this star many times, and since reading of its colour being "orange" or "ruddy," I have examined it particularly for the purpose of satisfying myself more thoroughly on this point. But, notwithstanding a willingness on my part to see the star ruddy, its colour has always appeared to be the same as when first observed, except that, perhaps, it has become slightly yellowish instead of white, but still retaining the greenish tinge. I last examined it on Oct. 17th, at 10h. 30m. Sky cloudless, air good, moon about first quarter and shining brightly. The star well seen; the nebula being quite extinguished in the 6½, power 360. The colour recorded at this time was "yellowish-white, tinged with green, the green tinge being faint, but noticeable." I then tried several lower powers, and finally the 2¼in. refractor; but the result in each case was the same as before. All these observations were made before I knew anyone had thought the colour to be greenish, so I could not possibly have been prejudiced in favour of that colour. The star has always attained a good altitude when observed; perhaps its nearness to the horizon in the evenings at the time of discovery may have had something to do with its ruddiness. Will Mr. Tarrant, "F. R. A. S.," and others, look again when the star is near the meridian?

I am at a loss to understand how I could have made such a mistake *in re* Littrow's formula, as shown by "Orderic Vital" in his kind reply to my inquiry. On reading his letter I saw the point at once.

Owing to the press of other matters I have been obliged to temporarily suspend work on my 5in. achromatic; but will soon avail myself of the privilege of asking "Prismatique" a question or two more. Meanwhile, would he kindly tell me something about his paper polisher, and its advantage over pitch? And also in what numbers his articles on "Object-glass Working" appeared? The mention of Mr. Penny's name reminds me that I hope that gentleman has not given up telling us about the effect of the separation of the lenses in an achromatic on the spherical aberration. I am sure all practical amateurs would like to hear from him.

I do not know any way by which "Countryman" (query 57665, page 110) may obtain the results he desires. Perhaps some one else can tell him, or if I have time I will look into the matter.

From what Mr. Smith writes (letter 24878, page 125) I should attribute his failures to secure good films primarily to two causes—viz., the mirror was not clean (though it finally became clean through repeated trials) and the temperature of the room and chemicals was too low. As I said in letter 24805, page 82, the importance of having the mirror *perfectly clean* is likely to be overlooked, especially by beginners; the result with an imperfectly cleaned mirror being almost always like that described by Mr. Smith—thin, patchy films, which rub off on attempting to polish. The temperature should be about 70°—not lower than 65°—in order to secure the *best* results, as the film will be thin if the temperature is too low, and the benefit of some of the silver will be lost if too high. I have tried all the processes for silvering mirrors which I have seen; and though under proper conditions I have always succeeded in obtaining good films, not one of the processes will compare with that invented by Mr. Brashear for simplicity and surety of action. **Chas. L. Woodside.**

Boston, Mass., Oct. 26th.

MEROPE NEBULA.

[24993.]—SOME of your correspondents have from time to time asked for observations of this object. I send you all the observations of it made by Rev. T. W. Webb, and extracted verbatim from his note-books.

Last night, Nov. 5th, the Pleiades were examined with the 17½in. Calver equatorial reflector. I was careful not to find out which was Merope before going to the telescope. Each of the larger stars was then examined, and the nebula at once seen. It extends for a considerable distance in a triangular-shaped haze. The *f.* boundary is marked by a line of small stars, the proceding side is much less defind, while at the base of the triangle the nebulosity fades away imperceptibly. The power used was 70. Increasing the power decreases its visibility. Merope appears immersed in the nebula, which seems to extend beyond the star some 1′ or 2′. By moving the telescope rapidly, the nebula was a staring object through contrast with the dark sky. I could not see Goldschmidt's nebula.

REV. T. W. WEBB'S OBSERVATIONS OF THE MEROPE NEBULA, 1863-1882.

1863, Oct 5.—Rather flaring definition, 5¼in. Alvan Clark, 84in. focal length. Pleiades: The star *p.* the brightest has a large, feeble nebulous space *f.* I did not know where to look for this, merely remembering that Merope was said to be near the corner of a nebula of a somewhat triangular shape; but it was readily perceivable, though I should not have discovered it. I saw it with 64, and afterwards, but not at all plainer, with 29. Its extent was about ⅓rd of the field of 29 (= 52′).

1863, Nov. 10.—A very splendid transparent night. With 29 it appears to extend about ⅓rd of field, as on Oct. 5. But it fully surrounds and extends beyond the star, and is brightest in that part. It is egg-shaped or triangular, with rounded angles; but excessively ill-defined. Its longest axis seems to make an angle of 140° ±, with a line joining Merope and Alcyone; and 100° ±, with a line joining Merope and Electra.

1863, Nov. 14.—Well seen with 29. Fine night.

1863, Dec. 1st.—Sky not very clear. Visible with 29, but I think less so than on former occasions. I fancy the other bright stars of the Pleiades seem a little nebulous, probably from haze. I cannot perceive Goldschmidt's surrounding nebula.

1863. Transparent night.—Nebs. as last night, 64. I could fancy the whole Pleiades on a nebulous ground in the finder of the telescope.

1863. Dec. 29.—Fine, but a little fluttering. Merope neb.: very plain and sparkling, evidently, in several places. Goldschmidt's neb. not to be found.

1864. Feb. 9.—A little haze in parts of the sky. Merope neb. pretty evident. Goldschmidt's invisible, 29.——Nov. 4.—Transparent, but rather blotty night. Neb. feeble, but tolerably evident as a known object.

1865. Sept. 25.—Fine transparent night, and luminous. Neb. very feeble, 30, 65, but rather low. No trace of Goldschmidt's neb.

1866. Feb. 12.—Nebula very feeble, 30 and 64, but considerably better seen, I think, especially with 64, when the eye is so oblique that the direction of the inner canthus is nearly vertical, than when it is either horizontal, or in the opposite direction.

1867. Nov. 2.—Air not very fine, 9·38in With. This object is very faint though perceptible, 65.

1869. Dec. 28.—Sharp frost. The traces of this object are very feeble; but the air may not be very transparent.

1872. March 1.—Clear evening. There seems with 65 to be some feeble diffused glow S. of the star; but I do not trace it up to the star, nor am I sure of its existance.

1872. March 4.—Especially fuzzy and woolly definition. Very little of any trace of it with the star in the field of 65: but when the star is just hidden by the stop, there is a feeble but evident glow 15′ or 20′ S., and a little *s.p.*, which does not exist when the next bright star *p*, is in a similar situation.

1876. Jan. 15.—Fine clear night. This is a difficult object with 65, and would certainly have escaped in a general survey. When the other large stars are just out of the field, it is quite dark; but when Merope goes out of sight S., there is a broad, but very feeble, though certain, luminosity with no defined boundary, but extending about 15′ N. (*sic*), or nearly as far as a 9 mag. star N., a little *f*., about 20′ distant. Its *f* edge seems to follow a line of three or four small stars; but the whole is very diffused, and in its present state would hardly have been discovered with this instrument.

1881. Jan. 31.—A little haze; definition pretty good.

Merope nebula a very perceptible glow.

1882. Feb. 18.—Blotty definition.

I do not see this; but air not very transparent.

T. E. Espin.

THE GREAT MELBOURNE CASSEGRAIN.

[24994.]—As there has been a good deal said in your columns on reflectors, &c., it may be of some interest to know what will be the spherical aberration of the above, according to the constants given by Dr. Royston Pigott.

With regard to the mirrors, he only gives their focal lengths, but not the form of the curves, which ought to be known in order to determine spherical aberration; however, it will suffice for the moment to suppose the larger mirror to be parabolic, and the smaller one spherical—a common arrangement. Accordingly, for rays parallel to the axis, the spherical aberration of the first mirror will be 0, since all reflected rays pass through its focus; so that the aberration of the instrument is reduced to that of the second mirror only.

The aperture of this latter is 8in., and its focal length is 74·71. The second image is formed at a distance 332·31 from the second mirror, and the distance between the two images is given as 61. But surely this last is a mistake, or probably a misprint. 61in. is, I find, the distance at which the small mirror ought to be placed from the *first image* in order that the second image may be where it is. Besides, in a Cassegrain, the small mirror lies between the two images, therefore their distance must be *greater* than that of either of them from the small mirror.

Using, then, the formula for spherical aberration $\left(\frac{1}{r}-\frac{1}{a}\right)^2\frac{v^2y^2}{r}$, and observing that we have $u = 61$, $f = 74·71$, $r = 2f = 149·42$ we obtain on reduction to numbers, aberration $= 4·887\,\frac{y^2}{f}$.

Let us compare this with the aberration of an *uncorrected* object-glass, which we will suppose to be equiconvex. The aberration of this latter is $\frac{5}{3}\,\frac{y^2}{F}$. Let us suppose F and 29 to be as 15 : 1 for object-glass of 8in. aperture, F will be therefore 120: in our mirror it is 74·71. Hence it is easily seen that the aberration of our mirror will be to that of an uncorrected object-glass of 8in. aperture and 120 focal length in the proportion of—

$4·887 \times \frac{3}{5} \times \frac{120}{74·71}$ to 1, or 471 to 1, so that the aberration is between four and five times as great as that of an uncorrected object-glass of 8in. aperture and 120 focal length, and if we wish to compare it with the aberration of an object-glass of 48in. (that of the large mirror), and belonging to a telescope similar to the former, the aberration will be $\frac{1}{6}$ of 4·71 or ·78, so that finally the aberration will be something more than $\frac{3}{4}$ that of an uncorrected object-glass having aperture of 48in. with focal length 15 times aperture.

The aberration, therefore, would be very bad; but possibly the actual curves are somewhat different from what has been supposed above.

The separation of γ_2 Andromedæ is not much of a test for 48in., since, if the distance were ·4, as in year 1842, 12in. would separate it, and if it were ·6 as in 1865, 8in. would suffice.

W. G. P.

THE TELESCOPE.

[24995.]—If Mr. H. Ingall will again read my remarks, he will see that I only intended to show that altering the character of the central disc does not affect the dividing power, but only the *measuring*; because the planet-like disc is better to *see* than a small bright point, though the latter allows of closer dividing. The curves of a reflector must be more perfect than those of a refractor, which are spherical: hence the rings are more numerous and obtrusive.

I may tell Mr. Holmes that I see no reason to "reconsider" my remarks about not being able to magnify the stars, and that he will be more benefited by informing himself on the question.

Widford, Nov. 2. **G. Calver.**

DIAMETER OF STAR DISCS.

[24996.]—I think Mr. Calver will alter his opinion if he will turn to page 550, No. 568, English Mechanic, or to R.A.S. *Monthly Notices* for March, 1867. The article being interesting and conclusive, I ask the Editor to reproduce a portion of it—

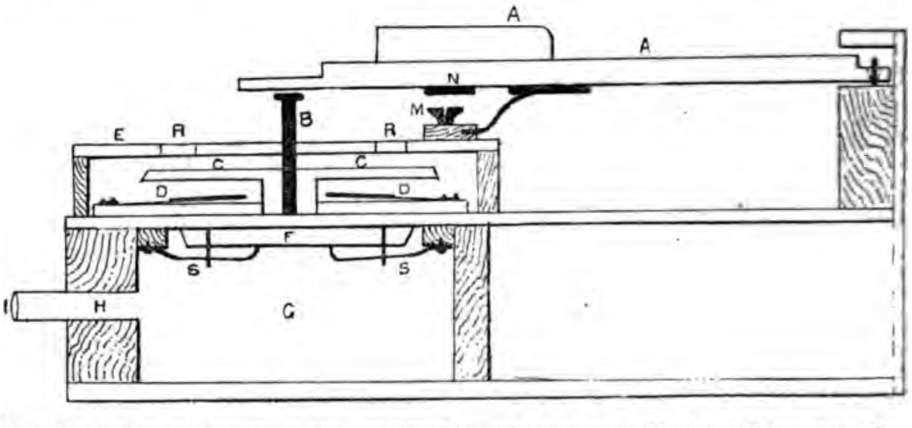
Aperture of telescope. Inches.		Dia. of disc calculated.		Dia. of disc observed.
		″		″
7·33	...	0·752	...	0·693
6·00	...	0·920	...	0·870
4·95	...	1·113	...	1·120
4·00	...	1·380	...	1·437
3·00	...	1·840	...	1·862
2·00	...	2·760	...	2·572

The observations were made by Mr. George Knott, F.R.A.S., whose name is well known to many of us, on stars of the 1st and 2nd magnitude.

J. C. L.

NEW PEDAL ACTION FOR AMERICAN ORGANS.

[24997.]—In a recent volume of the English Mechanic I described the construction of a separate pedal organ for American organs and harmoniums. I have now a wish to bring before the notice of your readers particulars of the construction of a pedal action which is superior to the former method. The diagram will clearly explain the principles of construction. A A show the pedals; B, the plunger, which is actuated by the pedal; C C, the tubes; D D, the reeds (2 sets); E, the sound-chamber or box fixed over tubes; F, the pallet, furnished with two pallet springs, S S; G is the wind-chamber; H is a metal pipe, fixed in back of rim of wind-chamber. A similar pipe is inserted in back of wind-chamber of instrument to which the arrangement is connected. An indiarubber tube is connected to the pipes, by which the air is conducted to the reeds. M is a regulating screw for the pedal; and N a bit of felt glued to under part of pedal, to prevent any noise when coming in contact with regulating screw. The other portions will be easily understood. R R are inlets to allow sufficient air to enter the reeds. I must now inform interested readers that this pedal action has been practically tested and found to be successful. The indiarubber tubing should be of sufficient length to allow the whole of the pedal action to be drawn out from under the instrument when the pedals are required to be used. If the instrument to which this pedal action is connected is raised 6in. from the floor, that will be quite sufficient. This arrangement also admits of the application of a pedal coupler if required. I am quite willing to describe the mode of attaching pedal coupler to keys if asked to do so. I may remark that the effect of this arrangement leaves nothing to be desired. With sufficient wind-pressure the reeds speak promptly, and give out a good solid tone (if I may so express it), equal, if not superior, to any pedal bass yet arranged. This pedal action can be disconnected from the instrument without trouble, and at a moment's notice, as will at once be seen.



G. Fryer.

SIMPLE EXERCISES IN TECHNICAL ANALYSIS—OXIDE OF IRON PIGMENTS.

[24998.]—I am thankful to your correspondent (Mr. Hurst) for giving me an opportunity of stating that the oxide of iron reds, described in No. 1072, and to which he refers, are sold under the name of "*common* oxide of iron reds." Whether the word "common" justifies the addition of chalk or not it is impossible for me to say; but it is, nevertheless, a fact that chalk is present in greater or less quantity in a large proportion of samples of this class. That good samples should contain from 96 to 98 per cent. of oxide of iron I was well aware; but such are not usually sold for common paints. Out of twenty-five samples taken at random, only nine, or 36 per cent., were quite free from chalk; only eleven, or 44 per cent., contained upwards of 90 per cent. of pure oxide of iron; and only four, or 16 per cent., contained upwards of 95 per cent. of oxide of iron. I can only conclude from this that your correspondent's experience is very different from mine.

London, Nov. 4. **Analytical Chemist.**

NEUTRAL SALTS IN DANIELL BATTERIES.

[24999.]—I must differ from "A. E. B," (24981, p. 204), when he says that neutral salts prevent the passage of copper sulphate into the zinc cell, especially as the way in which he words the statement implies that I have shown them to have this advantage. Nothing will prevent this and the consequent deposit of copper on the zinc. The best plan is one of my own device, and that has the disadvantage of increasing the internal resistance; that, as described years ago in these pages, and page 137 of the second edition of my "Electricity," is to use a double porous cell, and place either zinc cuttings or oxide of zinc in the space between them, so as to decompose the copper sulphate in transit. It passes at all times, and whatever is used in the zinc cell; but, of course, its endosmose is increased if the hydrostatic pressure is greatest in the copper cell, and a strong current produces this by driving part of the zinc solution into the copper cell. It is also greater when the battery is not working, just because this action of the current, while passing, sets up an opposing pressure. If a Daniell is to be used permanently, as, for instance, to ring bells (which I should not use it for), or to work a clock, &c., I think the gravity form is much to be preferred, as in it this difficulty is more easily controlled than with vertical plates and a porous cell.

As to the practical advantages of sulphate of zinc over sulphate of soda, I think it is always a disadvantage to introduce any inert and foreign matter into any work. I am not prepared to admit (not having the figures at hand) that the soda salt is a better conductor than the zinc sulphate, which itself is a good deal more conductive than the copper sulphate. But the zinc salt is there, and must be there, as the battery makes it while working: the soda salt is a substance foreign to the working, and a nuisance, because it will diffuse into the copper solution. I think someone has lately claimed as an "invention," possibly patented, the use of ammonium chloride. I remember that the first battery I ever used, as a small boy, when electrotyping was first invented and became the excitement of the day, was a Daniell with a porous cell turned out of sycamore wood, and charged with sal-ammoniac in the zinc cell.

As to myself, I thought the readers of this paper—at all events those concerned with electricity—were fully aware that "Sigma" was the old nom-de-plume of J. T. Sprague, and that "Electricity: its Theory, Sources, and Applications," made its first appearance in a series of articles running through several years in these pages. This is the thirty-eighth volume of the English Mechanic in which I have used that signature, as the Greek initial of my own name. I used it strictly anonymously, for good reasons, for several years, and continue its use in the correspondence and reply columns, partly from habit, and partly because it is more convenient than the use of initials or one's personal name. Of course, as I have not written so much of late as I did formerly, recent readers only know the signature itself.

It is quite unnecessary for "A. E. B." to remonstrate against any supposed "charges." When a letter appears in these pages it becomes something more than the purely personal property of its writer. It becomes a text from which illustrations and advice may be derived for others: I suppose I may have answered some hundreds of letters, and I have always done so in that spirit. When I spoke of the waste of time and money in experiments "without a guiding principle," I made no *charge* against "A. E. B.," though the remark was suggested by what he said. I simply made a suggestion to the many readers who are learners in science; and I think "A. E. B." himself will find his methods and aims improved by what I have said in reply to his letters.

The coating of the zinc with copper is not a case of so-called "polarisation," because it certainly does not produce a counter E.M.F. in the circuit. It does, however, produce a lowering of the E.M.F. of the cell, as I have explained on p. 141 of my "Electricity," where I state that the effect either of touching the zinc with a copper wire, below the liquid, or of any copper deposit is to lower the E.M.F. ·03 per cent. The action is analogous to placing a wire across the poles of a cell: the "local action" diverts a part of the energy of the zinc, and lowers its power of generating E.M.F. in the external circuit.

I have not Prof. Thompson's book at hand at the moment, but I think "A. E. B." only partially comprehends its teaching, for his rendering of it in his explanation of the action of "bubbles of hydrogen" is certainly erroneous or incomplete. I think this subject was first thoroughly worked out and published by myself in these pages, in a form then considered heretical and now generally adopted. The whole subject is gone into in my chapter on "Electro-motive Force," and at p. 334 there is the statement that the total potential energy of zinc and sulphuric acid represents 2·248 volts, from which is to be deducted whatever energy is absorbed—first, by the opposing E.M.F. of the negative plate itself, as tending to form a sulphate; and, secondly, any absorbed by the chemical action at that plate, or the substance set free, which, in the case of hydrogen, is 1·464 volt, and with copper ·506 only, as shown in a table at p. 341, accompanied with a remark similar to my recent one at which "A. E. B." protests, "Much waste of time and money may be saved in testing any idea which occurs as to a probable combination." That is why I said that "A. E. B." would not speak as he did about the action of these bubbles of hydrogen if he thoroughly studied the principles involved.

Sigma.

POLARISATION IN BATTERIES.

[25000.]—In reference to my letter of last week (p. 204), whether I am right or wrong in applying the term polarisation to a zinc plate partly coated with copper, I must confess, on consideration, that I cannot bring it within the scope of "Sigma's" definition as a "counter E.M.F." caused by decomposition of the electrolyte, since he evidently means by that term to convey the idea of something tending, not to divert or withdraw the current, but to arrest it in the direct line of its action, e.g., if sulphate of copper were decomposed in an electrolytic cell with platinum electrodes, and copper were deposited upon the whole surface of the cathode. But, then, would it not be correct to speak of the platinum *pair* as polarised, rather than to apply the terms to the single plate which formed the cathode.

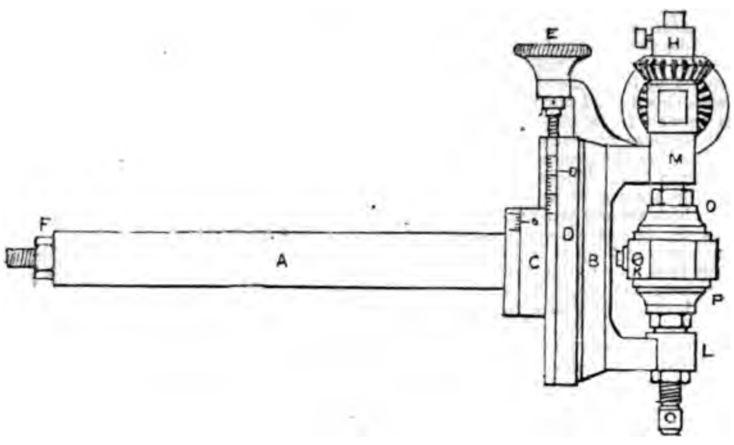
Professor Thompson, on p. 135, appears to speak of hydrogen (especially, but not exclusively, when freshly deposited) as "electro-positive" in a higher degree than copper; and "Sigma," in one passage of his last letter, implies the same. May I ask, with all deference, how this is to be reconciled with what seems to be stated by the Professor on pp. 381, 382—viz., that copper dissolves in sulphuric acid spontaneously, evolving E.M.F.; but that in order to precipitate copper from sulphate of copper by the intervention of hydrogen, we must make use of E.M.F. previously obtained by dissolving zinc?

A. E. B.

CUTTING WHEEL TEETH.

[25001.]—Seeing some engravings with accompanying descriptions of appliances for cutting wheel-teeth, I have permission to send you the inclosed rough sketch of one which has been in use for seven or eight years in our shop, and which, I believe, was designed from hints gathered from former numbers of the "E. M." by one of my employers, who, judging from his book-shelves, has been one of your earliest and best subscribers. In addition to cutting wheels and worm wheels, this machine is used for other purposes, such as cutting long slots or grooves, making large milled heads, fluting columns, and ornamenting work on the face-plate, &c., and nothwithstanding the vast amount of work it has done, it seems little the worse for wear.

A is the limb or stem for fastening it in the tool-holder; B is the body which carries the spindle, and is pivoted at C so as to be set at any angle; it also works on the slide D, and can be raised or lowered by means of the milled head at E. Both of these parts are graduated, as will be seen by the drawing, the whole being clamped into position by a bolt passing from B through the stem, and by the nut F. At the bottom boss L is a screw having a taper point, on which the cutter-spindle revolves; the upper portion passes through the boss M to receive the bevel-wheel H.



The driving-pulley has two grooves, and to it is fixed another bevel-wheel which gears into H, but is mounted on a spindle having a sleeve at right angles to it, which fits on the boss M, so that this wheel can be turned round to suit the position of the driving-band, and is fastened by a set-screw.

The cutter-spindle has a thread on it to receive two nuts of the shape shown at O P; these clamp between them a brass ring which has a projection at each side; the cutter is fixed in one of these projections and fastened by the set-screw K; the other projection serves as a balance to the cutter.

We drive this machine at about 6,000 revolutions per minute. It has done a great deal of work in its time, and still continues to do it well; nevertheless it has one little defect which, if those interested cannot discover, I will come to the rescue. On a future occasion I will describe some other useful machines in our well-stocked workshop.

Fred. Baker.

LATHE FLYWHEELS.

[25002.]—A. F. Shakespeare writes on the above subject, on p. 205, a letter which is to me most extraordinary, and I will here explain why I think it so.

My flywheel on a 5in. lathe is 1cwt. 20lb., and 29in. in diameter over all. I do not think there is any wear of centres to speak of after use for 12 years. If the centres do wear at all, what is easier than to turn them round now and then, one-half or one-third of a turn, so as to distribute the wear equally? I cannot imagine a lathe running like anything but a "lame horse" if the treadle is not balanced. Also, if not balanced, you must, to run forward, start it by hand *always*, which is a much more important objection than not being able to start a balanced one the reverse way now and then. With my balanced wheel I can always start from rest, and when once set in motion I can stop it and keep it steady at any point of the revolution, and run backwards or forwards just as I please without putting a hand to it at all, it going like a well-trained circus horse, and apparently obeying my will as if it were an intelligent animal. I quite admit that a counter-weight is "an abomination" if it is not correctly placed, as, *e.g.*, on the treadle, and not on the flywheel, or is not of the right weight, or not in its right place on the flywheel itself; and there are plenty of lathes offered for sale that will hardly run at all with or without a counter-weight, owing to the centres of treadles and crank being incorrectly placed in the frame of the machine.

I never could see the advantage of the treadle proposed and adopted by "D. H. G." It may be all very well for pedalling when you are standing with your face to the front, but must be extremely awkward for the right foot, and dangerous to the left leg when standing sideways, as you must do for inside work. What I consider the test of proper balance of a flywheel is *slow* pedalling, and I find on trial that I can keep my lathe running steadily at 12 revolutions of flywheel per minute, and, as I said before, can stop dead at any point, and start either forwards or backwards by altering the pressure of my foot, with occasionally a little lift with the toe of the boot applied *under* the treadle, if the stopping has occurred at any very critical point. My grindstone, which is 26in. diameter and 3½in. thick, also runs on steel centres, which have been in use for 25 years without much wear. When set going fast, and reckoning from the moment when the treadle ceases jumping, the stone will run for two minutes. The treadle in this case is not balanced, and is of wood, which, just out of curiosity, I have taken out and weighed, and find it to be 7lb. exactly, which is not much considering that it means 2ft. 10in. from back centre to front of foot-board.

J. K. P.

PYROLOGY.

[25003.]—I (and I hope many others) have been following Col. Ross in his examples of determinations of minerals, blowpipe in hand, and it gives me great pleasure to say with entire success.

His system in my hands, applied to other unknown minerals (and in my profession I have many to determine), has given results which have been confirmed by the assay furnace and laboratory, excepting that in some cases I missed finding some constituent which generally was a non-essential.

My difficulties seem to centre in the determining with absolute certainty the presence or absence of lime, magnesia, &c., in an alkaline aluminous silicate. In the absence of the alkali this would only be a matter of a few moments, so that my efforts have been entirely directed to its elimination.

Col. Ross directs that these silicates be fused, and as in the majority of cases this can only be done partially, if at all, he adds, "With soda if necessary," and then the boiled and dried residue is to be treated in phosphoboric acid, in which lime, &c., will form their characteristic borates or phosphoborates.

Taking Labradorite for an example. I have tried for hours, using this and other methods to be found amongst his books, utterly unsuccessfully, for in spite of all these and many other methods devised by myself I always get the same alkaline aluminous silicate. May I hope to have a few words from Col. Ross on this subject, and the experience of any other contributing pyrologist.

I should like to direct the attention of Col. Ross and others to the fact that gold can be oxidised and be made to afford a sublimate far more distinctly and copiously without the use of lead than with it. A few specks of gold oxide (which are immediately reduced, however) are mixed with soda, and heated *per se* on the Al plate, with a strong O.P. After some time a distinct rose-coloured sublimate, together with the white one of soda, is seen. If, however, instead of heating the assay on the bare plate it is supported by a charcoal slip, a sublimate is obtained which is so beautiful that it defies description, and with a powerful O.P. very copious. The soda sinks into and permeates the charcoal slip, which lasts all the longer in consequence. The little globule of gold is seen on top in a state of intense vibration. One globule, after affording three sublimates, had not, by a Harkort's scale, sensibly diminished in diameter. By this method I have obtained distinct reactions for gold in vein stuff not assaying more than 3 dwts. to the ton. I have sometimes, however, obtained (though not with soda) another sublimate of gold equally characteristic of a golden bronze colour. With silver I have not succeeded in getting a sublimate by this method, and perhaps fortunately, as it might obscure gold reactions. I trust that Col. Ross and others will examine gold and other sublimates (especially lead) produced in this way. I, unfortunately, shall have no time to investigate the matter any further for some time.

W. H. Furlonge.

THE BORAX TONING-BATH.

[25004.]—There is no doubt the borax toning-bath, mentioned in your last issue by Mr. G. Legge, is one of the best, if not the very best, especially for ready-sensitised paper. I have seen various modifications of this bath given. In its present form it appears as a contribution to the *British Journal Photographic Almanack* for 1883, by that accomplished photographer and lanternist, Mr. William Brooks, of Reigate.

Mr. Brooks ascribes it to Mr. A. Cowan, well known in connection with chloride plates for transparencies, and the inventor of many useful appliances in photography.

Briefly, the toning formula may be quoted thus:—Water, 15oz.; borax, 90gr.; chloride of gold, 1gr. I find it convenient to keep the gold in a more concentrated form, 15gr. in 15 quarter-ounces of water, but this is a mere detail. It is important that the prints should be well washed previous to toning, and don't get the toning-bath *too* warm. Slow toning is safest, as it is generally the best. I may add that with this bath I always find 1gr. of gold more than enough for a sheet of paper. It may appear a little more troublesome to make a new bath each time, but the greater uniformity of the results will repay this. There need be no waste of gold. Learners are apt to ascribe to the toning-bath faults which are not attributable to toning at all. Unless the negative is strong enough to produce a good vigorous print it is hopeless to expect a good result from any toning-bath. Sometimes a negative slightly too weak, by slow and careful printing and toning will give a fair print. When this can't be done, intensify, if the shadows of the negative are clear. Print till the high lights are decidedly tinted, but don't overtone, especially when the print is rather weak.

Nov. 9th. **John Bate.**

REFLECTORS v. REFRACTORS.

[25005.]—DR. FERGUSON'S letter on "Experiences with an 8½in. Reflector" is particularly interesting, owing to the opportunities he has enjoyed of examining both forms of telescope, and to the candid manner in which he details the results.

His honest admission that the perfect views obtainable with his reflector are only momentary is consolatory to me as showing that, at least in this respect, it is no better than a refractor. It is an experience common to both forms. We must all admit that certainly in this climate, and I suspect in every other, the periods of perfect vision are few and aggravatingly short; but when they are vouchsafed one feels impelled to cry out with admiration, and the impression left is for ever a source of delight.

Dr. Ferguson's description of the view of Jupiter in the Grubb 12·2in. at Oxford is at first disquieting; but surely does it not mean that more light was admitted than the eye could bear? Too much light, both in telescopes and microscopes, is fatal to definition, and I cannot help thinking that had the light been modified, either by reduced aperture, or by a neutral-tinted glass, his report would have been very different; indeed, I have always understood that with large apertures the light of the moon and the brighter planets is unbearable to the unprotected eye. Even with my own 4in. the view of Venus on a dark night is enormously improved by a slightly-tinted glass, and I can fancy what it would be with an aperture three times as great.

As to the general question, even allowing that reflectors have an advantage over refractors as regards planetary views, the superiority of the latter for star work is, I think, generally admitted; and, bearing in mind the excessive sensitiveness of the glass mirror, and the consequent greater difficulty of adjustment and manipulation, I cannot but come to the conclusion that where money is not an object refractors must carry the day, at the same time thankfully conscious of the fact that the moderate price of large aperture reflectors, coupled with their superb quality, has enabled an enormous section of the public to participate in a delightful occupation previously confined to a very few. **Beta.**

London, Nov. 9th.

REFLECTOR v. REFRACTOR—LARGE v. SMALL TELESCOPES.

[25006.]—I AM not surprised that the altogether unwarranted attack on reflectors by Mr. Burnham should have called forth a rebuke from men so well qualified to speak *ex cathedrâ* on the question as the Revs. Perry and Espin, and Messrs. Calver, Franks, and others. In spite of the mere prejudices which continue to exist in certain minds as to this form of instrument, it has been gaining immensely in popular favour of recent years, and there is no question it will hold its own in the future regardless of the aspersions levelled against it. My intention is, however, not to prolong this controversy by any attempt to deprecate refractors. The opinion I have formed accords with that expressed by Dr. Ferguson in your last number (letter 24968), where he says: "For pure celestial views generally the reflector is best." Judging from results, I should also add that for micrometer work, especially in reference to double stars, the refractor may claim an unquestionable advantage, but for the study of planetary markings, the reflector stands unrivalled.

Mr. Burnham's letter on the question of small v. large telescopes was evidently indited under a misconception as to the basis of the discussion which had been previously carried on in the *Observatory*. His remarks, therefore, were quite irrelevant to the special point at issue, namely, the relative capacities of small and large instruments in displaying the more delicate surface features of bright planets. Now, what I have maintained is that big glasses have proved thoroughly disappointing in this branch of observation, and that telescopes of about 8in. or 10in. aperture seem able to compete with the largest instruments yet constructed. If the impartial comparison of results is worth anything, no other conclusion can be arrived at. The mass of published observations and drawings of Jupiter and other planets made in recent years, with every variety of telescope, enable such a comparison to be effectively made, and the result is all in favour of small apertures. This is a fact which fortunately does not need to rest on mere assertion: it is substantiated by evidence of the clearest kind.

I have carefully watched the English and foreign scientific journals for some years, and in collating the results obtained with large instruments, have been much surprised to find no notice taken of certain features distinctly visible in my 10in. reflector. In other instances, I have found described as extremely difficult, objects which are most obvious with smaller apertures; I do not ascribe this to any marked superiority of eyesight on my part, because other observers with specula of less diameter than my own have detected the same features: it can only be attributed to incapacity in these large glasses. The effects of glare from the bright images, and the moulding and flaring occasioned by atmospheric turmoils, have the effect of obliterating those finer details which are distinguished in the sharp and steady outlines afforded by moderately small telescopes in which glare and air disturbance are scarcely appreciable.

It has been alleged that, in regard to the latter instruments, want of light has given the impression of feeble markings where none really exist, and where, certainly, none are found under the scrutiny of large apertures. This is a ready way of obviating the difficulty, but, unfortunately, it is not significant. The disputed features are not mere glimpse-objects, barely within the limits of vision and detected on one or two occasions only; they are well defined in outline, and not only capable of being frequently re-observed during several months, but their passages across the centre of the disc on which they are placed are definitely observed with nearly the same facility as that of a conspicuous marking. And what is even more conclusive still is that they are usually seen by several observers independently, and the descriptions are perfectly accordant with each other.

It is strange to find it insisted on by nearly every one possessing a big telescope, that whatever is visible with a smaller instrument can be seen, and seen better, in a larger one. The statement is remarkable as being opposed to the conclusion derived from the safe judgment formed on the basis of past results. The recorded work of large apertures proves them to have signally failed on bright planets. Whatever their efficacy may be in other lines of research, they have been disappointing in this. For the important thing we have to consider is *what these instruments have done*, not what they are said to be *capable of doing*. The assertion that large apertures will show more planetary detail than small ones contains a self-accusation, or rather a reflection upon those who employ the former instruments, because they have hitherto utterly failed to afford the proofs of their superiority. It seems left to very moderate appliances to correct and extend the work effected by the large and costly telescopes of the present day.

Whether the new 50in. mirror by that unrivalled maker, Mr. Calver, or whether the 36in. object-glass by Alvan Clarke and Sons, now being worked for the Lick Observatory on Mount Hamilton, will do better on the planets it is hard to say. It is stated that with regard to the prospective capabilities of the latter, "when placed in so favourable an atmosphere it is not unreasonable to expect that on the best nights the maximum magnifying power (about 3,500) may be advantageously employed." Surely with this tremendous capacity we may expect to hear of such revelations on the planets as will for ever put the work of small telescopes into the shade! But great expectations, never unfortunately to be realised, have been encouraged before in reference to certain large instruments, and it will hardly be wise in the present case to be over-sanguine.

Bristol, Nov. 9. **W. F. Denning.**

COMPOUND LOCOMOTIVES.

[25007.]—I WAS glad to see by last week's "E. M." that this important question has not been dropped altogether by our readers. All that has been said, however, has chiefly been with regard to Mr. Webb's engines; but the letter of "In Favour of an Old Racer" clearly shows these engines are not worth further discussion, for a compound engine that is not more economical than a simple one is *nil*. Like Mr. Stretton, I have tried to obtain all the information I can with regard to the working of the compound locomotives, and I have had much the same experience as he—viz., they are not a success. The reasons why they are not seem to be: (1) At high speed expansion is carried out *too* far. (2) That the remaining power obtained by compounding is chiefly absorbed by overcoming the resistance of the atmosphere and the increased friction. Mr. Stretton says compounding is excellent for stationary engines and steamships. True, because the piston speed is low, and also the atmospheric pressure is removed by condensing; but I do not quite see how a condensing locomotive is to be made. A very good example of the poor results obtained by compounding a high-speed non-condensing engine was seen at the Stockport trials of road locomotives held last year. Among the engines entered were a double-cylinder engine by Mr. E. Foden, and a 2-cylinder compound by Messrs. Fowler. The trials lasted two days, and as the results obtained are likely to be of general interest I give them now.

The weight of Mr. Foden's engine was 9 tons 16cwt.; that of Messrs. Fowler's 12 tons 12cwt. Mr. Foden's engine, with 120lb. of coal, made 10 laps; Messrs. Fowler's compound, with 160lb. made 12¼ laps. Foden's engine burned 11·3lb. per lap; Fowler's engine burned 12·97lb. per lap.

With the allowance of coal above mentioned the engines had to run with a load of 4 tons as far as they could. The total load moved by Foden was 13 tons 16cwt.; by Fowler, 16 tons 12cwt. It is clear from this that Foden's engine was more economical than the compound. This was the result of the first day. On the second day the steam was raised to 100lb. before the commencement of the trial, the working pressure being 125lb. in both engines. Foden made 8⅝ laps, burning 7lb. per lap; Fowler made 8⅝ laps, burning 9lb. per lap (omitting fractions), the extra weight moved by Fowler being 2 tons 16cwt. The figures quoted appeared in the *Engineer* for Sept. 19, 1884. These figures show there is *nothing* gained by compounding an engine with a high piston speed. My remarks have been till now on express compounds. On goods work the conditions are different. The speed is comparatively slow, the cut-off late, and the load is almost always heavy; and I hope before long some one of our superintendents will try a compound goods engine on Mr. Worsdell's system. I say Mr. Worsdell's because it costs less than Mr. Webb's: also I do not see how a satisfactory goods engine can be built on Mr. Webb's system. For frequent-stopping work, where the train is generally the same weight, the compound system seems suitable; and I think I am right in saying that the small compound on the Metropolitan Railway is the only one on Mr. Webb's system giving really satisfactory results. **G. D. Seaton.**

THE HYDRAULIC RAM.

[25008.]—"J. N.'s" experience, as I now understand it, quite agrees with my own. When I had screwed a pressure gauge on the snift, and then held up the valve, there were several violent oscillations of the needle, corresponding, of course, to oscillations in the motive column, which, however, were not sufficient to allow of the fall of the valve. In this instance the secondary air chamber was full of air, and the motive column was evidently rebounding upon it as a leaden bullet might rebound on an indiarubber floor. I have made several attempts to measure the force with which the valve falls; but have not yet hit upon any satisfactory method. "Water," Todhunter says, "loses [illegible] per cent. of its bulk for every 7,000ft. of pressure. It is perfectly elastic; but, as the figures show, very incompressible."

I wonder if "J. N." has quite taken in the theory of the recoil which I gave from Morin in my letter (24862). To me it appears by far the most probable solution of our difficulty. The case of a ram working into an air ball and delivery pipe is different from that of a ram working with no valve at all. In the former case, elasticity cannot to the same extent be called into play; yet in my experiment with an American ram (24944) the recoil was decidedly greater—i.e., with less help from elasticity there was a greater recoil. There must then be some cause for the recoil beyond the elasticity of either metal or water, if the experiment is to be trusted.

Mr. Davies must excuse me for saying that I fail to see any explanation whatever of the point we are discussing, either in the two authors he quotes or in the quotation from his own articles on the ram. Of what use is it to tell us, however authoritatively, that "the momentum of the water causes a partial vacuum." Nearly every writer on the subject has got as far as this—that there *is* a recoil. It is the *cause* of the recoil which we are inquiring about, and that I maintain has not been correctly explained in any English work I have yet seen.

Mr. Davies's theory about the external atmosphere above the outer valve, if seriously meant, will hardly commend itself to most minds. Such an effect, if conceivable at all, must surely require in the valve a velocity something like that of a cannon ball.

There should be no great difficulty in constructing a ram such as Mr. Davies specifies, but [illegible] doubtful whether any ram would go "contin[illegible] for a year certain" under the conditions [illegible] time the inner valve would be sure.

less, and then the delivery pipe might be emptied in the night and the start in the morning prevented. I should consider only the 10ft. delivery, for if we get the ram to go well at that the rest will follow. Seeing, then, that the pressure in the air ball will be so low, I should use a low head of water, not exceeding, say, 5ft., a large but not long drive pipe, and a large outer valve with just so much metal in it as was required for strength. I should dispense altogether with the secondary air chamber, also with such abominations as springs to assist the drop. To make the ram self-starting it might or might not be necessary to use a float in the supply tank to open and shut a flap-valve on the mouth of the drive pipe, as is sometimes done; if, however, the water was turned on in a stream of sufficient volume to fill the drive pipe at once, and not gradually, the float might not be required. I assume that the drive pipe would be empty (and, therefore, the outer valve down) every morning, for this always is the case when my own ram has drained its supply tank. And now that I have done my best to meet Mr. Davies's requirements, may I beg of him in return to tell me in pounds avoirdupois of what weight the outer valve should be to counterbalance the statical pressure of the motive column. The valve is to be, say, 6in. in diameter and the head of water 5ft. **W. A. S.**

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[57360.]—**Chronometer Balance.**—The question is answered by the law of gravitation, that "the force of gravity varies directly with the mass and inversely with the square of the distance." Therefore, gravity acts with less force on the chronometer balance (or anything else) at the Equator than at the Poles—that is, its weight is less. The effect on a chronometer would be—to lose time. Centrifugal force, caused by the revolution of the earth, is also greatest at the Equator, and tends to counteract the force of gravity; hence must be considered in a question of this kind.—FIRST-CLASS HONOURS.

[57386.]—**Throttle Valve.**—I should recommend an equilibrium throttle valve, as it will shut dead off. The cost of a 6in. valve would be about £8.—BOWLING.

[57575.]—**Amount of Oil used in Engines.**—In reply to "Nun. Dor." and others, the quantities which I give are supposed to be the greatest quantity which a driver should use per 100 miles; but some can do it on less. First-class passenger engine: 3 pints oil, 1lb. tallow per 100 miles. First-class 18in. cyl. goods engine: 5 pints oil, 1lb. tallow per 100 miles; and, for information of others, they are allowed a consumption of 30lb. and 60lb. coals per mile.—B. C. NBSUJO.

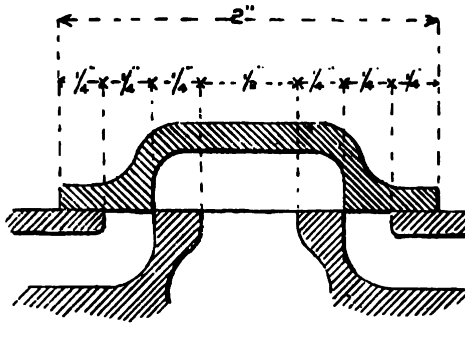
[57579.]—**Invalid Tricycles.**—Much obliged to "Essar." I did apply to some makers; but their machines were on the lever-and-crank principle, except those of a Manchester firm, which were rotary, but were rear-steerers, had no balance gear, no reversing power, no check down hill but the brake which acted on the rubber tires. I wanted something free from these defects.—J. COLBY.

[57628.]—**Watch Work.**—Punch used is what is known in the trade as a riveting-punch; it is a straight flat-ended punch, with a small hole drilled up the centre to allow of an arbor or pivot going freely within. They can be bought at any material dealers for 2d. or 3d. each. Balance or wheel must be tight on, with very slight projection through for riveting. A few gentle taps with punch, turning the wheel or balance round at same time, will make quite fast. Very much smaller punch must be used for balance-staff.—FIRST CLASS HONOURS.

[57633.]—**Acid in Oil.**—"Rera" can ascertain whether oil is acid or contains acid by the usual litmus-paper test, or by means of any of the carbonates (carbonate of soda, for instance), but as to which acid it is, that would require a rather elaborate qualitative analysis. See Allen's "Commercial Organic Analysis," Vol. II.—S. R.

[57634.]—**Photography.**—I have no doubt the process referred to has been described in back volumes; but I have no time to look. When the subject is raised it is more usual to work with zinc, and the process is called zincography, concerning which there was some useful information on page 155.—S. R.

[57505.]—**Engine Query.**—To cut off steam at three-quarters of stroke, the lap on your valve should equal the width of one steam port. Thus [illegible] valve will be 2in. long, as sketched. The [illegible] valve is twice width of one steam [illegible] lap = 1in. With this valv[illegible] no lead, the exhaust will cut off at about seven-eighths of stroke, thus giving cushion; and at the same time the exhaust on steam side of piston will open, so that there will only be steam pressure on one side of piston. As the travel of valve is 1in., the centre of eccentric will be ½in. from centre of shaft. To find the position of eccentric on the shaft, put the crank on its dead centre, and then put the valve in such position that a slight move forward will open that steam port which is at same end of cylinder as piston. Then fix eccentric. If this is not clear, I shall be glad to help the querist if he will advertise his address; and also, to send him a rough model of cardboard that I made of his valve, &c. I think the ports are quite large enough.—BOWLING.



[57639.]—**Privet.**—This plant is not very delicate; but the best time to remove is now up to February. It is very hardy stuff, and for all I know (not having tried), would stand a lot of "burying;" but, as a rule, trees and shrubs of all kinds should have their roots covered to about the same depth as they had before removal.—NUN. DOR.

[57643.]—**Mechanical Singing Bird.**—If this querist will say what is his difficulty with the whistle, he might perhaps obtain an answer. The whistle is of the ordinary kind, and, as explained, a piston moving in it varies the pitch.—S. R.

[57645.]—**Removing Blacklead from Brass.**—This is one of the "helpless" queries. If turpentine will not remove the blacklead, try a piece of fine emery cloth.—NUN. DOR.

[57656.]—**Locomotive Slide Valves.** — Mr. Gobert answered this query as recently as No. 1,008, p. 447. It is explained in No. 962, p. 601; No. 899, p. 338; and there is an article by Mr. Joshua Rose in No. 652, p. 32.—NUN. DOR.

[57657.]—**Gun-stock.**—If querist cannot use a carving tool, he can make a very good "roughing" with a three-square file. Of course, it is possible to convert a muzzle-loader into a breech-loader; but whether it would be possible for "Gunsmith" to do it depends. Should think not, as he asks such questions.—C. L.

[57658.]—**Balloons.**—These are made by cementing up plastic rubber into a hollow ball, and then forcibly expanding by wind pressure.—JEROME.

[57662.] — **Colouring Photographs.** — This question is answered in nearly every volume. Querist should consult his indices, and try those methods which appear to him most likely to suit his abilities. There is a good process on p. 206, No. 1,050.—CAMERA.

[57664.]—**Blacking Brass.**—I suspect the blotched condition mentioned by "Old Subscriber" is due to the fact that the brass was not thoroughly cleaned. Let the querist read an article in No. 944, p. 168, and put his "considering cap" on; or, better still, make a few experiments.—NUN. DOR.

[57673.]—**Oil Stove.**—Any stove which has sufficient dimensions of wick to raise the temperature to the required degree. N.B.—Oil stoves are very expensive in working.—NUN. DOR.

[57677.]—**Travelling Light.**—Plug the wall with wood, and screw the brackets to the wood plugs in the ordinary manner. Put washers of vulcanised fibre between the bracket and the brass rod, and insulate the screw from either the rod or the brackets by means of washers. The screw must pass through either the bracket or the rod without touching the metal.—S. R.

[57678.]—**Cement.**—Plaster of Paris; shellac; Portland; finely-powdered chalk and soluble glass. Powdered glass 10 parts, powdered fluorspar 20 parts, and soluble silicate of soda 60 parts, both powders in the finest possible condition; mix rapidly and apply at once.—NUN. DOR.

[57680.] — **Distillation of Essences from Plants.**—This querist wants a still, and had better have one of copper; dimensions depend on quantities of plants to be distilled and on size of the "Fletcher's gas-burner" — scarcely a definite phrase, for Mr. Fletcher makes them small enough to boil a kettle on the parlour table, or large enough to melt a hundredweight of lead in a few minutes.—NUN. DOR.

[57743.]—**Microscope Eyepieces.**—I must take it for granted that Dallmeyer's Orthoscope is the same as anybody else's ortho., in which case it is Kelner's. Kelner's is the achromatic ortho. eyepiece, Ramsden's is the ordinary micrometer eyepiece, made of two plano-convex lenses of equal focus, placed at such a distance apart as to throw the combined focus just a little below the lower lens. Now, my "Countryman" must take (honestly) an achromatic lens of 1in. focus; also an equi-biconvex simple lens of 2in. focus; fit them 1in. apart, that is, so that the near surface of the plain lens is in the focus of the achromatic lens. That will be a B orthoscopic. A C will be made on the same plan with lenses of ¾in. and 1½in. foci. A rough and ready way to tell crown and flint glass, the only one that I know of, is to find its specific gravity crown glass = about 2·6, flint about 3·3. I should have sent this before, but courtesy required that I should give "Procella" a chance first. I will give further information if required, and it is in my power.—ROB. CRUS.

[57756.]—**To Mr. Wimshurst.**—Many thanks for your advice. I shall attend to your suggestions about the vulcanite washers on bosses. My varnish is ordinary spirit varnish; but I do not place much confidence in it, and will make some new stuff, and apply it. My balls are equal size, but I shall alter them. Sectors are 3½in. long; plates 18in. The wire for the brushes is good brass, not tinsel. I shall report after the alterations. As I live in Scotland my frosty day is accounted for.—C. P. C.

[57771.]—**Commonplace Book.**—I do not think the plan proposed by "Norman" for keeping a commonplace book is a good plan, as it entails too much labour, and the entries are too scattered. Permit me to suggest what appears to me a better plan. Get half a sheet of foolscap paper, and cut it up, say, in three slips, or, if you like, only in two. In fact, you may cut your slips to any size; but having commenced to adopt one size of paper, that must be adhered to. Make your entries on these slips, heading the top of the slip with the subject. Sort these slips in alphabetical order, and according to taste tie them up longitudinally with string or an indiarubber band; the paper can either be broad or narrow-ruled, according to taste. Devote a drawer of suitable size for the keeping of these slips. If a drawer in a chest of drawers, ordinarily used for clothes, is used, it would hold in depth two sets of slips, and a light wooden tray might be easily made to contain the second tier of slips. The advantage of using slips is that in collecting information on any one subject you can always add to the slips, and extend them without difficulty, and thus you have all the information on the one subject together. The cross indexing described by "Norman" can easily be carried out, as you have simply to head a slip, and put it in its alphabetical place, referring to the parent slip where the information is treasured. By my plan you save the trouble of a separate index, and what cross references that have to be provided are done at the time. This is also a useful plan when a man has a large library, either to index the books or to index subjects with reference to the books, in which the subject is treated upon. Of course, care is necessary in keeping the slips in place, and they should be beyond the reach of ladies or servants who have a propensity for "clearing." If the ultimate intention is to bind them up in book form, then the slips must be cut in double sheets, so that they may be stitched. Single slips may be bound if, as bookbinders term it, they are "stabbed"; but the binding is not so satisfactory. For years I have used loose sheets of foolscap for pasting-up newspaper cuttings. The advantages are: (1) You can the better sort your cuttings in subject order, and have them bound afterwards, each subject in a separate volume; (2) you can form the cuttings better on a loose sheet, and press and dry it better, than in using a scrapbook, where one damp leaf damages another dry one.—E. R. IVATTS.

[57810.]—**Dynamo.**—To MR. BOTTONE.—For converting your series-wound machine into a shunt-wound machine, and for instruction as to the proportion and size of wire to be used, as well as to the mode of coupling up, please refer to Vol. XLI., page 564, of the ENGLISH MECHANIC. If the matter is then not clear to you, I will, provided you give me full details as to the present condition of the machine, such as size of fields, size of armature, and amount of wire on fields, &c., furnish you with sketch.—S. BOTTONE.

[57813.]—**Gramme Dynamos.**—Will Mr. W. H. Eaves pardon me if I point out that if the machine figured on p. 207 had the wires wound, and the current flowing as indicated by the arrows, the poles would be just reversed to what the illustration would lead us to believe? The illustration under reply 57842 shows the correct flow of the current.—S. BOTTONE.

[57846.]—**Chamber Organ.**—To "MECHANIC."—In your specification, you have not included the important foundation stop "open diapason." In a small one-manual organ, I think a clarionet stop out of place, and I should also insert a principal instead of the flute for several reasons. If you have sufficient room to place the instrument, don't you think it would be better to build a two-manual? Say, open diap. C; stop diap. bass; stop diap. treble C; dulciana C; and principal C C, for great organ; and for swell, keraulophon C; gamba C; stop diap. bass (small scale), and stop flute. Couplers: Super octave, and swell to great. In the ENGLISH MECHANIC for August 21st you will find a reply of mine to "Anxious" on organ building, and would draw your attention to the remarks therein as to pedal bass. See also the October monthly as to scale for dulciana separate bass. If I can be of further service, let me know. The above specification can be reduced a stop each in great, and swell if chosen.—A. EVANS, Bank, Llanduduo

[57861.]—**Portable Electric Light.**—"Electric Light" can get reliable lamps from most makers, taking 1 volt per c.p. A 10 c.p. lamp would take about 7 Bunsen or Grove cells. I can strongly recommend the Burke and Holmes form of cell, as being powerful and lasting. I will forward a description of some cells I have if you like.—P. C., Hornsey.

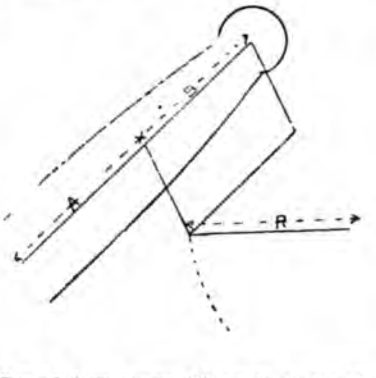
[57863.]—**Boiler.**—I consider that "L. W. D.," p. 208, has a very badly-arranged boiler if any of its tubes are not always full of water. He must be a furious firer if he melts brazing of tubes. Query: Was it not soft solder? I have a copper boiler, height 21in., diameter 11in., central flue 2in. diameter; 14 cross-water tubes; safety valve, largest diameter, ¾in.; area of aperture, say, ½in. It is quite superfluous to put two safety-valves as "Belgian" proposes on p. 171. With coal alone, this gave great trouble from choking; but mixture of one-half coke answers well, and easily supplies a cylinder of 5in. stroke by 2½in. bore; it also has "Bourdon pressure-gauge" and a glass water-gauge, and was tested up to 220lb. per square inch. I feed it by the method which we were patenting some time ago until stopped by a previous American patent, which was evidently copied from our specifications and published in these columns some time since by "Invicta."—A., Liverpool.

[57864.]—**Magneto-Electric Machine.**—To MR. BOTTONE.—The querist evidently wants, as you say, a machine with bobbins in the armature; but then you say "such a core is known as the Victoria." If you mean such a machine known as the Victoria dynamo, supplied by the Anglo-American Brush Company, you are wrong: the Victoria machine has no bobbins in the armature whatever, neither has it any wire cores whatever. Then what do you mean by the "running resistance"? It reads as if you wanted the querist to test the resistance while the machine was running, which, of course, would be impracticable. If you would kindly explain, it would oblige—P. C., Hornsey.

[57894.]—**Dynamo.**—To MR. EAVES.—For your reply to my query I am much obliged. I have tried your suggestions as follows. The machine running at 2,000 revolutions (measured) as series, with limbs of magnets in parallel, and six eight volt five c.p. lamps in circuit, fully lighted, and absorbing five ampères. Under these conditions, I understand the E. M. F. is less than half what it should be? R of A between brushes (measured) ·43 ohm.; magnets ·21. I then put the limbs in ordinary series, not in parallel, bringing their R to 1·23 ohm, this being the nearest I can get to the one ohm you advise, and to light the lamps fully it had to be driven considerably faster. Though the whole five ampères in this arrangement circulates round each limb, whereas it is divided between the two in the former, the magnetism does not appear to be increased, so the extra resistance is so much extra work for nothing. The cores of the magnets are 8½in. by 4½in. by 1in., and pole pieces 6½in. long by 3in. by 3in., ordinary cast iron, and weigh 36lb. each. The armature drum is ordinary cast iron, 6in. long, with ten small cogs to form divisions 3in. outside diameter, metal ⅜in. thick, two coils in each space, and ten altogether, and the same number of segments on commutator. Please pass your opinion on the wiring. Should it do for a shunt machine, and is there any hope for improvement without reconstructing? Thanking you for trouble taken.—CARNFORTH.

[57896.]—**Belts v. Pulleys.**—Try running the belt with the smooth (or grain) side next to the pulley. If laced, have a neat butt joint (not a lap joint). The best thing for all machine belts (leather) is castor oil. There is nothing to beat it, both for preserving the leather and increasing its adhering power. Pour a little on the belt whilst it is running; stand by with a stick to keep it on the pulley, as it has a tendency to run off at first, but in a minute or two it will be all right. Do not use resin on any account, as that very soon destroys the belt.—FERRUM.

[57903.]—**Beam-Engine Repairs.**—To find the length of the radius rod of the parallel motion of a beam engine, divide the length from centre of air-pump studs to centre of cylinder-studs into the square of the length from centre of beam to centre of air-pump studs.



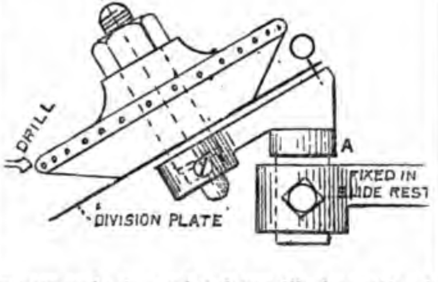
A = Length from centre of beam to centre of air-pump stud.
B = Length from centre of air-pump studs to centre of cylinder studs.
R = Length of radius rods.

$$R = \frac{A^2}{B}.$$

To find the versed sine of the arc described by the beam of an engine.
S = Stroke of the engine in inches.
R = Radius of arc described in inches.
V = Versed sine in inches.
$V = R - \sqrt{R^2 - (\frac{1}{2}S)^2}$.—T. R. SAXTON.

[57919.]—**Breaking in Pony.**—First of all, feed him well, and clean him well, and make a pet of him. Put him in chain harness between a couple of horses, and be kind with him in all respects; and, when he has been there a week or fortnight, put him in cart or trap harness, as you wish him to have. Be careful when you put him in cart, as Welsh horses are more frightened than others, in my idea. Use a broken bit for him, and you will be able to hold him better.—SNOWSTORM.

[57921.]—**Drilling Bicycle Hubs.**—I have drilled a few with a simple contrivance as per sketch, and find it answers very well. Of course you can make it any bevel you like by putting it farther round at A in socket; and if you make the plate large enough, it will do for any size hub or any number of holes that the plate is divided out to.—E. A. W.



[57921.]—**Drilling Bicycle Hubs.**—Do you mean the correct angle to drill the holes so that the spokes on both sides meet at the rim? If so, the angle will vary for each diameter of wheel. The only way of finding the angle is to set out a drawing of a cross section of the wheel through the axle. When turning the hub in the lathe, instead of making the sides square with the centre line of axle, make them at the same angle that the spokes make with the centre line of axle. You will then have a guide for fixing it on the table of the drilling machine; for if you tilt the hub until the upper part of its side is square with the machine, then when the holes are drilled perpendicular they will be at the correct angle. With regard to the marking off, the only way is to equally divide it with the compasses, unless you have a division plate fixed on a mandrel.—FERRUM.

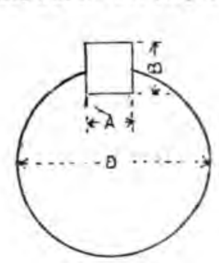
[57928.]—**Cutting Carbons.**—In the replies which appear under another heading on page 209, "Bobadil" and our old friend "Sigma" speak of "silver sand" for cutting carbons. I do not know what "silver sand" is like in Birmingham, but in London one goes to the oil-shop for it, and gets a sand which has usually a lot of mud with it, and each grain of which is rounded. There is a coarse sharp silver sand which comes from Reigate, I believe; but you will never get that except of a dealer in horticultural requisites. A friend of mine, a glass cutter, uses a sand which comes from Wimbledon, every grain of which is angular and as sharp as possible; that would be the kind of stuff to use for cutting carbons, with a bit of hoop or soft iron, not steel, and is, I suspect, what "Sigma" means when he says "silver sand," which, in London, does very well for cleaning pewter, because it has so little cutting power. I fancy that glass cutters' "mud" would be capital stuff for slicing up retort scurf if the finer particles were taken out of it. Anyhow, carbon cutting is a good test of an amateur's patience.—NUN. DOR.

[57931.]—**Legal.**—A. can transfer his business to any other premises in which it may be legally carried on (6 Geo. IV., c. 81, s. 21). After obtaining magistrates' authority for the transfer, he must give notice to the Inland Revenue officer of the district, in order that the particulars of the transfer may be endorsed on the license for the original premises.—J. R.

[57932.]—**Telescopic.**—You can improve your present arrangement as a telescope, but it would cost you more than it would be worth ultimately. You would require four lenses in the eyepiece alone, and if you have no optical knowledge, it would be a very difficult task for you; but Mr. Lancaster would supply you with a set of lenses with instructions, or you might buy a second-hand eyepiece for a few shillings. It is possible to get rid of the spherical aberration, but no form or shape of a single-lens o.g. will prevent the formation of the coloured image that troubles you. You might find a concave flint lens to match your present convex o.g., but it is likely to prove a very difficult and tedious search. You will never make a telescope worth having with your present o.g., but if you do not wish, or cannot afford, to buy an achromatic of this size, or even 2in. diameter, your best course would be to buy a double concave eye lens of 1½in. or 2in. negative focus, and use it in place of the convex eye lens you have now. This will reduce the colour, give an upright image of an object, and very fair definition on terrestrial objects. I shall be very pleased to advise you further if you insert another query.—J. C. L.

[57912.]—**Damping up Fire.**—Try putting on a large quantity of small coal, and close the ashpit damper and door entirely; have only a small fire, and after it has been clinkered.—FERRUM.

[57943.]—**Keyways.**—The proportions for keys are—



When D = 3⅛in. and above.

$$A = \frac{D}{6} \text{ and } B = \frac{D}{8}.$$

When D = less than 3in.

$$A = \frac{D}{4} \text{ and } B = \frac{D}{4}.$$

—T. R. SAXTON.

[57943.]—**Keyways.**—The most important point is that they should be square with the face of the boss. This you are aware of. Do you want to know the exact width and depth, for these measurements vary with each diameter of shaft and will be found in Molesworth or any sin work. Knowing the width and de mark them out by a circle struck of the pulley, and by making th on one side you can give any degr you may require. I shall be pleased to give a table of size of keys if required.—Ferrum.

[57945.]—**Galvanometer Resistance.** — The desired reference is to be found in Vol. XVIII. "E. M.," p. 567. It is under the heading "Testing Battery," &c.—An A.S.T.E.

[57946.]—**Small Compound Wound Dynamo.** —To W. H. Eaves.—If you wind the armature with 2lb. of wire, then, to compound the machine, wind the magnets with No. 20 and No. 14, 10lb. of No. 20 for the shunt coils, and over this two layers of No. 14 for the series coils. You must connect the ends of the shunt coils to the brushes, as at the terminals of the machine the E.M.F. will not be high enough. If your sketch is intended to convey an exact idea of the dimensions of the F.M.'s I am afraid you have got the yoke too thin.—W. H. Eaves, Coventry.

[57948.]—**Cone Pulleys.**—The way I should take to remedy this would be, if the cones would allow, to turn down the offending diameters, and if there is not stuff enough, I would forge a thin iron ring and shrink it on, and then turn it up to suitable size.—A., Liverpool.

[57948.]—**Cone Pulleys.**—Unless the diameters of the steps vary proportionately, it is impossible for the belt to be tight; therefore, the only thing that can be done is to make the diameters proportionate. To do this you must either reduce those that are too large by turning them down, or increase those that are too small. If you have room fasten a piece of belt on by cone-headed screws, and Pront's glue. Drill and tap the holes on step, then put the cone over the gas, and make it sufficiently hot to melt the glue when rubbed on, and while still hot draw the piece of belt tightly round, and screw on, and leave it to cool. This makes a first-rate job. If there is not sufficient room for leather, screw or rivet on some sheet iron or brass. —Ferrum.

[57949.]—**Electrical Units.**—To Mr. Bottone.—After the beautifully clear and explicit explanations given by "our" Mr. Sprague in the English Mechanic, I feel it would be a work of supererogation to attempt any further elucidation of the electrical units. With regard to the particular example for which information is asked, I may say: Size of plate has no influence whatsoever on the electromotive force, since each element is gifted with a certain E.M.F. or "volts," and no more; as in heat, ice has always 32° and steam always 212°, and a large block of ice is no colder than a small one, nor a large volume of steam any hotter than a small one. Hence, whether you use two zincs or twenty, one carbon or fifty, if all the zincs be coupled together so as to form but one plate, and all the carbons be also coupled so as to form one plate, then the E.M.F. is, and can only be, that of the zinc, minus the counter E.M.F. of the carbon. For the very best constructed batteries this amounts to about 2 volts. But please remember that "volts," or E.M.F. is that which sets up electricity, but it is no more electricity than a pump is a stream of water. Now to increase volts we must be able to add the E.M.F. of one plate or element to that actually existent in another. Say, for example, that we had 20 pumps, each capable of throwing water to a height of 60ft., and no more. If all twenty pumps were playing at once, on one particular spot, the height of the water would still be 60ft. (the E.M.F. would be the same), though the volume of water thrown (the ampères) would be very much greater. But suppose we throw the water by one of the pumps to a height of 60ft. into a tank (the negative plate), and then connect another pump (zinc plate) to this tank. Now the second tank can throw the water up another 60ft. Hence while one pump, or twenty pumps in parallel, could only throw the water 60ft. high, so one plate, or twenty plates in parallel, can only give about 2 volts; but couple up the pumps in series, pump to tank, pump to tank, pump to tank, and so on, and you can raise the water to as many times 60ft. as you employ pairs of pumps and tanks; so in the case of the battery, by coupling up the zinc to next copper, zinc to copper, and so on, you get just as many times 2 volts (for example) as you use cells thus coupled up.—S. Bottone.

[57952.]—**Electro - Motor.**—To "Sigma."—"H. B." is correct in the conclusion which he draws that the law is to obtain the greatest number of ampère turns, and equal resistance in motor and battery. But this, while giving a principle, does not apply it, because the same result may be obtained from one cell and large wire, or several cells and small wire, and that with same expenditure of action in the battery. I should prefer the large wire and cell, but the other is more often used because the smaller wire is more manageable. As to nitric acid and its work, I think "H. B." (if the [illegible] one) has my book, and if he refers to the [illegible]stances used in electrical working he [illegible] [illegible]id of 1,400 sp. gr. contains 78 ÷ 5·7 [illegible]er lb. for 10 hours, [illegible] 110 [illegible]n considerations ex[illegible] on p. 146 of the second edition, as to the reaction effected and the E.M.F. developed, the actual work might be either one half or double that figure. Wooden cells are not suitable for nitric acid, which passes out by endosmose, and is sure to attack them. But I have made a tolerably successful cell of wood, well boiled and coated with paraffin, upon which sheet glass has been made to adhere by warming it.—Sigma.

[57954.]—**Piano.**—I have seen pianos with a plate of sheet brass screwed on the face of wrest-plank, and drilled for the pins to pass through, and so take the strain. This would be much easier than the plan you propose.—A, Liverpool.

[57956.]—**Arc Lamps.**— If this correspondent will turn to my articles on "Experiments with the Dynamo," which appeared in the English Mechanic for 1884 (between June and July, I believe), he will find figured and described an excellent arc lamp.—S. Bottone.

[57957.]—**Electro-Motor.** — Three bichromate cells, gallon size, used as a dynamo. It might light four 5-candle lamps; but the disproportion between the amount of wire on the fields and the armature is too great to admit of the machine working well, either as a motor or a dynamo. If the two legs of the field magnets were coupled up in parallel instead of in series, the resistance would be just right, and you might get three or four 10-candle lamps well lighted. One man-power is practically the work a man can do, and is equal to about 5,000ft-lb. per minute. It may be measured by a dynamometer.—S. Bottone.

[57958.]—**Faulty Dynamo.**—Probably this is wrongly coupled up. Exact directions, with the necessary explanation for finding the flow of current from the armature, will be found in my book "The Dynamo: How Made and How Used."—S. Bottone.

[57959.]—**Brass Mixture.**—The best mixture for brass bolts and screws will range from 80 copper 20 zinc to 65 copper 35 zinc; but not more than 35 per cent. of zinc should be used in brass for mechanical purposes, unless a little tin or lead is added to the alloy. Copper 76, zinc 23, lead 1 makes a good tough brass; the strongest alloy of the kind is made of copper 55, zinc 44·5, tin 2·5; or, as a standard percentage alloy, copper 55, zinc 43, tin 2.—Nun. Dor.

[57959.]—**Brass Mixture.**—Equal parts of best pure copper and old brass, melted together in a crucible along with a piece of wood to flux, size of wood, say, equal in bulk to either brass or copper; then, when melted nice and thin, draw your crucible; then add 1lb. each of tin and lead to every 14lb. of copper mixed, stir well up from the bottom of crucible with an iron skimmer, then cast up. You will find this a good tough metal. The best copper to get will be old loco. fireboxes or copper tubes. The old brass must not be common yellow stuff; better get old gunmetal fittings; the brass is to make copper more solid in grain, and is much better to finish or work up.—Brass Moulder.

[57960.]—**Dynamo.**—To Mr. Bottone.—The cause of the sparking is wrong position of the brushes, and perhaps some defect in the form of the pole pieces. Can be wound compound; improvement doubtful. Gramme will not do.—S. Bottone.

[57961.]—**Small Dynamo.** — From your description, and especially from the fact that there is a heavy drag on the armature when the machine is not coupled up, I should imagine that the machine short-circuits at some point. In Patrick's older form of dynamo, one end of the wire on the armature was fastened to the iron of the armature itself. This was very bad, as it produced a tendency to leakage round the field-magnet cores. Of course, if the machine is connected to any outer circuit, part of the current flows round the magnets through the leak, and part through the outer circuit. Such a machine, if properly constructed, would give 35 volts and 8 ampères.—S. Bottone.

[57962.]—**Material to Stand Intense Heat.** — Platinum, iridium, fire-clay, alumina. — S. Bottone.

[57962.]—**Material to Stand Intense Heat.** —Some of the pure sandstones, or ganister, will stand any heat; but I will not vouch their doing so in presence of lime, which might flux them into a glass.—Sigma.

[57968.]—**Length of Musical Strings.**—"A Poor Lad" does not say whether it is C below treble or bass stave. I take it, however, that it is below treble; if he uses wire it will need to be the covered wire used in pianofortes; but I have no idea how they will work for a harp. I think it would be best to order a set of harp strings (they are made of gut) from, say Lafleur, musical instrument sellers, London. In this way he would get exactly what was required for his purpose.—Jason.

[57969.]—**Eclipses of Satellites.** — Without the sight of an eclipse, it is doubtless possible, if the satellites of Uranus are observed with extreme accuracy, to find, in one year, which side of their foreshortened orbits is nearest to us, and hence in which direction they revolve. If the earth did not move we should have no means of ascertaining this; but by comparing the perspective shapes of the satellitary orbits at the season of the planet's evening quadrature and that of his morning quadrature, we may find at which of these times they are most foreshortened, and hence whether their east or west side is nearest us. The case of Neptune, however, where the difference will be far less, for two distinct reasons (the relative smallness of annual parallax and the low inclination of the satellite's orbit) must be far more difficult, unless eclipses have been seen.—E. L. G.

[57970.]—**Walnut Oil.**—This oil is used almost all over the Continent, to the exclusion of linseed oil, as it dries without the use of driers. It can be bought in England under the name of nut oil and walnut oil from any wholesale druggist.—S. Bottone.

[57970.]—**Walnut Oil.** — There is not much "news" in the statement made, and the correspondent can obtain walnut-oil of most dealers in artists' materials. It is called walnut-oil, comes mainly from the south-east of Europe and Asia-Minor, and is highly siccative. The oil is greenish or yellowish, rather syrupy, and when fresh has a pleasant faint smell and a nutty taste. It is acrid when stale. Quicker than linseed-oil in drying in just such proportion as this—that whilst in a table linseed-oil might be marked siccative, walnut-oil would be marked very siccative; but that is partly due to the fact that, as a rule, the walnut-oil of the shops is more carefully prepared than the linseed-oil.—Nun. Dor.

[57975.]—**Clock Star.**—The performance of a centre second watch will not equal that of one made in the ordinary way. The great weight and long leverage of centre second hand prevents escape wheel getting into action as sharply and rapidly as it would if exit wheel was not loaded with a hand that acts somewhat like a fly; also the extra motion work required is not in its favour. A key-winding watch, provided it is of fusee construction, is likely to perform better than an ordinary keyless watch, with going hand as usually made; but if the keyless watch is also of fusee construction, then there should be no difference of performance, the keyless work having no effect on performance of watch. Certainly the daily rate of a first-class lever watch could be within rate given (5 or 6). One second + or − is not unusual.—Pegandredstuff.

[57975.] — **Centre-Seconds Watch.** — 1. A centre-seconds watch would not, generally speaking, be as accurate as an ordinary watch of the same grade. Centre seconds require to be of the highest quality and finish to obtain anything like a good rate, and often, when very well made, do not give the best results. Centre-seconds watches cannot be recommended to non-professional men—a good ordinary style watch is much more serviceable. 2. There is a difference in principle between the two which "Clock Star" does not appear to be aware of. The usual keywinding watch has a fusee; the usual keyless watch has not, the spring being wound direct in the latter. In the ordinary run of watches there is practically no difference in the rate of either fusee or going-barrel keyless watches; but where scientific accuracy is required, the fusee watch is infinitely superior, and is always used. Those watches are also made keyless. The keyless work itself has nothing to do with the accuracy of a watch; it is mainly a question of convenience. Keyless watches will doubtless in time displace keywinders, because they are so much more convenient; the watch itself is better protected from dust, damp, or injury, the cases being closer, and need never be opened except by the watchmaker. 3. From half a minute to a minute a month—i.e., from one to two seconds ± daily, is a first-class rate for a good pocket watch.—First-class Honours.

[57976.]—**Elliptical Firebox.**—To "Glatton," "Boswell," and Others.—Rankine gives the following formula for calculating approximately the collapsing pressure P, in pounds on the square inch, of a cylindrical plate-iron flue, whose length L, diameter D, and thickness T are all expressed in the same units of measure :— $P = 9{,}672{,}000 \frac{T^2}{L\,D}$. For an elliptical flue it is found by substituting in the preceding formula for D, the diameter of the osculating circle at the flattest part of the ellipse—that is, let A be the greater and B the less semi-axis of the ellipse; then we are to make $D = \frac{2\,A^2}{B}$.—S. J. R., Cardiff.

[57979.]—**Cuttriss Motor.**—To Mr. Bottone. —Put on about ½lb. of No. 18 on the armature, and about 1lb. of No. 16 on the fields.—S. Bottone.

[57646.]—**Steam-Engine Formula.**—Before explaining the formula under this number, at page 207, it may be observed that the numbers 1, 2, 3, which are all put in this formula as indices, ought obviously to be suffixes, and I shall here make the proper change in each. The equation, then, has three terms on the right side, each of which must be computed separately. The first term is $a \cdot \text{hyp. log.}\ \frac{t_1}{t_2}$, in which $t_1 = 718{\cdot}2^\circ$ and $t_2 = 4932^\circ$; hence

$$\begin{aligned} \text{hyp. log.}\ \frac{t_1}{t_2} &= 2{\cdot}302585 \times \text{com. log.}\ \frac{718{\cdot}2}{493{\cdot}2} \\ &= 2{\cdot}302585 \left(\begin{matrix} 2{\cdot}8562454 - \\ 2{\cdot}6930281 \end{matrix} \right) \\ &= 2{\cdot}302585 \times {\cdot}1632223 \end{aligned}$$

And the first becomes

$$1109550 \times 2{\cdot}302585 \times {\cdot}1632223$$

Hence—

$$\begin{aligned} \text{Log.}\ 1109550 &= 6{\cdot}0441468 \\ \text{Log.}\ 2{\cdot}302585 &= {\cdot}3622185 \\ \text{Log.}\ {\cdot}1632223 &= \bar{1}{\cdot}2127734 \\ \hline \text{Log.}\ 416040 &= 5{\cdot}6191387 \end{aligned}$$

And the first term is 416040. The second term is—

$$\begin{aligned} b\,(t_1\ t_2) &= 540{\cdot}4 \times 225 \\ &= 121590 \end{aligned}$$

The third term is

$$v_2\,(p_2 - p_3)$$

in which v_2 is the volume of 1lb. steam at the temperature of 32°. An approximate formula is given by Rankine for the ratio of v_1 to v_2, which is—

$$\frac{v_1}{v_2} = \left(\frac{p_2}{p_1} \right)^{\frac{9}{10}}$$

Now we find the value of v_1, at page 187, to be 12·672 for the volume of 1lb. steam at a pressure of 33·7 per square inch—

$$\therefore v_2 = 12{\cdot}672 \left(\frac{33{\cdot}7}{{\cdot}085} \right)^{\frac{9}{10}}$$

$$\begin{aligned} \therefore \text{Log.}\, v_2 &= \text{Log.}\ 12{\cdot}672 + \tfrac{9}{10}\,.\,\text{log.}\ \frac{33{\cdot}7}{{\cdot}085} \\ &= 1{\cdot}1027766 \times \tfrac{9}{10} \times 2{\cdot}5982110 \\ &= 3{\cdot}4411665 \\ \therefore v_2 &= 2761{\cdot}6 \text{ cubic feet}; \end{aligned}$$

and the third term is—

$$2761{\cdot}6\ (p_2 - p_3).$$

In this p_2 the terminal pressure is equal to 12·24lb. per square foot; but the back pressure p_3 has not been given. All we know about it is that it is less than p_2. When the formula is used for high pressure, p_3 is the pressure of the atmosphere; and if the steam is discharged into a condenser p_3 is the remaining pressure in the condenser. In the present case we may assume it to be a little less than p_2; suppose it to be 11·9, then $p_2 - p_3 = {\cdot}34$. And the third term becomes—

$$2761{\cdot}6 \times {\cdot}34 = 938{\cdot}944.$$

Adding this to the computed value of the first term, and from the sum subtracting that of the second term, we have—

$$\begin{aligned} \text{Work in foot-lb.} &= 416040 + 938{\cdot}944 - 121590 \\ &= 295{,}388{\cdot}94. \end{aligned}$$

The number quoted in the original question is—

295,410 foot-lb.

Had we assumed $p_3 = 0$, which would be equivalent to discharging the vapour into a vacuum, we should have found as the result, 329,246ft.-lb. With reference to the formula at page 187, the effect of putting ·085 in the formula as the tension of vapour at 32° would not be to make so great an alteration as "Ungenannt" fears; the characteristic of the logarithm would still be 5, and not 7. In fact, we should have to put the logarithm ·4146726 in the computation in place of ·3188143, and the result would be 5·5657098, which is the logarithm of 367,880; this is, of course, too large, and it is owing to my having used $\frac{p_1}{p_2}$ as the approximate value of $\frac{v_2}{v_1}$ in the formula; work in foot-pounds $= V p \,\text{log.}\, \frac{v_2}{v_1} \times \text{hyp. log. } 10$. If, however, we use the value of $\frac{v_2}{v_1}$ found above by Rankine's approximate formula, we shall find that the result will be 337,550ft.-lb. as compared with that of Rankine's formula when the back pressure is supposed to be zero.—MILVERTON.

[57975.]—**Centre Seconds Watch.**—A centre seconds watch is not to be advocated where great accuracy is desired, as that mode of planting the hand entails additional friction, and consequently is liable to affect the performance of the machine. Still a good centre seconds watch will keep excellent time in spite of its drawbacks. As regards keyless watches, there is nothing to prevent a fine fusee keyless performing as well as one of the same class without the keyless work; but such watches (fusee keyless) are very expensive, and unless carefully made, give a great deal of trouble. A going-barrel keyless watch with properly tapered main spring and timed in positions, will give very good results; but with the best of them there is always a small "winding error" (about a couple of seconds per day), which is only perceivable by checking the watch by some standard at different hours of the day. The same watch, with properly adjusted fusee winding with a key, would be without this error. The present fashion is all for keyless watches, and, I believe, the prevailing idea is that they will run so very much longer without cleaning. But no watch case will prevent the oil either drying up or thickening, and it is when that happens that a watch requires cleaning. Given a well-made case and a wearer who is not always opening it to "look at the works" or "move the regulator," and it will be found that all the dust that finds its way in will not prove so very mischievous. In answer to the remaining query, I submit the following couple of watch rates, for the truth of which I can personally vouch, and indeed could send some others about as good. The watches are both precisely similar, being ¾-plate fusee levers, sprung with the ordinary flat spiral spring with index, compensated for temperatures and positions, guaranteed for eight years, and costing, in 18 carat gold cases, £16 (sixteen pounds). They are entirely of English manufacture, and were obtained directly from the maker in Clerkenwell, who sprung and adjusted them himself.

	Date.	Mean Daily rate. Seconds.
1884	March 6	− 1·00
	" 13	+ 0·40
	April 1	− 0·13
	May 9	+ 0·43
	June 24	− 0·47
	Sept. 8	− 0·63
	Oct. 8	− 0·03
1885	Feb. 23	− 0·60
	April 13	
Oil dried up at fusee pivots, and watch stopped.		
	July 4	− 0·17
	Aug. 31	− 0·00
	Oct. 1	+ 0·30
	" 20	+ 0·50
	Nov. 7	
1883	March	− 0·97
	April	− 1·35
	May	− 1·09
	June	− 0·39
	July	+ 0·25
	Aug.	+ 0·70
	Sept.	+ 1·21
	Oct.	+ 0·50
	Nov.	− 0·87
	Dec.	− 1·46
1884	Jan.	− 2·42

In conclusion I will just remind "Clock-star" that he must expect to pay from £25 to £30 if he goes to shopkeepers for watches like the above.—LADY OF THE LAKE.

[57981.]—**Power of Pocket Lens.**—(*a*) It does. (*b*) Yes.—ROB. CRUS.

[57981.]—**Power of Pocket Lens.**—1st, yes; 2nd, yes.—S. BOTTONE.

[57981.]—**Power of Pocket Lens.**—Any lens is said to magnify 10 diameters, or "linear measurement" as it is sometimes termed, when a line or, as supposed, the diameter of a circle, appears 10 times as long: this is in contradistinction to square or superficial measurement, which of the magnifying power in question would be 100.—L. E.

[57983.]—**Electrical.**—TO MR. BOTTONE.—Length of armature (laminated), 4in. by 1½in.; height of fields, 6in. by 4in. wide, ½in. thick. This would light three tens, or six fives.—S. BOTTONE.

[57984.]—**Dynamo to Melt Wire.**—TO MR. BOTTONE.—You will require an E.M.F. of about 35 volts, and a current of about 8 ampères to effect this with certainty. Use an armature about 6in. by 2in., wound with No. 18 wire. F.M.'s about 6in. by 9in., by ¾in., putting on about 11lb. of No. 18 on the fields, in four strands coupled up in parallel. This will require to be driven at about 1,600 revs. —S. BOTTONE.

[57984.]—**To Mr. W. H. Eaves or Mr. Bottone.**—Use a laminated H-armature 2½in. by 6in., wound with ½lb. of No. 20. If you want the machine to be compact use wrought-iron F.M.'s; an ordinary horseshoe-shaped electro-magnet would do. Wind the electro-magnet with 6lb. of No. 16. If you purpose to drive the machine by foot-power, I can assure you that it will take a strong man to fuse the 4in. of No. 26. If, however, you can use a heavy flywheel, you would find your task much easier. Do not think of using "permanent" magnets; they would be no use whatever.—W. H. EAVES, Coventry.

[57985.]—**To "No Sig."**—I am not able to give you the relative measured efficiency of glass and vulcanite plates, nor can I say positively whether any combination of glass plates and vulcanite plates, nor vitreous and resinous varn give better results than the simple with shellac. For the last two month a machine with one glass and one vul advanced up to the stage of the mounted; but my time is so fully occu branches, that it is not yet finished time I should get superior results fron experiments, I will certainly commun JAMES WIMSHURST.

[57986.]—**Dynamo.**—TO MR. BOT haps three, perhaps even five, 20-c lamps; ¼in. carbons will do. The la by me is one of the best for the purp power required from ¼ to ½ horse; revo 1,600 per minute.—S. BOTTONE.

[57987.]—**Small Dynamo.**—TO TONE.—Put about 1lb. of No. 18 on and couple up the wires on the fiel parallel, not in series. You may ex three tens.—S. BOTTONE.

[57989.]—**Entomological.**—The looking bodies" deposited by the ca the produce of an ichneumon fly, a factor to man, which lays its eggs in the caterpillar; the mature inse monidæ) will appear in the spring.—I

[57989.]—**Entomological.**—Nearl I noticed the same apparent laying of by a caterpillar. A school friend tol yellow things were not eggs, but the c ichneumon fly. The ichneumon fly la the bodies of live caterpillars. The live there till they are ready to spi break out and kill the caterpillar.—X.

[57989.]—**Entomological.**—The s bodies are not eggs; but the cocoons fly, known as Microgaster, the eggs been previously deposited by the fem body of the unfortunate caterpillar become the living prey and host of little larvæ, which, after having dev was good in the caterpillar, pierce skin, and turn into chrysalides, and on the corrupted remains of their mis The insect belongs to the genus of Ich BOTTONE.

[57989.]—**Entomological.**—T bodies are chrysalides of some ic which have been boarded and lodged pillar's expense. They come through body at all points, and each weaves its but the caterpillar may bind them to afterwards. Keep them till they em CRUS.

UNANSWERED QUI

The numbers and titles of queries which swered for five weeks are inserted in this lis unanswered are repeated four weeks afterwa our readers will look over the list, and send wh they can for the benefit of their fellow contribut

57378. Condensing Engine, p. 19.
57387. Hopkinson's Valves, 20.
57391. Compound Tandem Engine, 20.
57402. Broad-Gauge Engine, 20.
57404. Legal, 20.
57408. Power from the Waves of the Sea, 20.
57414. Brakes, 20.
57418. Hot-air Bath, 20.
57420. Incubator. To Mr. H. Rowton, 20.
57422. Lathe Tools, 20.
57424. Fireworks for Balloons, 20.
57426. Bull-Headed Rails, 20.
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57632. Technical Education, p. 109.
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57665. Hints on Silvering on Glass, 110.
57668. Lunar Glaciation, 110.
57669. Plating, 110.
57679. Ball-Bearings, 110.
57682. Working Single Lines of Railway by
57683. Int. Science Exam. of London, 110.
57685. G. E. R. Locos., 110.

RICH deposits of saltpetre of very hi were recently, it is reported, trans-Caspian region near the the neighbourhood of Sukr

QUERIES.

-**Electro-Capillarity.** — Would "Sigma," 'our numerous electrical correspondents, state iow can be obtained a full account of the elec- omena attendant upon capillary movements of d other fluids? Is there an English version of mann's researches, or of Mons. A. Bégruet's? unt du Moncel, in his work on the "Telephone," ers to them and to some experiments by M. M. it I require as full an account as possible, to going over the ground again, &c. I noted the description of a Lippmann capillary electro- 1 in "Ours" a few weeks back, and I must here gratitude, with others, for the early and thus ble information afforded.—CAPILLAR.

-**Telephone.**—Is the use of metallic vibrating ephones other than thin iron, patented? Judg- cent statements in "Ours," I should say not. A ynopsis of telephonic and microscopic patents ery interesting and valuable. Surely some of s would kindly summarise the matter for us. ut dates and numbers of patents, it would be of e use to amateurs.—TELEPHONE.

-**Telescopic.**—I have a silvered-glass New- bright star, or a planet, is surrounded by a , and, upon pressing the power, faint objects ne appearance with four different flats; but upon power c.p. front view as steadily as possible, e.p. in the hand, the field is perfectly clear and st object sharp—no fog, no glare; adjustment I d, as stars of from 2½ to 6 mag. appear as neat, ll discs with one or two concentric rings round no stop on; ap. 12in. Where is the fault? to use the card, 3in. or 4in. in dia., for squaring e with the body tube, mentioned in Horne and endix"? Must it be fixed or held in the hand eye is applied to the ½in. hole in centre? If est way to fix same? I have silvered and polished g piece for eye tube, inside, to get the reflection ry plain. Will that do in place of card?—

-**Gas Engine.**—I use a 3½ H.-P. Otto. It well, except when a little extra work is wanted ich as an 18in. round saw, in 2in. stuff, when requent explosions and a plentiful escape of 1 exhaust. Can any one of "Ours" explain the ame a remedy? Including the saw, the power more than 2-horse. Also, does the exhaust pipe cleaning? Would a stoppage in that cause the —J. J. H.

-**Astronomical.** — Would "A Fellow of the r. Sadler, or Mr. Gore kindly give the latest ions of the great proper motion Mr. Webb speaks ses of the following stars in "Celestial Objects": , δ Equulei, P. XIV. 212 Libræ, 85 Pegasi, ι (Iota) ris, and η (Eta) Cassiopeiæ?—M. ARKWRIGHT.

-**Metal Spinning.**—Some of the readers of ANIC will, perhaps, be able to give me some regarding the above—e.g., in spinning a ½ ball ow is it fixed on the lathe, and what kind of tool What material is used for the chuck? Is the in or out, and by what arrangement is the metal e centre of the chuck?—SPINNER.

-**Ebonising Ornamental Woodwork.** er will be grateful for information how to pro- eat dead ebonised appearance so much used for d other knicknacks? How to fill the grain of Is there a better stain than the logwood and in vinegar process, and what is it? Should wood be varnished, and what with? How to ff? Is the dead stained wood burnished?—

- **Turning Coal.**— Will some reader inform ols are used for turning coal? Also hints as to and the speed to drive the work at?—J. K.

Land for a Charity.—I have a freehold ch I desire to leave at my death to a charity. I ve it by will, as that would not be legal. I can leed of gift in my lifetime, and, provided that I for 12 months after, that would be legal. The w that I feel uncertain about is this: can I keep my own possession, and can I at any time t deed and legally give the property to another at I may consider more in need of it?—A.

-**Faulty Dynamo.**—I have made a dynamo I. Jones's castings. It should light seven 10 c.-p. parallel at 1,700 revs., but will only light two it 2,000 revs. Armature, laminated H, wound oz. 20 B.W.G. d.c.c.; F.M.'s, 10½lb. No. 16 d.c.c., ch leg. The lamps I have been trying are 12 they unsuitable? The machine will heat to . 30 iron wire. Would the slits in commutator allow magnetism of fields to decrease before the came under the brushes? If anyone can point lt, I shall be very grateful. I ought to mention halt of F.M.'s is much harder than the other. t make any difference?—Z. S.

-**Dynamo.** -TO MR. BOTTONE.—Could you izes and quantity of wire to give an E.M.F. or plating? I am wishing to make a small save the trouble of rigging up batteries for copper on the tops of Leclanché carbons. A pable of depositing ½oz. copper in 15 minutes vell.—Z. S.

-**Piccolo.**- Will the person that answered the o. 56634 in May 18th last kindly give particulars hin piccolo, cylinder bore, size of holes, position, ength of each part?—S. R. P.

-**G.N.R. Engines.** — On the 21st ult., an press train from Doncaster to London was taken ne (No. 557, I think) having inside cylinders driving wheels about 7ft. 6in. or 8ft diam. Will ay correspondent kindly give particulars and of this class of engine? How long have they been ow does their working compare with the 8ft. The engine referred to was dated 188 t was new within a few weeks.—W. H. T

[58004.]—**Coil.**—Will "Bobadil" kindly give me size and quantity of wire for medical coil? With only one kind of wire, I thought of using about 4oz. of 26 or 30 s.c. I want same to give shock that one man could not stand. Have made two very successful intensity coils. Will you kindly say what is a proper quantity of tinfoil sheets, 3 by 4, and will that size sheet be large enough for a coil 4in long? Can you say what size spark it will give with two rows of 16 cotton-covered, and 4oz. of 36 silk covered?—A. PLUMBER.

[58005.]—**Refining.**—I occasionally have some quantities of different quality gold, which I wish to bring to a pure state. Will some correspondent kindly say the easiest and best means of so doing? I have mills and chemical apparatus.—F. L. N.

[58006.]—**Chain Sheave.**—Will any reader inform me the size of the chain sheave that I have to make? The size of chain is 7-16in., and the size of link is 2in. long by 1½in. wide, and the centres of links 2¼in., and the sheave to contain twenty clips. Also the practical way to find the diameters, as I find that when I try the chain it either gains or loses around the circumference of sheave?—CONSTANT READER.

[58007.]—**Worm Wheel.**—Will any reader kindly inform me through your valuable paper what bevel and how to obtain the bevel at root of teeth of worm wheel, supposing the pitch is 2in. and the worm 5in. dia. to pitch line, the length of teeth as generally used by millwrights? Also the bevel at points of teeth?—CONSTANT READER.

[58008.]—**Fungus on Fish.**—I have been in the habit of keeping some roach and dace for baits in a stone trough under a pump, from which I give them a little water daily. This year, however, they do not live at all well, but die off one by one after being in a short time. A sort of fungus grows on them, which gets bigger, until at length it kills them. Could any of your readers account for this, and is there any cure?—PIKE.

[58009.]—**Specification for Small Observatory Transit Instrument.** — I should feel obliged if "F.R.A.S.," or others, would kindly criticise the following and assist me by suggestions:—Best workmanship in essentials, but no unnecessary finish elsewhere. Telescope: object glass to be of the very best kind, not less than 2in. clear aperture, with focal length of about 2ft., outside of telescope tube to be covered with white or light enamel, tube of brass, dew cap 4in. long, firmly attached by friction (but movable at will) to end of telescope, dust cap to cover end of dew cap, but to be removable with less friction than attaches dew cap to telescope, eye end to move underneath when telescope is being revolved, five vertical and one horizontal wire, utmost care to be taken to space the former equally, some ready means of placing wires in stellar focus and clamping them there. The want of some such arrangement has been such a trouble to me. A total reflection diagonal to be supplied, into which are to fit three positive eyepieces of about 20, 40, and 60 diameters power on this telescope, to be made to take dark caps at present in use, one of which will be sent as a guide; illumination to be by colza-oil lamp, pierced axis, and annular mirror so placed as to be outside cone of rays from object-glass, a sensitive axis or striding level with holding knob at centre on top, and scale marked on the glass of the bubble-tube itself; setting circle to be not less than 6in. in diameter, divided on gunmetal (silver?) reading to minutes by one vernier with radially-mounted reading glass, to be divided into quadrants. There is to be a good vernier level, with clamp and tangent screw, as well as two setting screws at lower end of radius bar. The frame is not to be of the portable type, but is to be attached to a cast-iron plate or slab, 14in. by 9in. by 1½in., which is already firmly cemented to the top of a solid brick pier. Said frame is to be composed of two side pieces or cheeks and a bed piece, all cast together in one casting, and of such dimensions as to be very strong, solid, and free from vibration (most portable transits that I have seen were, from the necessity for lightness, liable to spring in the frame); hole to be drilled in centre of bed of frame to fit head of centre plug that is already screwed into slab on top of pier, so as to allow frame to swivel on its centre. There are to be two curved slots struck from centre, one on each side close to side cheeks, cut through bed-plate to carry ⅜in. hexagon-headed Whitworth screws, by which the frame will be screwed down to the cemented cast-iron slab. The curved slots will give the necessary play in setting the frame approximately in the meridian. Two holes will be drilled and tapped in the slab to receive these screws; gunmetal Y blocks to be inserted in each cheek; motion in azimuth to be given to one of them by micrometer-headed screws, and motion in altitude to the other by capstan-headed screw and jam nut, no levelling screws under bed of frame. It will be made approximately level by the insertion of wedges or liners under bed, and finally by striding level and altitude screws as above specified.—E. M. RICHARDS.

[58010.]—**Tar Solvent.**—I am in want of information with regard to coating wrought-iron pipe with common gas tar. I boil the tar first, and dip the pipe almost red hot; of course, when it cools it is crooked, and in re-straighening it cracks the tar enamel off. Cannot some of "Ours" suggest a solvent commercially cheap enough to use on a large scale, by the use of which I can make the tar thin enough to dip the pipe while cold?—DROMIO OF SYRACUSE.

[58011.]—**Lubricating Oils.**—I should be glad to know the readiest mode of testing the lubricating quantities of the innumerable kinds of oils which are now being sold (as the best and cheapest in the market) for lubricating machinery. The time and patience of manufacturers is sorely taxed by canvassers for oil orders, and a simple test would enable me to distinguish between good and bad oils. Can anyone give particulars of the test of dropping one drop of oil each (of various kinds) on a slanting sheet of glass, different oils travelling different distances down the glass in a fixed time?—JOHN WALKER.

[58012.]—**Shannon Fishing Cott, or Punt.**—Will someone kindly give the full particulars of the building of a 25ft. boat used on the Shannon for fishing? It has flat bottom and pointed ends. I am anxious to build one for my own use: I wish to make it tight without pitching the bottom inside and out. Please give lines, best material, if nails or screws, and best plan to get the joints tight.—NOSLIW ECIRB.

[58013.]—**Metal Moulds for Vulcanite.**—Can any reader tell me of what metal to make a mould to vulcanise rubber in, so that the rubber leaves it polished and finished?—NOSLIW ECIRB.

[58014.]—**Astronomical Objects.**—Not possessing "Webb's Celestial Objects," perhaps some kind friend will help me. In the last "Astro. Notes" in this paper it was stated that Neptune was favourably placed for observation. Would it be possible to see it at all with a good 3in. telescope? and, if so, to recognise it as planetary? Could you also name a double star (if possible, of not less than the 5th or 6th mag.) which would form a good test for my telescope, with a power of 180—i.e., one which would be just barely divisible with that power? Also, ought the planetary nebula in Ursa Major to be visible in the same instrument? and, finally, would it be worth my while to get a higher power for fine nights? and, if so, what power, and Ramsden or Huyghens make of eyepiece?—DEAR DIRTY DUBLIN.

[58015.]—**Boat.**—Will someone oblige me with the best lines and sail plan for a boat about 16ft. long, which shall be easily handled by one and capable of carrying three or four? Must be very shallow draught, easily pulled, sail well, light to tow or carry, and safe; the best possible for a tidal lough where there is a great expanse of shallow water at full, but where at low water you may have to tow a mile to get your boat home; of course, deep water a mile or so away at full sea.—WHITE SAND AND GRAY SAND.

[58016.]—**Wheel-flange Depth.**—The depth of the railway wheel-flange is a subject to which I consider more attention should be directed than it receives, and more experimental tests made with a view of gaining knowledge as to the best means of preventing trains running off the rails, particularly at the points. On the occasion of the Penistone accident, a couple of years ago, Mr. Adamson, a high authority in these matters, stated that he considered the present flange insufficient, and graphically expressed it that "there was only 1½in. between the public and destruction." No doubt Mr. Stretton and other correspondents would be willing to give their opinions thereon, and they might also inform us what amount of flange depth is adopted in the United States and foreign countries generally?—VULCAN.

[58017.]—**Carpet Beating Machine.**—Will any reader kindly give any particulars how to make a carpet beating machine?—J. W. W.

[58018.] — **Employment of Diaphragm in Microscope.**—Will Mr. E. M. Nelson kindly explain how it is that a diaphragm placed close under the object slide gives a far better result than one used further away from it on the under side—e.g., of a thick stage? Of the fact there is no doubt; I am referring to an instrument used without a substage condenser.—L. E.

[58019.]—**Musical.**—Would some kind friend tell me the number of vibrations there are in each note of the chromatic scale from G below the lines to G on the second line in the treble clef, concert pitch? I am fretting a mandolin, and wish, by fretting each string separately, to have the chords absolutely correct.—CARLO.

[58020.]—**Screw Cutting.**—How can I calculate the wheels that will be required to cut a thread of 16 threads per inch with a leading screw of ½in. pitch, or two threads to inch? Also how to cut a pitch of one thread in 4in. with ½in. leading screw?—J. E. B.

[58021.]—**Geometry.**—Will some of our geometrical correspondents kindly show a method of developing the surface of what I will call a frustum of an elliptical pyramid, with particular reference to the dimensions given in query No. 57872, in which it will be noticed that the major and minor axes of a section do not diminish proportionally with the base in any portion of its height when cut by a plane parallel with the base?—FERRUM.

[58022.]—**Rust in Soldering.**—How can I prevent rust caused by acid used in soldering needle-wire to brass frame? Rosin cannot be used, owing to fineness of work. Would tinning the wire prevent its action, or immersion in some chemical?—JASON.

[58023.]—**Straight German Silver Wires.**—Can they be made perfectly straight—thickness of sewing-needle?—JASON.

[58024.]—**Set Boilers.**—I have several set boilers, which I want to keep at a boiling point. I want to use gas to heat them instead of coals. Would any reader give me information what kind of burners I should use to burn part air and part gas? The boilers are 18in. long, 12in. wide, with flat bottoms. I might say that I put a cold ladle in the boilers every few minutes, and it stops the water from boiling.—SNOWSTORM.

[58025.]—**To Mr. Wimshurst.**—Accept my thanks for your illustration; and would you kindly answer the following questions? Would brass sectors in place of those cut from cartridge paper be best? Where can the lacquer be got for finishing brass-work with? Is the tinfoil coating on the glass jars as supplied by the makers you mentioned? If not, where can it be got, and how is it fastened on? In your letter, No. 24971, you give sizes of two brass balls; would you kindly give sizes of the others?—EVENO OAKLAND.

[58026.] -**Setting Slide Valves.**—Will some reader kindly inform me how to set the slide valves of a double cylinder portable engine, fitted with link motion?—C. R.

[58027.]—**Electric Light.**—I made up a battery of 30 salt jars, as follows:—Outside jar, 4in. by 5½in., containing circular zinc 3in. diameter by 6in. deep and eighth thick, charging with solution of acid sulph. and water 1 to 7; porous pot, 6in. by 2½in., containing carbon block, 6in. by 1in. by 1in., and solution bichromate (2oz. to one pint water), and one pint sulph. acid to twelve bichromate solution. On putting three 5 c.-p. lamps in circuit they flashed out for some 15 or 20 minutes, but every effort since failed on connecting up to get more than a flash, and then goes down to red glow. What is wrong?—ELGAR.

[58028.]—**Wimshurst Vulcanite Plate Machine.**—I have made a Wimshurst influence machine (vulcanite plate). Will any reader of the "E. M." kindly tell me how to take the twists out of the plate? I have tried heating it and putting on flat surface, with weights above; but on the removal of weights it returns to its old shape. Perhaps there is some other method of obtaining the desired end. I cannot see anything relating to the question proposed in the back numbers of this year, so will feel obliged for any information on this subject.—H. G. M.

[58029.]—**Electric Greenhouse Alarm.**—Will some reader of "Ours" kindly describe a simple and easily-constructed contact, so that it transmits the current when it freezes?—THERMO.

[58030.]—**Albatross Head.**—Will some kind friend inform me the best way to cure the above?—SAILOR.

[58031.]—**Two Telephones.**—Could Mr. Bottone, or any of the readers of "Ours," kindly oblige me with a plain working drawing of the connections of a pair of ordinary battery telephones? There are a number of excellent diagrams in the back numbers of the "E. M." of single telephones, and the various parts; but I have not been able to find any perfect diagram of two together. I want to get a drawing of an ordinary couple, receiver and transmitter at each end, which I could carry about in my pocket-book, to work by, generally, when putting up or arranging connections of telephones. I understand all the action of the receiver, transmitter, and induction coil; but want to get the wire connections on to line, battery, bell, earth, &c., just as they stand, with a pair of telephones in working order.—GEORGE BURNS.

[58032.]—**Automatic Firing of Furnace.**—What is the latest news of the chain grate for boiler furnace? Is it a discarded novelty, or a useful invention? Should be pleased to see any information concerning automatic firing for furnace of stationary plain cylindrical boiler.—FIREMAN.

[58033.]—**Steam Navigation on Canal.**—Can any of our readers say what are the latest methods of steam navigation on canals, and give the objections of the several companies to the use of steam? Having seen that the only method of reducing the freight from the midlands to the several ports must be by water carriage, I wish to know the latest inventions and the objections of the Canal Companies to their use?—A SURVIVALIST.

[58034.]—**Dynamo.**—Thanks to Mr. Bottone and Mr. Eaves for the clear and definite replies to 57901. The amount of wire I reported on F.M. in this query was what should have been on, as represented to me; after attending to everthing as directed, and finding no improvement, I examined closely the wire on F.M. I find there are only three layers, or 182ft., of No. 18 c.c.—that is, 1½lb. on each F.M. The armature is wound with same size c.c. I think there are six layers on it, of about 162ft. If I put more wire on F.M.'s will it improve the dynamo? If so, how much may I put on, and must it be same size—No. 18? There would be room on each F.M. for 2lb. or 3lb. of No. 18.—BRIAN BORU.

[58035.]—**Condenser Tubes.**—I have a surface condenser, the tubes of which are thickly coated inside with a hard deposit of salts of lime, caused by the circulating sea water. Can anyone inform me how this deposit can be removed? I have had some of the tubes out of the condenser heated in a fire, and then plunged into cold water; also had them for some days laid in a strong solution of caustic soda, but without any satisfactory result.—R. M.

[58036.]—**Patent Compound Duplex Engine.**—Can any reader give particulars of what is called the patent compound duplex engine, which is said to be far superior in working capacity to either gas or steam engines?—X. Y. Z.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 11, and unacknowledged elsewhere:—

J. W. CAMPBELL.—J. S. Gradwell.—Jas. Wilson.—T. B. Etty.—Cooper Cooper and Co.—H. Holt.—Horological.—A Beginner.—J. R. D.—E. Nelson.—An Old Natalian.—H. Rey.—Hot Water.—Verax.—G. Stock.—J. F. C.—Susie Webb.—Vulcanite.—Canis.—Benson.—P. Ibottson.—Ex-Fireman.—S. E. Peal.—Rev. J. Pearson.—A Fellow of the Royal Astronomical Society.—B. C. R.—Bowling.—J. Sutcliffe.—Dr. Royston-Pigott.

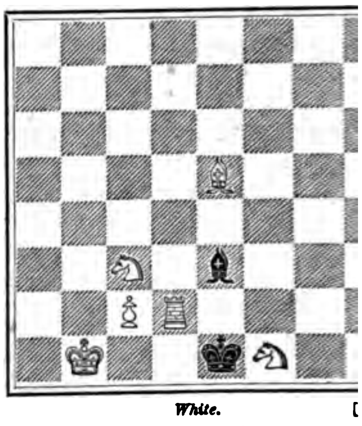
ENGINEER. (The "spectacles" would depend on whoever employed you. A twelvemonth must be spent at sea in the engine-room before you can sit for the examination for which the second-class certificate is awarded.)—S. A. R. (Look through your back numbers—recent volumes—for much about lathe mandrels. 2. The size of the wire depends on the dimensions of the magnets,—No. 26 or 30 for small bells, up to 18 or 16 for larger ones. 3. Do you mean nickel-plating? If so, look at the series of articles in Vol. XXXIX., pp. 96, 117, 139.)—A. J. C. M. (Have you an engine and dynamo, or do you intend to use a battery? If the latter, which sort do you prefer? Then what is the size of the rooms, or preferably, how many lamps, and of what candle-power would you like? You will find general directions in back numbers, and can adapt them to suit your requirements.)—F. W. JACKSON. (Merely being engaged in the profession or trade, and recommendation from so many members. The secretary will give you all particulars.)—CERES. (No, we think not. The list of English publications may be found in any of the newspaper directories; but we could not afford space for remarks on the contents of periodicals. We presume you can see most of them in your town, for Birmingham is as well supplied as London in that respect.)—A. Z. (For marine aquarium see pp. 593, 643, 667, Vol. XXII., and the indices of back volumes. You ought to have little difficulty in procuring a supply of sea-water; and having once obtained it, you ought to make it last for years. See one of the handbooks published on the subject.)—LEAD ORE. (See "Hints" No. 4.)—PAISLEY. (They are the cause. 2. Pasteur. 3. Pasteur's—Liebig would have altered his opinion in view of our present knowledge.)—APHIS. (Will you kindly make your query a little more comprehensible?)—ELECTRON. (Given many times. See indices. A battery to suit will be found in No. 939, p. 435, "Neuralgia.")—P. P. (You want some caramel, which you can prepare by melting carefully lump-sugar in an iron spoon over a Bunsen burner.)—RUBBER. (There is no book of the kind,—the processes being, as a rule, kept secret as to their details. See answer to "G. R. B." last week. Hancock's "Treatise on the Origin and Progress of Caoutchouc or Indiarubber Manufacture," published in 1857, by Longmans, may help you.)—J. K. FERNE. (No remedy necessary: it is nothing. Bathe with cold water, if it persists.)—W. G. FRANKS. (The only details are that a number of glasses, sold by dealers in musical instruments, are mounted on supports, are partly filled with water to tune up to pitch, and are rubbed with the fingers wetted with a solution of alum. 2. It is a matter of no moment—certainly not of sufficient interest to occupy space in our columns just now.)—M. M., A NOVICE. (The waste should "fall away direct." 2. A turbine.)—F. R. FLINTAW. (See indices about the "any other way"; but as to the "Sunlight battery," it will be necessary for you to explain what is meant by that term. We presume you mean something in connection with selenium, for which see index to last volume.)—BARCLAY WALTON. (An advertisement in the "Wanted Column" would no doubt bring a number of replies offering the required instruction; but why not join the evening classes at King's College?)—C. (It is a matter for analysis of the samples; but its lubricating properties would scarcely be injured.)—D. G. (Instructions are supplied by those who sell the paint and preparations. As to whether hands or dials should be painted, that is a matter of taste: perhaps the dial, as that has the larger surface. Must be exposed as much as possible to light.)—TEL. (We described the mechanical telephone in No. 1,061, p. 447. Any kind of willow that can be interlaced basket-work fashion; varnished certainly. Wood for sounding-box immaterial; but see place cited and then send query if you find any difficulty.)—AMATEUR PHOTOGRAPHER. (For a changing-box for dry plates see Nos. 895, 897, in the former of which one is illustrated. See also the indices of back volumes.)—P. DONNELLY. (No. Designs are registered at the Patent Office; copyrights in books, plays, music, &c., at Stationers' Hall. You can ascertain whether anything is registered or copyrighted by applying at the respective offices. There is a small fee at Stationers' Hall.)—H. FAIRLEY. (Will not some of those given in recent volumes suit you?)—B. A. L. (The board is usually beech or lime; but some use glass. Have you seen what was said in Nos. 891, 892, 954? 2. Either the paper had some mildew spots, or you wetted it too much. In future see that the board is dry, and merely damp the paper with a sponge out of which the water has been squeezed.)—EVAN GRIFFITHS. ("Corn remedies" are of no use for so troublesome a thing as an enlarged joint complicated with a bunion. Better let a surgeon see it; he may be able to suggest a remedy, or give some relief. Meantime, bathe frequently with the hottest water that can be borne, and rub in liniment. Total abstinence from all alcoholic drinks is necessary.)—CONSTANT READER. (For the ants, place oil in plates or saucers; for the "beetles," mix dry flour and red lead with a little sugar, and place small heaps of it on paper in their haunts.)—INVENTOR. (How in the name of common sense can anyone say without knowing what the modifications are, or to what extent they affect the patent? Better take out two "finals," and better still, put the matter into the hands of a competent patent agent.)—T. MORRIS. (On the contrary, we did not misunderstand you. It is doubtful whether the quantity of silver in so small a measure will be worth the trouble, but you will find the methods of recovering fully treated in back volumes, or in any of the handbooks of photography.)—ZOETROPE. (As a "reader" you ought to know that we do not insert such queries; see Hints No. 4. We believe you can get what you want of the London Stereoscopic Company, Cheapside, E.C.)—A POOR DUNCE. (An astatic galvanometer was described so recently as Nos. 1,054, 1,056. 2. Yes; for practical purposes, if you are sure of your size; but it is better to have a standard ohm.)—PHILOSOPHER. (You will be able to answer your question by reflecting on the following figures. Dr. Angus Smith found in specimens of air taken in front of the Houses of Parliament ·0329 per cent. of carbonic acid; at the foot of Ben Voirlich he found exactly the same percentage. In the worst parts of towns it is rare that more than ·05 per cent. is found. There is too much solid carbon in the form of smuts in the air of towns. 2. Certainly. There is no such thing as a *perfectly* level road, or a perfectly level sheet of water.)—H. B. (It is obtained by calculating the units of heat which the carbon and hydrogen of the coal are capable of yielding when combining with oxygen. Roughly, for a good average coal, take it as 15,000 units per pound. 2. Yes, that is so, because so much of the thermal value of the fuel is lost in the furnace.)—TUNUS. (Certainly it will; it is a question of the strength of the framing. By measuring the old string with a gauge; but as a rule, the numbers are marked on the wrest-plank. There is a small handbook on the subject published by L. U. Gill, 170, Strand, W.C. It ought not to be below pitch, and should be brought up to it at once. Look through the back volumes for much information on pianos which cannot be found in books.)—E. J. J. (If you mean a telephone receiver, one was described so recently as p. 186. All useful receivers are protected by patent rights.)—F. J. PAYNE. (Query much too general. You will find much information in back volumes (see p. 168, Vol. XXXVII., for instance); but
specify what it is you wish to lacquer.)—HARR
DRAPER. (Send; we will use what we
SCIENTIST. (We do not know which is the
Perhaps Smedley's work would suit you; th
lished, we believe, by Bemrose and Sons, of De
possible you mean hydrostatics?)—J. K. H.
reeds must be tempered in the usual way f
spring steel; the brass must be hammered or
silver the same; but as to gold reeds, suppo
brass first?—that is good enough for the best
DIANA. (It is a matter of personal taste and
No room at present for a discussion on such
—B FLAT. (Answered recently. Wipe them
a rag moistened with a little paraffin oil.)
(Procure the prospectuses of the schools. It i
to be apprenticed, and any one can sty
"electrical engineer.")—D. W. W. (Any stove
duces the amount of oxygen in a bedroom is
There should always be free ventilation.)
DOUGLAS. (Send the lad to the Agricultural
Cirencester, for a year or two.)—A SUFFER
should defy them; let them sue you in th
Court, and tell the judge the whole story. T
men deserve exposure, and we do not think th
Court judge would decide against you.)—JOH
(Send the sketch, and then all will benefit.)
(We have given the subject all the space
spare.)—ACOLYTE (in type.)

CHESS.

ALL Communications for this department
addressed to J. PIERCE, Langley House, Dorkin

PROBLEM DCCCCLXV.—BY J. P. TAYL

Black.



White.

White to play and mate in two moves.

SOLUTION TO 963.

White.	*Black.*
1. Kt-K Kt sq.	1. Kt-Q B 8 (*a*)
2. B-Q B 7	2. P-B 3
3. B-Q 8	3. Anything
4. B or R mates	
	(*a*) 1. Kt-Q B 6 (c
2. B takes Kt	2. Kt-Q Kt 3 (
3. K-K 6	3. Anything
4. R-K 2, mate	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 961, by Rev. W. And
Romney); to 962, by C. S. Bright and A. Bolus
F. O'N. Hopkins (very neat, but simple), A. S.
A. Bolus (but defence 1. Kt-B 8 not given); to
E. T. Glover, A. S. Olver, and E. Stanley Folwel

E. S. T.—We are sorry to lose you, but hope
be for a time. Thank you much for your kind
good wishes.

A. S. OLVER.—We heartily congratulate yo
double success. Could you let us have a c
problem?

F. O'N. H.—Your letter and criticisms hav
much pleasure.

WE subjoin the names of the prize-winners
petitors in the Problem Tourneys.

Three-move Tourney.

1, Fritz Sorko, Heiermark, Oesterreich; 2, C.
London; 3, Dr. E. Müller, Darlington; 4, G. Slate
5, B. Fison, Hendon. Captain V. S. Pochin
Herman Fousson (Orlando), J. Jespersen (Væ
A. E. Lecluse (Chess Struck), F. E. Page (Ty
Carter (Salutation), J. W. Abbott (Ariadne),
(Measure-for-Measure).

Two-move Tourney.

1, J. Taverner, Bolton; 2, W. B. Huggitt,
Tyne; 3, Louis Whalley, Leeds; 4, C. P
Captain V. S. Pochin (Check), J. Jespersen
Slater, G. W. Mitchell (Beware of the D
(Four Knights), H. Bristow (Phono).

WE append the names of the successfu
the Solution Tourney:—

1, H. H. Davis, Bristol; 2,
H. Culmer, Bow; F. O'N.
Bennett, Oxford, bracketed

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, NOVEMBER 20, 1885.

MICROSCOPICAL ADVANCES—ANCIENT AND MODERN.—I.

By Geo. Royston-Pigott, M.A., M.D. Cantab.; F.R.S., F.R.A.S., F.C.P.S., Formerly Fell. of St. Pet. Col. Cambridge.

It is proposed first to attempt a sketch of the progress of this fascinating instrument from the dim days of antiquity to the present time.

Layard unearthed a rock-crystal lens and microscopic engraving at Nineveh.[*] Very many are the ancient gems now extant in the British Museum that no unassisted sight could possibly have engraved. Further on in the annals of time comes the evidence of Pliny, Seneca, and Plutarch. Glass hollow globes, filled with water, were used both as burning and magnifying glasses. The vestal virgins rekindled their sacred fires by the solar beams. About the eleventh century Alhazen, the Arabian, made known in Europe the magnifying power of lenses. It is generally believed that the first microscope with double glasses was invented by Jansen, in 1590. Subsequently Drebbel, alchemist to James I., exhibited it to Borelli and other *savants* in England, and passed for its inventor. Whilst Roger Bacon is credited with a previous invention at Oxford, in the 13th century.

Hartsoeker was the first to use minute glass globules. He mounted them between two pieces of lead, and showed them to M. Leuenhoek[†] when he visited him. Until this time (about 1690) no one had observed their powers. All the twenty six microscopes which he bequeathed to the Royal Society are composed of minute equiconvex lenses, and not of glass-thread globules. But their surfaces are now so oxidised by age and the London fog that they are no longer of any practical use. The rock-crystal lens found at Nineveh alone remained uninjured by time.

Powerful, however, as minute globules of glass may be, particles seen within their substance appear enormously enlarged. A further application of this principle gave, in Hooke's hands, wonderful results (1665). If a drop of water contained animalcules, he attached a minute quantity to the glass globule, when there resulted most extraordinary clear and great amplifications. This was probably the first water-immersion lens recorded. Dr. Hooke, therefore, was the first microscopical immersionist. From 1738 to 1770 Hooke[‡] and Custance laboured to augment the field of view; whilst Adams in 1774 invented his "lucernal microscope." [§]

It was Euler, in 1747, that first proposed mathematically achromatic combinations for the objective of a microscope, a subject that had for a long time agitated England, Holland, France, and Italy. Dollond, in 1757, had made achromatic telescopes after Chester Hall had constructed an achromatic telescope in 1733; nevertheless, the priority must be given to Euler. The enterprise was so difficult of accomplishment that even Biot wrote, in 1821: "Que les opticiens regardaient comme impossible la construction d'un bon microscope acromatique."

In 1738 Lieberkuhn, having invented the solar microscope, created a profound sensation among the *savants* of the day, just about the epoch when Buffon advanced his famous system of organic molecules by his microscopical studies. He also discovered a new method of brilliantly illuminating opaque objects by means of perforated silver reflectors attached to the objective of the microscope—an apparatus still used with striking effects.

A rare work, published in Russia in 1774, details a microscope constructed on Euler's principles. It says: "The objective will be composed of three glasses, the first and third of crown glass, and the middle glass of flint; focus half an inch, aperture the eighth. The lenses are as thin as possible; two crown lenses are bi-convex, and the middle one biconcave." This was the first achromatic objective.

It has often been frequently repeated that Dr. Goring was the first to use, as test objects, the Podura and Lepisma scales. This is not true, as Dr. Wallaston, F.R.S., in 1812, used them as tests for the quality of his "Periscopic Microscope," which was a doublet made with plano-convex glasses with their convexities in contact. He says: "With this doublet I have been able to see the finest striæ and serratures on the scales of the lepisma and podura, and on the scales of the gnat's wing." The angular aperture of a doublet is very small. The statement that these striæ can only be seen with large angular aperture, is, therefore, quite erroneous and purely theoretical.

M. Chevalier, of Paris, claims to be the first to cement the achromatic glasses, in order to prevent loss of light and the entrance of damp.[*] He says he made (1824) the first achromatic objective of this kind. In 1824—1825, Dr. Goring induced Tulley to make one for him. Peter Borello, in Holland (1655) described a microscope, and recorded 100 observations, and figured several kinds of poduridæ. Here is one:—

> "Insectum album acari instar mensam percurrens accepi et microscopio percepi cornua 4 habere. . . . Cauda ei longa et crassa ac duplex." [†]

He describes another podura, which leaps in an admirable manner; also a green insect found on sycamore trees, with large black eyes, and that lives only 24 hours. Borello thought it must be a young locust. He observed that in the leaves of Solomon's seal there were no less than 74 nerves (veins?), whereas the eye alone could see only 9. He asserts, too, that in time of the pest invisible animalcules can be shown which are breathed, and thus propagate infection.

Dr. Hooke gives an enormously enlarged view of the podura nitida, above 7in. long, white, on a black ground, with black eyes and covered with scales. This great philosopher, speaking of the past great spirits that had appeared on the world's horizon, finally declares: The good success of all these great men, which, from the beginning of the world, have as 'twere trod on, and yet not minded till these last *inquisitive ages*, puts me in mind to recommend such studies, and the prosecution of them by such methods, to the gentlemen of our nation, whose leisure makes them fit to undertake, and the plenty of their fortunes to accomplish, extraordinary things in this way. And I do not only propose this kind of *experimental philosophy* as a matter of high rapture, and delight of the mind; but even a material and sensible pleasure, so great is the satisfaction of finding out new things, that I dare compare the contentment which they will enjoy, not only to that of contemplation, but even to that which most men prefer, of the very senses themselves. And the end of all these inquiries they intend to be the pleasure of contemplative minds."

In 1813 the interest in microscopes had revived vividly. Sir D. Brewster proposed the use of jewel lenses, and showed the diamond possessed almost three times the magnifying power of glass. Pritchard made a few. Topaz seems eminently fitted for this purpose, and it is strange that none of our celebrated makers take advantage of jewels for microscopes. Pritchard's plates of test objects in his "Microscopic Cabinet" (1832) are surprisingly inferior to Chevalier's plates published in 1839. From this fact it may be concluded that Chevalier's glasses at that time were vastly superior to Goring's and Pritchard's (see the engraving). M. Chevalier having brought him one of his achromatic, thereupon Goring succeeded in getting enlarged angular aperture, and contrived an instrument called an aperture goniometer. Some of Chevalier's sets were admirably corrected. And judging from the exquisite engravings given in Chevalier's plate, which bear a watchmaker's eye-glass, developing wonderful details, executed by a young French artist, these glasses, in 1839, greatly exceeded Goring's in defining power. The longest focus lens was placed posterior to the shortest, both being achromatic. Subsequently Chevalier constructed them of equal pairs, which diminished the aperture further.

Goring had already attempted in 1815 to construct one, and it was not till Fresnel reported so favourably that he pursued the object successfully, and exhibited it in Paris in 1827. The gold medal was awarded to Charles Chevalier in 1834 for the perfection of his microscopes. Lister must not be omitted, whose paper "On the Double Aplanatic Foci of Achromatic Object Glasses" was published in the "Phil. Transact." for 1830. From this time Andrew Ross constantly employed himself in this department, and in 1837 communicated to the Society of Arts his discovery that, by separating the front lenses, a correction could be introduced for the aberrations caused by using different thicknesses of covering glass. It had, however, long been known to mathematicians that a plate of glass produces aberration proportionate to its thickness divided by the refractive index. Thus,

$$V = u + \frac{t}{\mu}.$$

The aberration for plate glass is $\frac{1}{3}$ thickness.

Prof. Amici, of Florence, at last succeeded in constructing achromatic glasses, composed of six different kinds of glass, to be used as immersion objectives, and it magnified, when mounted, 1,310 times, with the angular aperture of 160°. This microscope exceeded all others in the splendour and power of its definition. His objective No. VI. contained four achromatic combinations. It showed parallel striæ whose distance apart was 1-72,000th of an inch, and possessed a working distance of 6-1,000ths.

In an historical sketch, it is impossible here to do more than to allude to the noble roll of English worthies who have enriched the annals of our instrument with innumerable improvements during the past 50 years: Ross, Wenham, Powell, Smith, and Beck have all contributed the essence of their studies to the advancement of our knowledge. Powell, being parallel with Ross, soon distinguished himself, and Powell and

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[*] Exhibited by Sir D. Brewster, Br. Assoc., 1852.

[†] Leuenhock was originally an optical glass grinder; but he obtained so great a celebrity in this art that he was elected Corr. Memb. of the French Acad., and a Fell. Roy. Society. Peter the Great, passing through Delft, sent for him, requesting to see his "admirable microscopes," to whom was exhibited the circulation of the blood in the tail of an eel. He discovered that the arteries and veins are continuous. He experimented on the form of the blood globules. He discovered "the fibres of the brain" interspersed with blood-vessels. He accurately described the structure of the crystalline lens and the form of the spermatic animalcules.

[‡] One of Hooke's discoveries is worth recording. He gives a large folio plate of the head of a grey drone fly. Thousands of ocelli or facet eye lenses are engraved as forming the upper half of the head or face of the insect, below, divided by a horizontal line, other thousands at half their size. Besides this, Dr. Hooke invented an [illegible]lent method of illumination of opaque objects by [illegible] of a globe of water, an adjustable lamp, and a small [illegible] lens condensing the light upon an object held by [illegible] focussing was accomplished by a [illegible] rotating the body of [illegible] objective and [illegible]

[*] Cement formed of mastic dissolved in turpentine.

[†] The late Rev. J. B. Reade, F.R.S., called this insect the [illegible] *podura*, because he found it on his instrument [illegible] nitida).

Lealand soon took the lead in the splendour of their glasses, and to this day take the leading honours; whilst foreign effort is scarcely a whit behind our best constructions.

THE DIVINING ROD.

IN a remarkable lecture delivered by Dr. Rossiter W. Raymond, of New York, at the International Electrical Exhibition in Philadelphia last year, the speaker, who has made an elaborate research into the history of the divining rod—whether the witch hazel fork of the village water-finder or the more imposing wand of the ancient magicians—said that a whole library of learned rubbish about it remains to us, which furnishes jargon for charlatans, marvellous tales for fools, and amusement for antiquarians. Its claims to virtues derived from the Deity, from Satan, from affinities and sympathies, from corpuscular effluvia, from electrical currents, from passive perturbatory qualities of organo-electric force, are hopelessly collapsed and discarded. In the one application left to it with any show of reason, it is nothing unless held in skilful hands, and whoever has the skill may dispense with the rod. We call attention to the exhaustive work of Dr. Raymond in this connection, because within the past few months two cases have occurred in England in which the divining rod is alleged to have led to the discovery of water. A few weeks ago at the brewery of Messrs. Fremlin, Maidstone, Mr. J. Mullins, of Chippenham,—"who claims, by means of the divining-rod, to possess the power of indicating where water may be found," and whose claim is said to be recognised by many noblemen and gentlemen, Lord Jersey, Lord Leigh, and Mr. Hornsby, of Grantham, being specially mentioned—pointed out a spot where, on digging, two good springs were found at a depth of from 20ft. to 25ft. Mullins was provided with a hazel twig cut in the shape of a V, one limb of which was held in each hand with the point downwards. Walking slowly over the ground the point suddenly turned up, and the operator made a mark to indicate the spot. He then commenced his walk from the other end of the ground when the twig again turned up, and Mullins gave his decision at once—at least so we judge from the report which has reached us, though it is subsequently stated that during the stages of the experiments several persons held (singly, we presume) one end of the twig while Mullins held the other; but despite all efforts to hold it firmly "the point of the V twisted up with great force." Altogether Mr. Mullins seems to have been successful in finding on or near the brewery premises seven springs of water. The other case alluded to above occurred some months ago at the Fletton Waggon Works of the Midland Railway Company. Here, so the report reads, the services of a gentleman of the district were requested, and he employed a forked hazel-rod, the point being directed to the sky. "After walking about the premises for some time, the point of the fork suddenly began to bend down," and at that spot a "plentiful supply of water" was prognosticated. The same indications were, it appears, given at another spot, where the "twig snapped from the violence of its spontaneous and sympathetic motion.' Water, it need scarcely be said, was found under both spots.

It will hardly be asserted by the most ardent believer in the divining-rod that the rod itself possesses the power of indicating the presence of water or metalliferous substances; but, as there is no doubt of the fact that the hazel twig does twist about and turn its point up or down when held in the hands of a suitable subject, it follows that the "influence," whatever it is, is present in the operator. Chevreul, the venerable savant, so long ago as 1812, made many experiments with the pendulum and the divining-rod, which he described in a letter to M. Ampère in 1833; but in 1853 he was appointed by the Academy of Sciences to report upon a work on the divining-rod, which he did in a paper bearing the following title, which was issued in 1854: "De la Baguette divinatoire, du Pendule dit Explorateur, et des Tables tournantes, au point de vue de l'Histoire, de la Critique, et de la Méthode expérimentale." *Chevreul* ascribes the movement of the rod (his *remarks apply equally to planchette*, hat, and table turning), apart from cases of deliberate deception, to minute, unconscious, muscular movements, caused, he thinks, by the imagination, or intuitive or unconscious decision or expectation of the operator. An impression that the rod will dip at a certain point, or a wish that it should, or even in some minds, a fear that it may do so, are all effective causes of the peculiar muscular movement. The position of the arms, hands, and fingers usually prescribed for the holding of the hazel twig does not favour the production by conscious effort of the peculiar movement; but it is one in which skilful effort, if employed, may be readily disguised. It is also one which really invites muscular cramps, and tends to produce muscular torsions and involuntary movements which cannot be resisted easily without a change of position. Dr. Raymond takes a wider view than M. Chevreul, and having examined all, or nearly all, the available evidence on the subject, he formulates the following propositions:—1. The material, consecration, astrological relations and ritual formalities (in allusion to the old superstitions) of the rod, are entirely irrelevant and indifferent to its efficacy, a proposition which Dr. Raymond rightly says disposes at a stroke of nine-tenths of the "science" of the subject which the Middle Ages laboriously accumulated. 2. The rod itself is entirely inert, even in the opinion of the most famous experts: it is merely an index, revealing and magnifying in visible results the peculiar inward sensations of the diviner. 3. The favourite and most convenient form of the rod (something like λ), is one which promotes involuntary movements, and also permits of deception. 4. The involuntary minute muscular movements may proceed either from the causes enumerated by Chevreul, or from a purely physical sensation. 5. The uses of the rod for discovering moral qualities, prophesying the future, &c., belong to charlatanry and superstition. 6. The agency of demons may be set aside. 7. The application of the rod to the discovery of metals, coal, buried treasures, &c., has been proved to be chimerical. 8. The transparent humbug of locating petroleum wells, to strike the oil at depths of from a hundred to thousands of feet, needs no comment. 9. The case is somewhat different in connection with the discovery of springs and (since ore deposits are, or were, the channels of springs) of ore deposits; for the evidence in favour of the rod is much more abundant and cogent, and there is a residuum of scientific value after making due deductions for exaggeration, self-deception, and fraud—the last-named not being an altogether unknown factor in the history of the divining-rod. Knowing what we do of the capabilities of such an instrument as the induction balance of Prof. Hughes and the phenomena of magnetism, it does seem feasible that an apparatus might be constructed which would indicate with approximate accuracy the position of a metallic lode from the surface of the earth. In No. 904 we gave a description of the "divining-rod" of Mr. C. F. Varley, an instrument which was based on scientific principles, and which that gentleman thought it worth while to patent. As nothing has been heard of its practical success, it may be assumed that there is really little demand for such an instrument, which, as a matter of fact, is the case in all districts that have been geologically explored. It would be interesting to learn whether it has been tried in districts about which nothing is known, for the instrument is free from the personal influence, and its indications should form an unerring guide to its usefulness or the reverse. There is undoubtedly a practical science of discovering mineral deposits and springs, especially the former; but the most successful prospectors of mines can scarcely explain why they decide to dig at one spot in preference to another. That their knowledge, such as it is, is intuitive may be taken for granted, for while they are often wonderfully successful in locating the position of mineral veins in localities and amidst natural features with which they are familiar, they are almost ludicrously in error when giving an opinion under an entirely new set of conditious. Thus Dr. Raymond says that some of the most absurd gold-mining enterprises he has known were set on foot by old Californian miners, who, returning to their homes, have said at once of some ravine or hillside that it was "just the place for gold," because it had a similar appearance to other places in which they had learnt from practical experience to look for that metal. The Cornish miners, adepts in the art of finding lodes in their own county, have carried their knowledge of "omens and signs" throughout the world, but have rarely earned much credit away from this country. In localities with which they are familiar these prospectors arrive swiftly, surely, and without conscious reasoning, at impressions and decisions which are almost invariably found to be correct. If such men held a so-called divining-rod while prospecting, it is at least conceivable that they might unconsciously give to the hazel twig a movement which would be regarded as a clear indication of the presence of a metallic lode, especially if the local conditions happened to be the same as those in which they had been successful formerly. The art of finding water is an accomplishment of the Indians of the Far West, who certainly do not use the divining-rod, and yet, out on the dry plains, can indicate without fail spots where water will be found in half an hour's digging. To determine the position which an artesian well is to occupy is a different matter, and is beyond their powers, which are probably based on a keen observance of the conformation of the surface, the presence or absence of certain plants, &c.—in short, the science of observation, which is perhaps carried to the highest degree of perfection by the Indians, frontier-men, trappers, and ranchmen. Such men as these, by long experience, are enabled to locate with considerable accuracy the presence of springs or water channels. The unconscious judgment of such an expert may decide upon a given spot over which he walks certainly without the rod; but Dr. Raymond admits that the rod may help him [illegible] make up his mind by emphasising for him [illegible] own slightest tendency to a decision. Bleton, the great hydroscopist, who was called to Paris in 1782 and subjected to a variety of tests which clearly demonstrated that it was [illegible] in certain circumstances he could detect the presence of water, generally went many times over the same ground, when permitted, before he ventured to indicate the spot at which [illegible] well should be dug. Bleton must have [illegible] something of a charlatan, although he was [illegible] markably successful, for when tested in [illegible] scientific way and blindfolded, it was found that he could be taken over running water several times without noticing it, and the [illegible] trical tests showed that the magnetism of [illegible] earth had nothing to do with the movements of his rod. We have mentioned Bleton because he was perhaps the most dis[illegible] guished of the hydroscopists, possessing [illegible] usual skill as a prospector with less than [illegible] usual amount of mystery which appertains to the general run of hydroscopists [illegible] workers with the divining-rod. He was [illegible] cessful on many occasions; but made [illegible] egregious failures when put to the test [illegible] experts—notably when taken blindfold [illegible] the church of St. Géneviève, and indi[illegible] several spots at which streams of run[illegible] water might be found, although it was kn[illegible] that for 100ft. beneath the floor there was [illegible] thing but the vaults and foundations of [illegible] fabric. Here it may be noted that none of [illegible] hydroscopists has ever been able to ind[illegible] with even approximate accuracy the dis[illegible] of a spring beneath the surface, or to g[illegible] useful notion of its volume, except by a [illegible] guess, and although many of them have [illegible] successful in selecting suitable spots for well-sinkers to dig, it is rather to their [illegible] prospectors than to any peculiar power of [illegible] divining-rod they owe their success. [illegible] theless we know that the effects of m[illegible] and temperature upon the nerves ar

great, especially in the case of certain p

temperaments and constitutions, and just

animals can "scent" water at long dist

just as the Indians of the Far West dis

tuitively where to look for water,—

be that individuals are occasionally

in a peculiar manner by the presenc

and with unconscious muscular

twist the rod, as it u

Amongst the best

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its alleged use.

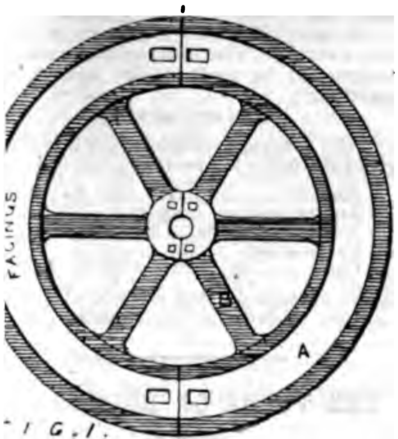

FIG. 1.

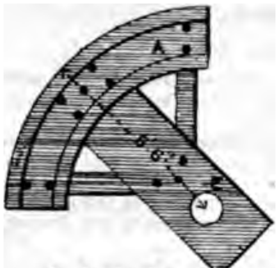

FIG. 5.

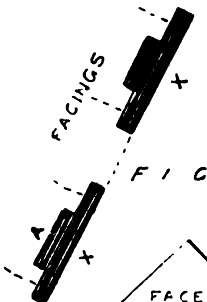

FIG 11

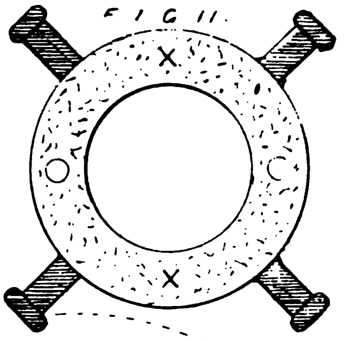

FIG 11.

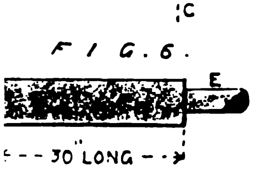

FIG. 6.

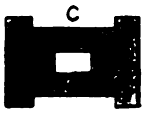

FIG 3.

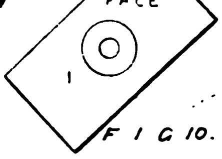

FIG 10.

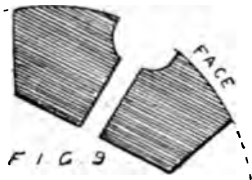

FIG 9

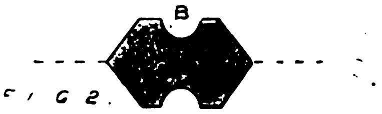

FIG 2.

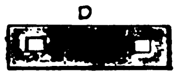

FIG. 4.

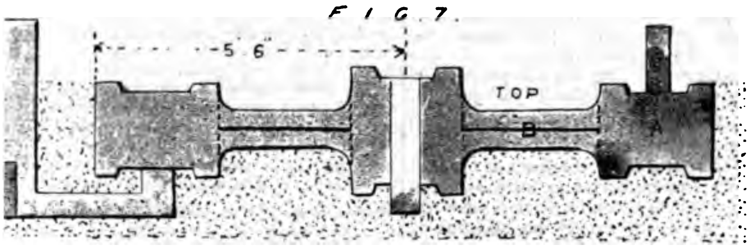

FIG. 7.

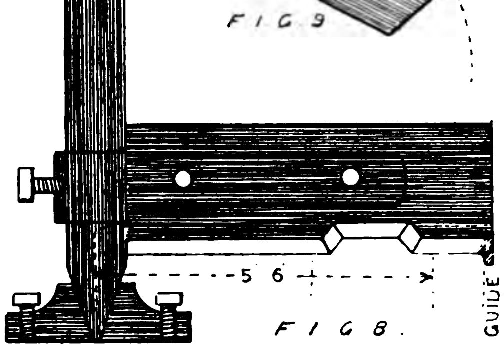

FIG 8.

arting any movement to the rod, found over spots previously or subsequently to be the seats of springs of water, and cal action being considered out of the on, it is not impossible that a superveness to temperature may be the exion of such phenomena as are true in tion with the divining-rod. If the subject th the attention of scientists at all, it e left to the students of psychology and y rather than to geologists and mineraloor certainly the rod is of no use to the

It is not a little singular, however, that rvices of a "hydroscopist" and a witchtwig should be called for in the declining of the 19th century—and that in the of Kent, the home of so many of our listinguished scientific men.

MOULDING.—II.*

By "SAND RAT."

Moulding of Large Fly-Wheels.

plates represent two different ways of moulding them. One is with a solid as shown in Fig. 1. I have shown it as split in two parts. A represents rim, acings top and bottom; B, arms fluted h sides, as shown in Fig. 2. Arms, too, and rather stronger joining the boss; igs. 1 and 3) is splitting plates. Fig. 4 to go through splitting plates, with holes in. I prefer the latter cores being loose, and put through when the plates ed in the mould. Plates to be about ¾in. and a thin coat of loam daubed on each keep the metal from melting them. to be arranged to size of wheel, both in d rim. It is a custom in small wheels, splitting them, to have plates in rim, [illegible] and wrought-iron [illegible] on each [illegible] in large [illegible] straight, and spikes over the cores to keep them parallel.

In moulding a large wheel, there ought to be a cinder bed laid under the mould, about 12in. from the face of the mould. After it is bedded, lift off and vent into the bed, then make up the vents and replace the pattern, and take it out of winding. It is a very good plan to run them with an under gate, as shown in Fig. 7, one at each side of splitting Plate, and a riser on each side of rim and boss for feeding. Sprig round the runner on face of mould, to keep it from scabbing. I will not give sketch of top part, as any box that is large enough will do by putting lifters in.

Next is a wheel made with a segment and wrought-iron arms cast, instead of cast iron. In moulding a wheel on this principle, we must dig a hole about 2ft. larger than the mould, and 12in. deeper, so that a cinder bed can be laid under; next level two parallel strips rather larger than the mould, being depth of pattern below shop floor. Next make a bed of facing sand, about 1in. thick, rather wider than pattern in diameter; next set the centre (Fig. 6) standing depth of pattern above the bed, then lay on (Fig. 5) segment with facings on bottom side. Stamp facings in the bed all round before commencing to ram. Next make six cores, as shown at Figs. 9 and 10, showing face and top view; J is boss for arms, I is face of arms, and to be laid in after the mould is blacked and finished. After the rim is rammed up, take out the centre peg and bed the boss, which can be set by trying a straight strip across the rim. Splitting plates can be put in as before; but instead of using a top box, we will use a loam plate, made about 18in. broader than the mould, with a lot of small pegs cast on to carry loam, and two riser holes, one in each half, as shown at Fig. 11, and having four snugs on to carry about and to swing it over with after it is dry. Fig. 8 shows spindle and centre, with wing on, bolted to loam-board; A shows facing; dotted lines present breadth of wheel. When it is turned it will require centring on four sides of to make equal facings.

SIMPLE EXERCISES IN TECHNICAL ANALYSIS.—X.

By AN ANALYTICAL CHEMIST.

VERMILION (*continued*).

(152.) ASH.—Take one gramme in a porcelain basin, and ignite over an argand. Should the percentage of residue exceed 1·5, the vermilion is of inferior quality; and should it largely exceed that amount, the adulterants mentioned in Art. 150 should be sought for by the aid of the tests given in previous chapters. When the percentage of ash does not exceed 1·5, and there are no volatile adulterants present, the sample is of good quality. But it is absolutely necessary to test each sample for volatile adulterants, of which sulphide of arsenic is the one most frequently met with.

(153.) *To Detect the Presence of Sulphide of Arsenic.*—Boil the vermilion in strong caustic potash, dilute with water, filter; to the filtrate add nitric acid till acid to test paper, pass SH_2. If a yellow precipitate is formed, it is probably due to the presence of arsenic in the sample. Proof of its presence, without estimation of the quantity, is in ordinary cases sufficient to condemn a sample of vermilion.

ANTIMONY VERMILION.

(154.) This is a beautiful orange-red pigment. The most common adulterant found is antimonious oxide, which may be dissolved in cream of tartar or dilute hydrochloric acid, leaving the sesqui-sulphide untouched. By the aid of the microscope, crystals of the oxide may be detected when present.

This pigment is of comparatively recent introduction.

REALGAR.

(155.) This is also known as *ruby of arsenic* and *red orpiment*. The samples in the market are usually very pure; the ash seldom exceeds 1 per cent. Chemically speaking, this pigment should consist only of the disulphide of arsenic; but as met with in commerce, it is usually a mixture of the disulphide with the sesqui-sulphide.

ORGANIC REDS.

(156.) Of these there is a great variety; but their use is confined chiefly to decorative work. They are of very delicate tints, and their comparative values may be roughly determined in a mechanical way. The following is generally adopted :—Take a weighed or accurately measured quantity of the pigment, and mix it with an equal weight or quantity of white lead, sulphate of baryta, chalk, or other white pigment. Take another equal quantity and mix with double the quantity of white; another with three times the quantity, and so on until six times the quantity of white material is used. Treat all the samples, or a standard sample, similarly, and compare the tints of the several mixtures. A good sample will possess greater colouring power, and its superiority becomes more evident as the proportion of white increases. This test is applicable to all dry pigments, and is a very useful one. One of the commonest of these organic reds is

ROSE PINK.

(157.) The following are the results of an analysis of several samples :—

	Max.	Min.	Average.	
Water	26·5	5·1	16·2	per cent.
Loss on ignition (=organic colouring matter)	19·8	9·2	16·0	„
Alumina	9·6	4·8	7·2	„
Chalk	78·5	45·5	61·0	„

(158.) CRIMSON LAKE

has the following composition :—

	Max.	Min.	Average.	
Water	11·1	8·9	10·0	per cent.
Organic colouring matter	66·5	54·5	58·6	„
Alumina	35·5	26·5	32·3	„
Chalk	2·0	1·5	1·7	„

(159.) BISMARCK SCARLET

gave the following results :—

Water, about	5	per cent.
Organic colouring matter, about	40	„
Alkaline salts	55	„

CARMINE.

(160.) A sample of French carmine had the following composition :—

Organic colouring matter	72·1
Water	21·7
Ash	6·2

(161.) In all the above cases the colouring matter was determined by estimating the "loss on ignition," and its nature ascertained when required. The tests by which this kind of pigment is recognised will be described when treating of dyes.

Blue Pigments.

ULTRAMARINE BLUE.

(162.) This important blue pigment is of complex composition, and on that account a complete analysis is attended with difficulty. For practical purposes, however, a complete analysis is not at all necessary, nor does it assist in a determination of the commercial value of a sample. The mechanical test described in Art. 156, is here of great value, for with it and a qualitative examination, the more lengthy and tedious quantitative examination can be dispensed with.

Different experimenters have obtained widely differing results in their analyses of ultramarine. Nor is this to be wondered at considering its peculiar composition, and our yet imperfect knowledge of its essential ingredients. This formula, among others, has been assigned to it—

$2Al_2O_3 . 3SiO_2 . Al_2O_3 . 4SiO_2 . SSONao_2 . 3SNa_2$.

It is foreign to the purpose of these papers to discuss the various views put forward by investigators in connection with the essential colouring matter; but in passing it might be mentioned that some hold that iron is essential to the production of colour, while Brunner found that a corresponding compound, in which dipotassic sulphide took the place of disodic sulphide was colourless. Whatever it may be due to, it is certain that the colouring matter is readily destroyed by hydrochloric acid, sulphuretted hydrogen gas being at the same time evolved. The portion insoluble in the acid contains silica, alumina, and oxide of iron.

In analysing ultramarines it is sufficient for all practical purposes to make a careful qualitative examination, together with a few simple quantitative estimations.

(163.)—*Qualitative Tests* :—

(*a*) *Sulphuric Acid.* — Concentrated acid deepens the colour, but does not destroy it. Dilute acid destroys it.

(*b*) *Nitric Acid* destroys the colour, nitrous fumes are given off, and the residual mass is of a foxy tint.

(*c*) *Hydrochloric Acid* destroys the colour; SH_2 gas is evolved; the residue is of a French grey colour.

(*d*) *Heated in Air.*—No change of colour other than slight development of a green tint. A brownish residue indicates Prussian blue. A blackish residue indicates mountain blue. Purple vapours given off indicate indigo.

(*e*) *Gum solution.* When mixed with this, if there is a brown colour on top, it is probably due to an excess of disodic sulphide in the sample.

(*f*) *Free sulphur.*—Treat portions of the sample with bisulphide of carbon, decant, evaporate the liquid over a water bath. If a yellow residue is left, it is probably sulphur.

(*g*) *Alumina, Silica, Soda, &c.*—Test for the presence of these, and for the absence of chalk, gypsum, sulphate of baryta, or other impurities.

(164.)—*Quantitative Tests* :—

(*a*) *Moisture.*—Take a weighed quantity and estimate loss at 212° F. as usual.

(*b*) *Loss on Ignition.*—Ignite strongly first over an Argand, and then over a Bunsen burner; weigh. These two simple determinations, together with the qualitative tests and the mechanical test, are sufficient for the purpose of estimating the commercial value of any sample.

The "moisture" should not exceed *two per cent.*, and often falls below *one per cent.*

The "loss on ignition" should not exceed *three per cent.* In commercially pure samples of poor quality the "loss on ignition" amounts to about *seven per cent.*, chiefly on account of an excess of free sulphur.

(165.) Should the "moisture" exceed two per cent., or the "loss on ignition" three per cent., adulterants and impurities should be carefully looked for.

In a sample recently examined in which the "moisture" was nine per cent. and the "loss on ignition" four per cent., further analysis disclosed the presence of fifty-two per cent. of sulphate of lime.

Chalk and sulphate of baryta are rarely used as adulterants now. Their presence is readily detected by the methods already described.

(166.) The following figures were obtained in the examination of good samples :—

	Max.	Min.	Aver.
Moisture	2·0	0·8	1·2
Loss on ignition	2·6	1·3	2·0

VICTORIA BLUE.

(167.) This consists of very pure ultramarine. See method of analysis above. The following figures have been obtained :—

	Max.	Min.	Aver.
Moisture	1·5	·5	1·0
Loss on ignition	3·5	2·4	2·7

PRUSSIAN BLUE.

(168.) Good commercial samples contain from 95 to 98 per cent. of Prussian Blue. The following estimations will guide to a conclusion as to the value of any sample :—

(*a.*) *Moisture.* From 6 to 8 per cent.
(*b.*) *Loss on ignition* 33 to 35 „
(*c.*) *Oxide of iron* 44 to 46 „

Multiplying the latter by 2·1142 gives the percentage of Prussian blue approximately. Commercial Prussian blue is not a definite chemical compound. Good samples are remarkable for their lightness, and for a fine, deep blue colour with a coppery lustre.

(169.) The adulterants that may be present are :—

Alumina, 4 to 9 per cent., recently found.
Chalk, rarely and only in small quantities.
Starch, not recently met with.

(170.) *To detect the presence of starch.*—Boil in water. If starch is present it will form a pasty mass. The "loss on ignition" w
be increased if starch is present in c
able quantity. The detection of the oth
terants may be made by the methods
described.

CELESTIAL BLUE.

(171.) The pigment sold under this n
given the following results on analysis

Moisture		2	per
Loss on ignition, from	0·8 to	1·6	
Sulphate of baryta, „	89 to	91	
Prussian blue		5	
Chalk	from 2 to	3	

The analysis is very simple. The
ignition" is due chiefly to Prussian blu

THE VALUE OF INCANDES LAMPS.*

THE value of incandescent lamps ma
pressed in terms of their photometr
their durability, and their first cost.
again must be considered in connection
amount of power expended in producin
amount of light. In dealing with this qu
the value of incandescent lamps, it is
things necessary to be quite clear and prec
use of terms. There is now a very consider
ber of incandescent lamps of various con
in the market, and the inventors of ea
maintain that it is better than any other.
how better, the reply is that it gives r
and is longer-lived than any of its rivals,
expended being the same. Now, a grea
vague talk circulates concerning the light
and the longevity of incandescent lamps
general public may rest certain that th
hear quite the worst. Putting this on
however, we may go on to point out th
really knows except by chance how muc
incandescent lamp gives with any accurac
for example, if we buy a 20-candle
shall find it labelled with the v
ampères it requires to run it to
advantage. Thus, we may find 80 volts
Such a lamp will require $\frac{80 \times 9}{735} = \frac{72}{73}$
about ten lamps to the h.p. These woul
at 25 candles each. We have taken h
figures, because we do not wish our calc
be identified with any special make of la
purchaser pays under the impression t
getting lamps which will, when burned
to instructions, give him 25 candles each.
average consumer, whether of gas li
light, or electric light, has not the mo
idea what 25 candles mean; and he
incapable of saying whether he gets
less than he bargained for. Ligh
be measured or weighed like milk
and the consumer is compelled to trust t
faith of the electrician to get what he
for. In the case of gas it is different.
tested by examiners, and when the co
told that he is supplied with 16-cand
knows that he has a Government guaran
gets gas of a definite quality—that, in
has what the company sold to him.
ing of incandescent lamps is a far mor
matter than the testing of gas, and
has not yet been brought to anything li
tion. To begin with, there is no such
standard sperm candle. This has long b
to gas examiners, who no longer use i
ing instead Vernon Harcourt's stand
which is produced by a mixture of seve
of gaseous pentane with twenty of ai
from an aperture ¼in. diameter, with a f
high, but the Franklin Institute lamp
all made with "standard" candles. Th
candles are defined in the Metropolita
of 1860—namely, sperm candles six to t
burning at the rate of 120 grains
Few people are aware how entirely
worthy the standard candle is. It can
snuffing be made to vary over 20 per ce
amount of light given out. No two ca
alike, save by chance. It is only necessar
one at one side and another at the opposi
a photometer screen to prove this. Thu
appears at the very outset that the test
so much importance has been attached
with instruments—for the standard ca
a light-measuring instrument—notor
worthy, but in this respect the Ame
no worse than any others. Further
very great difference in the amoun
out by an incandescent lamp in
vertical and horizontal. Do th
measure them in the worst or t
Who will say?

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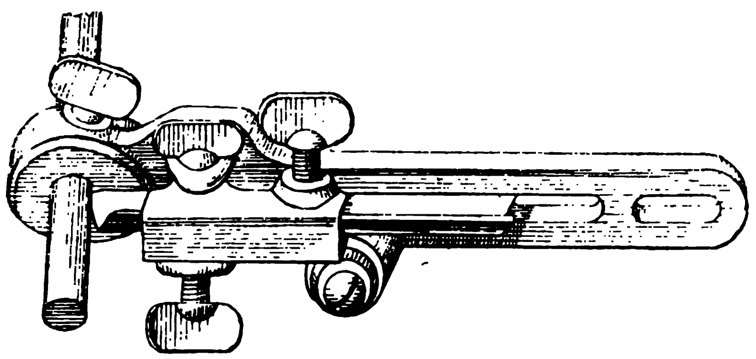
* Extracted from an article



LATHE TOOL FOR TURNING ROUND RODS.

THIS tool is designed to supply pattern-makers and others with a suitable and handy instrument for making round rods of wood for pins and dowels, or for any other purpose. It can be used by holding it in the hand or fastened in a sliding rest, doing the work with neatness and despatch. The cutter is independent of the bushing, and is adjusted with screws to turn the desired size. The tool is well made, the castings (with the exception of the bushings) being of steel, and the cutters of forged cast-steel. The size here shown is furnished with interchangeable bushings with standard-sized holes of $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$in. diameter, and three square tapering chucks for holding the work. Larger sizes are made to order, and are designed for use only with a slide-rest. The manufacturer is Isaac Fonda, Laconia, N. H.—*American Machinist.*

THE DUKE OF ARGYLL ON THE GEOLOGY OF SCOTLAND.

THE Duke of Argyll opened the Armitstead course of lectures in Dundee by delivering an address on the "Connection between the Scenery of Scotland and its Geology." In the course of his lecture the Duke said:—One of the two theories as to the origin of the mountains in Scotland was that they had been cut and carved out of the surface of the ground with the knives of Nature, the frosts, the snows, and the rains; the other was that they had been raised by what were called earth movements of various kinds, and that they assumed the forms which they now saw in consequence of these subterranean movements. After remarking that he thought all geologists now admitted that, both these agencies had been at work in the matter, the Duke of Argyll went on to say that he had been ledto address the meeting and to present his views asbest he could upon that occasion in consequence of the publication of a very interestin article by Prof. Geikie, the Professor of Geology in the University of Edinburgh, in the *Journal* of the Geographical Society of Scotland. In that article Prof. Geikie gave an account of the physicial geography of Scotland, and adopted a view with which he by no means agreed as regarded the nature of the structure of their Highland mountains. Prof. Geikie said the mountain ranges in the proper sense of theterm were such mountains as the Alps, the Appenines, the Pyrenees, or the Himalayas. In all these cases Prof. Geikie fully admitted that the mountains were due to earth movements and subsequent cutting and carving by the rains, the frosts, and the snows; but he said that in Scotland they had no true mountain ranges at all, that the hills were nothing but the remains of the great tablelands which were originally raised above the water in some form like a hog's back, and that the cutting and carving into hills and mountains had been due entirely to the denuding agencies of the atmospheric changes, an example of which in miniature they might find on railway embankments after a rain storm. This theory of Prof. Geikie he called the great gutter theory. His view, on the contrary, was that, so far as the Highlands were concerned, earth movements had had the principal effect, and that the guttering, although very great, had not contributed in the main to the configuration of the country. If they looked at the map of Scotland before them they would see at a glance one very remarkable fact, and that was that the predominant lines ran from the north-east to the south-west. They might depend upon it that the cause was not atmospheric; the winds and the snows and the rains did not always blow from the north-east to the south-west. These predominant outlines must be [illegible] to earth movements, and not to superficial [illegible] and so far as the Highlands were concerned [illegible] this was admitted by Prof. Geikie [illegible] physical philosophers w[illegible] that this globe was [illegible] was now, and [illegible] a contrac[illegible] the surface, and wherever a surface contracted they found that very often hills and valleys were formed. His contention was that their Highland mountains were due to the same cause. There was evidence of rocky masses having been shoved horizontally over other rocks to the distance of ten miles; yet Prof. Geikie had chosen to say that there were no mountains due to earth movements. The Duke of Argyll proceeded to say that about 25 years ago he was fortunate enough to discover a great number of fossil leaves beautifully preserved in rocks in the island of Mull. The beds which contained those leaves were lying at the bottom of those basaltic columns which were closely similar to the basaltic columns of the far-famed island of Staffa. He explained that the discovery was made by a man hunting otters, who in falling took hold of a piece of rock, which gave way, and he was astonished to find the impression of a beautiful large leaf, something like the leaf of the plane tree. He got some specimens and had them examined by one of the most eminent geologists, who said the discovery gave at once a clue to the geological age of the volcanic rocks. This discovery had been followed up this year by a committee of the Royal Society prosecuting explorations, and they were drawing for the Royal Society a vast series of specimens of the most beautiful vegetation his hearers had ever seen. One of the beds was so full of leaves that it could not be split with a hammer without some of them being discovered. There were araucarias, immense leaves like those of the plane tree, and a great quantity of specimens of a tree known as a native of Japan, whose leaf was like that of the maidenhair fern. The conclusion drawn from this was that in forests which had flourished at Mull there seem to have been magnificent vegetation in close analogy to the vegetation of Japan at the present moment. What did this reveal? The whole of Mull and Skye was covered with these volcanic rocks, and the same rocks recurred again in Greenland, and it was impossible to look at the matter geologically without seeing that the whole of the country he had referred to had been destroyed by earth movements. Staffa and all the group of islets of the Highlands were nothing but little bits remaining from the overflow of great volcanoes. What was the lesson to be inferred from that? That denudation, the mere work of rain and snow and of glaciers, was perfectly inadequate to account for the destruction of the whole of that country. It could only be properly accounted for by great earth movements.

Valve Gears.—At a recent meeting of the King's College Engineering Society, Mr. V. J. Bouton read a paper on "Valve Gears," in which he gave detailed descriptions of the single eccentric used in marine engines and the double eccentric formerly fitted to locomotives, Stephenson's, Gooch's, Allan's, Walschaert's, and Fink's link-motions, and Steven's and Joy's valve gear. He contrasted the advantages of the various link-motions, deciding generally in favour of Gooch's system, for simplicity and the constancy of its lead. He mentioned the superiority of Joy's valve gear over link-motions, obtained by its simplicity, efficiency, and comparatively low cost. The paper concluded with a brief notice of Mr. Stroudley's steam and hydraulic reversing gear, used on the passenger locomotives of the London, Brighton, and South Coast Railway, and descriptions of Mr. T. R. Ely's steam reversing gear, fitted to an express locomotive on the Pennsylvania Railroad, and Mallet's and Webb's reversing gear for compound locomotives.

MR. C. W. LANGTREE, Secretary for Mines in Victoria, in his report to the Minister of Mines, states that the total yield of gold in that colony in 1884 was 778,618oz. 7dwt. 22 grains, the total raised since the commencement of mining in Victoria being 53,023,985oz., or about 1,623 tons.

THE *Paris* states that Count Münster, the German Ambassador, has informed the French Government that Germany will abandon its pro[illegible] of holding a National Exhibition at Berlin in [illegible] if France definitely fixes on the year 1889 [illegible]te of her Grand International Exhibition.

SCIENTIFIC SOCIETIES.

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ROYAL ASTRONOMICAL SOCIETY.

THE first meeting after the long vacation was held at the Society's rooms, Burlington House, on Friday, Nov. 13th; E. Dunkin, Esq., F.R.S., president, in the chair.

The Rev. Stephen H. Saxby, of East Clevedon, Somerset, was balloted for and duly elected a Fellow of the Society.

Col. Tupman announced that 200 presents had been received since the last meeting. Amongst them was a photograph of part of the milky way, which deserved special mention. It had been taken by the Brothers Henry, of the Paris Observatory, with an exposure of an hour. The star discs were perfectly round and sharp, showing that the driving of the telescope during the exposure was practically perfect, and that the object glass had been corrected with great nicety for the photographic rays.

Mr. Knobel read a paper by Mr. C. R. Marten, entitled "Notes on the Total Solar Eclipse of 1885, September 9, Viewed from The Terrace, Wellington, New Zealand." No noteworthy diminution of light was observed until about two-thirds of the solar disc was covered, the light then faded away swiftly. As totality approached the shadows were weird and striking. About 15 or 20 seconds before the entire disappearance of the sun's disc the whole disc of the moon suddenly became visible, the further limb being seen projected upon the white background of the corona, while a narrow crescent of the sun was still visible. An instant before totality the light of the photosphere was reduced to one intensely brilliant point which shone like an electric light; then came complete obscuration, but the darkness was by no means complete. There was as much light as is given by the moon during its first quarter. All round the horizon were great masses of cloud which appeared lit up with sunset tints, which Mr. Marten attributed to the dust from Krakatoa, which has continued during the year to give rise to brilliant effects of colour at sunrise and sunset. The corona could be seen extending from the moon's limb in some directions for more than two lunar diameters; one long ray proceeded from the lower right-hand quadrant, and there was a large equatorial protuberance. Just before the reappearence of the sun brilliant pink and scarlet prominences became visible on the other side of the moon's disc. During the whole of totality the coronal light seemed to quiver in a way that reminded Mr. Marten of the unsteadiness of the Aurora Australis.

Mr. Ranyard said: I don't think it is necessary to assume that the colours on the horizon were caused by dust from Krakatoa. Such colours have been very frequently observed during other eclipses; in fact, nearly every observer of a total eclipse is struck by them. There are more observations of these colours than of any other phenomena associated with eclipses. The colours seem to be sufficiently explained when we take into account that the landscape and clouds just outside the area of totality are lit up by the light from the thin solar crescent. This is the chief source of illumination within the shadow area, and the light has to travel through a long distance in the lower atmosphere before it reaches the observer, so that the blue or short wave lengths of the spectrum are sieved out first as in the morning and evening illumination. The effect produced is very weird.

Mr. Knobel: Is Mr. Ranyard aware of any observations of the unsteadiness of the corona, such as is described by Mr. Marten? He says there was some unsteadiness and a distinctly varying degree of luminosity in the coronal rays.

Mr. Ranyard: Yes. Such observations are not at all uncommon. During the totality the atmosphere is often very disturbed; "an eclipse wind" springs up as totality comes on, and in other cases where there have been gusts of wind the air suddenly becomes calm: probably the air within the shadow cone is a little cooler than the surrounding air, and sinks, causing outward currents along the earth's surface.

Mr. Penrose: In observing the eclipse of 1878, I very distinctly noticed this unsteadiness; there were some very definite long filaments near to the south pole of the sun, and I distinctly saw the ends of these filaments tremble.

Col. Tennant: Does Mr. Marten mention anything about the waves of shadow or colour which observers have seen passing across the ground and over walls? General Addison saw them at Aden in 1868, and I have seen them; but where do these bands come from? One cannot understand them.

Mr. Ranyard: There is plenty of evidence that they do exist; they travel more or less slowly over the ground, not always in the direction in which the wind is blowing, and their direction does not correspond with the direction of the motion of the moon's shadow. I think that they may be accounted for by the fact that nearly all the ligh within the area of totality is derived from the coloured clouds upon the horizon. Some persons have attempted to observe the shadow cast by the corona during totality, but they have found that a pencil or other object held up casts no shadow; in fact, the light from the corona vanished in comparison with the illumination derived from the horizon, which is so bright that, looking towards the horizon, near objects appear black on a bright background. It is easy to see how light from the horizon coming slantingly along the surface of the earth would be interfered with by the variations of density in the atmosphere caused by the gusts of totality wind.

Col. Tennant: But General Addison saw them on the walls.

Mr. Ranyard: They are frequently better seen on walls than on the ground, because the walls are at right angles to the direction of illumination.

Col. Tennant: If you were to attribute it to a nervous feeling in the observer's eye caused by the change of light I could understand it; but I find it difficult to believe that it is a real phenomena which comes from the horizon.

Mr. Penrose: I have seen the shadows running over the ground, and have no doubt about them.

Mr. Klein: Might not this flickering be due to the fact that the last part of the sun which is seen is a mere point of light, and so there is a tremor, as with the electric light.

Mr. Ranyard: I do not think that can be the cause: there is really a very large surface of cloud and atmospheric haze lit up, from which the light within the shadow area is derived. When totality commences the source of light is on one side; towards the middle of totality the horizon is lit up in all directions, and towards the end of totality it is derived from the other side. I do not think that the phenomena can arise from any nervous effect, because different people have observed together, and concur in their estimates as to the breadth of the bands, their rate of motion, and the direction in which they travel.

Mr. Knobel read a paper by Prof. Pritchard on "Photometric Observations of the Nova in the Andromeda Nebula," made at Oxford University Observatory. The star was first observed on the 7th of September, when the wedge photometer gave it as of the 8·25 magnitude. The star then declined till the end of September, when it was about the tenth magnitude, at which brightness it continued till November the 12th; but there was considerable difficulty in accurately determining the brightness of the new star with the wedge photometer on account of the brightness of the nebula background.

Another paper was read by the Rev. S. J. Perry, entitled "The Outburst in Andromeda." The Nova was first observed at Stonyhurst on September 13th, when its spectrum was found to be continuous at the red end, and there was a decided maximum of brightness in the green. A bright band in the green was suspected, though not clearly seen. On Oct. 9th the spectrum was still brightest in the green. The star was then rapidly decreasing in brightness, but recently it had been nearly stationary, and of about the eleventh magnitude.

Mr. E. W. Maunder read a paper entitled "Observations of the Spectrum of the New Star in the Great Nebula in Andromeda," made at the Royal Observatory, Greenwich. The Nova was first observed on the evening of September 4th, a half-prism spectroscope was used, and no dark or bright lines in the spectrum were detected; but on September 11th Mr. Maunder, using a single-prism spectroscope, giving less dispersion than the half-prism spectroscope, was able to detect two bright lines, one of which appeared to coincide in position with the green coronal line 1474 K. On the same night he examined the spectrum of small stars in the neighbourhood, and found that the red end of the spectrum of the Nova was considerably fainter relatively to the rest of the spectrum than in other stars. On September 15th he used simply a prism before the eyepiece, and again suspected the existence of brighter points in the linelike spectrum.

Mr. Turner said: I can only repeat a remark at second hand. Professor Pritchard communicated his estimates of the magnitude of the Nova to us at Greenwich, and the general impression was that the star was brighter than his measures gave it. I do not know whether any other measures of the magnitude of the Nova have been made.

Mr. Knobel said: I have made some observations of this star, and I agree with Mr. Turner that the photometric measures which have been made probably make the star fainter than it appears to the eye. I have observed the star from September 3rd up to last Saturday, and on each night I made twelve or fourteen extinctions by the method of limiting apertures, and I came to the conclusion that all my measures gave the star too faint. It becomes invisible when it cannot be distinguished from the nebula, and that is some time before it would be extinguished if seen on a dark background. I disagree with Professor Pritchard as to the star remaining at about the tenth magnitude from the end of September to the present time. On November 2nd I compared it with the small star which precedes the nebula by about 112 or 114 seconds. It was about three-quarters of a magnitude brighter than that star, and on November the 7th it had unquestionably decreased in brightness, and was only about half a magnitude brighter. I would like to ask Mr. Maunder whether his observations of September 4th were not made with a spectroscope of too high dispersion, because on September 3rd Dr. Huggins, with a spectroscope of low dispersion, was able to see bright lines which he failed to see with a spectroscope of higher dispersion.

Mr. Stone: Does Dr. Huggins say that he unquestionably saw the lines? Was it not rather that he suspected them?

Mr. Knobel: No; I had a letter from him recently, saying that he was quite satisfied as to their existence.

Mr. Knott: As to the apparent magnitude of the star, I was away from home, and had no opportunity of examining it till the 28th of September, when I had a very short view of it between clouds. I then estimated it as about the 8½ or 9th magnitude; but that estimate may have been too high. On October 1st, when I saw it next, I estimated it as about the 10th magnitude; its colour seemed whitish, and the disc looked rather large and ill-defined for a star of this magnitude. On October 27th, I gauged it by the method of limiting apertures by placing discs in front of the object-glass of my 7in. equatorial, and I estimated it to be of the 11th magnitude. I also estimated the magnitude of the star preceding the nebula, which Mr. Knobel has referred to as of the 12·4 magnitude.

Mr. Hopkins read a paper on "Erratic Meteors." On more than one occasion he had observed that the paths of meteors were not perfectly straight; sometimes they appeared to be distinctly curved, and on two occasions he had seen meteors, whose paths appeared broken at an angle so that their paths appeared zig-zag. Mr. Hopkins drew upon the blackboard an illustration of the paths he had observed.

Mr. Penrose said: These zigzag paths are analogous to the course of a piece of slate thrown into the air, or to the path of a boomerang, which, owing to its strange surface and the resistance of the air, comes back again to the hand of the thrower.

Mr. Ranyard: I think there can be no doubt about the existence of the curved paths; I have seen a comparatively bright meteor which left a trail that was distinctly curved. There was a paper on the subject published some 10 or 15 years ago by Prof. Newton, of America. He accounted for the curvilinear paths by the irregular shape of the fragments which come into the earth's atmosphere.

Mr. Hilger was called upon to explain a driving clock which was set up in the meeting-room. The governing contrivance consisted of two fans, which opened out as the speed increased. He claimed that there was very little friction, and that the amount of the driving weight might be increased or decreased without altering the speed of the clock.

Mr. Ranyard said that the chief difficulty to be overcome in obtaining a good driving clock for celestial photography lay in the difficulty of obtaining a good driving-wheel and other gearing wheels about which there were no irregularities. He was very satisfied with the friction governor he used, which was similar to Mr. Common's, and afforded several means of regulating the speed.

Mr. Common objected to Mr. Hilger's form of governor on the ground that the speed would be altered by a change of temperature; the fans being closed by springs, which, during the period of a photographic exposure, would change in their elasticity as the night became colder.

Mr. Hilger said that the position of the fans made no difference to the speed of the clock so long as they did not touch the top of the governor.

The Astronomer Royal said that he thought the great advantage of Mr. Hilger's clock lay in the fact that it could be so adjusted that a decrease in the driving weight actually increased the speed of the clock.

The meeting adjourned at ten o'clock.

Durability of Slate.—Writing on the durability of slate when exposed, Mr. A. C. Kimber says: "In the Granary Burying Ground in Boston, there is a stone of slate erected to the memory of Captain William Condy, who died August the 25th, 1685. The style of lettering, position, &c., all indicate that it was put there soon after the burial. Yet every letter is clear and sharp, even the guiding lines scratched with the chisel being perfectly distinct. In fact, the stone seems to have suffered no change whatever. There are many others near it in the same condition, and of nearly equal age."

SCIENTIFIC NEWS.

THE death is announced, at the early age of forty-four years, of Dr. Walter Flight, F.R.S., the distinguished chemist, and until recently of the Mineralogical department of the British Museum. Dr. Flight was especially interested in meteorites, and has, we understand, left a nearly completed history of those interesting objects. The deceased studied under Kirchoff, Bunsen, and Hoffmann, and is a great loss to that branch of science which he had made his own.

The death is also announced of Mr. Randal Hibbert Alcock, F.L.S., of Didsbury, one of those enthusiastics botanists who are little known beyond their own circle. His most important work was "Botanical Names for English Readers," published last year. Mr. Alcock was born in 1833, and will be missed by Lancashire naturalists.

Amongst the Cantor Lectures to be delivered at the Society of Arts this session a course on "The Microscope," by Mr. J. Mayall, jun., will commence on Monday next, and be continued on the four following Mondays. For the purpose of illustrating these lectures Mr. Mayall will exhibit several of the instruments belonging to the Royal Microscopical Society, and also many from the extensive collection of Mr. Frank Crisp, secretary of the society, which includes examples of nearly every known microscope and microscopical accessory. The first lecture will be on "The Origin of the Microscope, and its Construction, to the Date of the Application of Achromatism," and upwards of 100 microscopes will be on view.

Prof. H. S. Hele-Shaw will deliver a course of four lectures on "Friction"; Prof. Guthrie three on "Science Teaching"; Mr. Boverton Redwood four on "Petroleum, and its Products"; Mr. Alan S. Cole three on the "Arts of Tapestry-making and Embroidery"; and Dr. Richardson five on "Animal Mechanics." The juvenile lectures during the Christmas Holidays will be on "Waves," by Prof. S. P. Thompson.

Amongst the papers to be read during the session we notice one on Apparatus for the Extinction of Fires, by Prof. S. P. Thompson; Calculating Machines, by Mr. C. V. Boys; Domestic Electric Lighting, by Mr. Preece; and the Scientific Development of the Coal-tar Industry, by Prof. R. Meldola.

At the Royal Victoria Hall and Coffee Tavern, on Tuesday next, the Rev. W. Tuckwell will lecture on a "Piece of Blue Lias"; and on Dec. 1 Dr. H. W. Crosskey will lecture on Great Britain from the Age of Ice until the Present Day.

The Siemens memorial window in Westminster Abbey will be unveiled at 2 p.m. on the 26th inst.

Herr Paul Reichardt, the sole survivor of the German East African expedition, arrived in Wiesbaden last week. He has brought many highly valuable collections of natural history specimens, as well as numerous photographs of the localities he was the first to explore.

One of the two borings lately made at Chatham in connection with the dockyard extension works is of much interest to geologists. After passing through 682ft. of chalk the borer entered the gault, which was found to be 193ft. thick. Sandy beds of the Lower Greensand were then pierced for 40ft. when the Oxford clay was reached. The Weald clay and the Hastings beds, which in the Weald are about 2,000ft. thick, are thus shown to thin so rapidly that they disappear completely at Chatham.

Lieut. Schwatka is making prepar tions for a new expedition to the North Pole. He p poses starting next spring, and wil rely than has been done before on dogs, ledges, boats.

Experiments with cocaine, as a remed sea-sickness, have been made by r. Wid wicz, and he confirms Prof. M ments, having tried the drug solution, giving half to three- as a dose for children. If v menced, the power of the dr tion is much diminished; so to administer it at the commencement of the voyage, repeating every two or three hours. A solution 2 to 5 per cent. strong yields the best results, and should be administered in capsules.

The North Sea Canal, to connect the Baltic with the Elbe and the German Ocean, will probably be commenced before long, as a Bill is to be laid before the German Parliament to sanction the expenditure—£7,800,000,—and the Government and the leading merchants are satisfied as to its great military as well as commercial value. Another great ship canal will also probably be made, in order to reduce the distance by water between Baltimore and New York by more than 200 miles. It will be cut from the mouth of the Sassafrazin in Chesapeake Bay to a point in Delaware Bay, and the money (a million and a half) has been subscribed, a contract signed, and the works begun.

A new coal-cutting machine has been tested in the Allerton Collieries, near Woodlesford. All the coal was at one time hauled by horses to the bottom of the shaft. now that work is done by endless wire ropes driven by steam power. The cutter of the machine is a disc 18in. diameter, and it is stated that it will cut 200 tons in a night with the help of two men and a boy. The cutting is done at night, the machine being driven by the hauling ropes which in the daytime are used to draw the coal to the shaft. The Messrs. Bower have had three of these machines at work for about a month, and they say that the machine reduces the cost of bringing coal to bank 40 per cent., and by diminishing the quantity of small enhances the value of the mineral sent up by about 30 per cent.

Prof. E. Süss, delivering a lecture at the Geological Institute of Vienna, on the means of preventing explosions in coal-mines, stated that experiments were still being made in the Karwin Colliery. It has been demonstrated that whenever the barometer falls, the quantity and intensity of explosive gases increase.

The National Fish Culture Association, with a view to studying the habits of marine fishes, and the effect of certain influences upon them, have arranged for observations to be made from three lightship stations—viz., the Seven Stones, off Land's End; the Royal Sovereign, near Eastbourne; and the Outer Dowsing, off the mouth of the Humber. Surface and bottom temperature of the sea will be recorded, with the density and transparency of the water, &c., and special efforts will be made to solve the problem why well-known fisheries have declined.

Volcanic Outbreaks in Java.—It will be remembered that early in May there was an eruption of Mount Smeru, the principal vocano in Eastern Java, which extended over some weeks. The lava poured down the sides of the mountain in several streams, filling wide chasms, 300ft. deep, and practically destroying the wide belt of coffee plantations which lay around the base of the mountain. Letters from Batavia say that even yet the extent of the mischief done has not been ascertained; but it is quite certain that over 500 persons lost their lives by it. Lately the Merabi volcana, in middle Java, has been causing great anxiety all over the island by its indications of an approaching outburst. Then, on the west coast, in the Krakatoa district, the scene of the great calamity of two years ago, electrical flashes and disturbances have become frequent, accompanied by subterranean rumblings and explosions, especially in the neighbourhood of the old crater. The great rock masses which were thrown up from the sea in the cataclysm of August, 1883, have again suddenly disappeared, and there is now a considerable depth of water where they stood a few months ago.

THE following figures in relation to machinery used on German farms, taken from a recently-published volume of imperial statistics, are interesting at the present time. Of 5,276,344 farms, only 391,746 used machinery at all. Of these, 836 used steam ploughs, 63,842 sowing machines, 19,634 mowing machines, and 374,057 and steam or other threshing machines. Thus much over 7 per cent. used machinery at all, of these by far the larger proportion only the [illegible] machine. Three-fourths of the whole [illegible] used no machinery, 4,000,000 [illegible] h it altogether. The [illegible] es, numbering [illegible] ures 213,000 t [illegible]

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE APPARENT ENLARGEMENT OF CELESTIAL OBJECTS ON THE HORIZON — THE REPORT OF THE DEARBORN OBSERVATORY — A PRINTING CHRONOGRAPH — THE RED SPOT ON JUPITER—NEITHER A SUN NOR AN EARTH—A FAULTY REFRACTOR — ORBITS OF THE SATELLITES OF URANUS AND NEPTUNE — POWER OF A LENS — THE LATE DR. W. B. CARPENTER—SECONDING MR. SADLER'S EFFORTS IN RE SIGNS—THE COLOUR OF THE NOVA IN 31 M. ANDROMEDÆ — PROPER MOTIONS OF STARS—SPECIFICATION FOR A TRANSIT INSTRUMENT — NEPTUNE, &c., IN A 3IN. TELESCOPE—AN ALMANAC FOR ALL TIME.

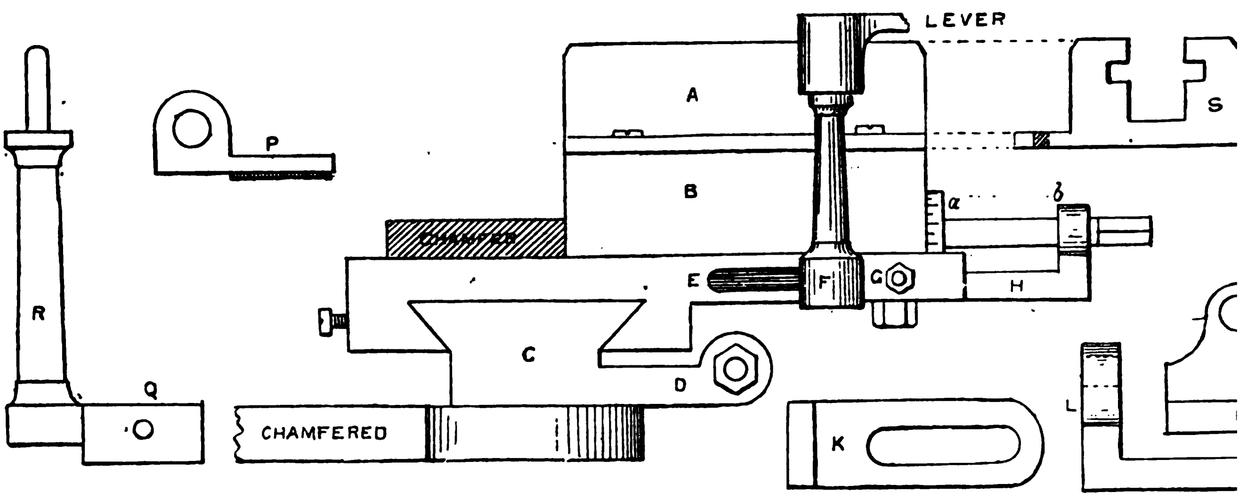
[25009.]—IN letters 23918 and 24416 (which appeared on pp. 30 and 388 respectively of your last volume) I invited attention to some remarkable researches of M. Paul Stroobant on the hitherto ill-understood and obscure subject of the apparent enlargement of the sun, moon, and constellations when on the horizon; and explained how that most ingenious Belgian observer had succeeded in tracing this illusion to definite optical and physiological causes. Since the appearance of the pamphlets from which I derived my facts, M. Stroobant has been pursuing his investigations with the most entire confirmation of his previous results, and has described his most recent experiments in a brochure which has just been issued, and which is lying before me as I write. I refer to it because it contains the details of one or two fresh experiments which I believe will interest my brother observers. Prior to the appearance of the results of M. Stroobant's first investigations, the popular and favourite theory of the seeming enlargement of celestial bodies on the horizon was the old one of the alleged flattened or elliptical form of the celestial vault; in virtue of which (it was supposed) an object overhead was imagined to be much nearer to the observer than one on his horizon, and hence its angular diameter being supposed to remain constant, to get bigger as it was removed farther from the eye. In connection with this hypothesis, the ingenious idea occurred to the late M. Plateau to see how far off the Moon actually appeared to be from the eye; and to this end he devised the following experiment. Going into an open space in which was a wall lighted by the Full Moon, he fixed his eyes steadily upon her, and then facing suddenly round, noted the size of the dark accidental or complementary image produced when projected on the wall. If this image was less than the Moon herself, he walked away from the wall. If the dark spectre was larger than the Moon, he went nearer to the wall; and so on, until he arrived at such a distance that the images, real and accidental, appeared of identical diameter. Under these circumstances, the spectral image must have appeared to be as far from the observer's eye as the real moon; and measuring his distance from the wall, M. Plateau found it to be as nearly as possible 56 yards. Repeating this experiment with the sun, M. Stroobant reduced this distance by about three yards. It is needless to point out that if this apparent distance remains unchanged when any object is observed close to the horizon and pretty near the zenith, such object must seem to remain at an invariable degree of remoteness from the eye; and, as a matter of fact, this is what really happens. Investigating the relation between brightness and seeming size, M. Stroobant found that by suddenly illuminating the eye, the [illegible] eter of the moon seemed notably to diminish, [illegible] subsequently devised an arrangement, an [illegible] moon of oiled paper, lighted from behind, in a darkened room, and a candle, covered by an instantly removable screen, by the aid of which the effect was strikingly shown. Details must be sought in his pamphlet itself, which is published by Hayez, of Brussels.

I have also received the Annual Report of the Chicago Astronomical Society, including the report of Prof. G. W. Hough to the directors of the year's work accomplished at the Dearborn Observatory: the latter containing a good deal that is eminently worthy of notice. Imprimis, Prof. Hough has devised a printing chronograph; an instrument as ingenious as it must be useful and valuable. Every practical observer knows how, in the ordinary chronograph, a series of broken lines is recorded on the rotating cylinder, and how the instant of an observation is determined by measurement of the space between the seconds' mark made by the sidereal clock and that indicating the time of the observation. The work entailed in a large observatory in converting this record into numbers is necessarily considerable, and to a certain extent costly; and the object of Professor Hough's invention is to obtain immediately a printed record of the time of each observation. It would occupy too much space here to describe how type-wheels with numbers on their rims are driven by clockwork, governed by an electro-magnet, which is, in turn, controlled by the standard clock; or how a spool of paper 2in. wide, passing between the type and the printing hammers, receives the impression. Suffice it to say, that the instant of an observation is thus automatically printed to ·01 second.

Interesting as this is to the meridian observer, another part of Professor Hough's report will appeal to a much wider circle. I refer to that portion of it in which he records the observations of the famous red spot on Jupiter, with the great equatoreal of 18·5in. aperture, during the year 1884 and 1885—observations illustrated by sketches of the planet reproduced by chromolithography. Of the red spot Professor Hough says: "The first observation was made on September 25th, 1884, when it was quite faint. As the planet approached nearer the earth, it increased in distinctness, and in the early part of November it was sharply outlined, exhibiting the same shape that it did in 1879." Now, however, comes the astonishing part of the Chicago observations. The cold winter of 1884-85 produced such indifferently defining weather, that it was not until February 27th of this year that any minute detail could be made out on Jupiter's surface. But on the night named Professor Hough remarks: "The spot showed a very curious change in structure. It appeared as an elliptical ring, the middle being white, or rather the general colour of the disc of the planet. From a prior observation recorded on the 2nd of the same month it would seem that this ring must have been formed between the 2nd and 27th. The ring shape of the spot," we read, "continued without material change for a month or more; then it began to gradually close up, and at the date of the last observation, May 15th, there was only a faint strip of white in the middle." Always a mysterious and inexplicable object, this most recently-observed astonishing change in the great red spot removes it further still from any terrestrial analogy, and renders it more mysterious and inexplicable than ever. It might, I think, interest English observers were Professor Hough's sketches reproduced in these columns.

Has Mr. E. L. Garbett (letter 24967, p. 199) heard of the ingenious and feasible theory of Mr. W. H. S. Monck, of Dublin, to explain the appearance of the recent Nova in 31 M. Andromedæ? Most working astronomers are familiar with the fact that this nebula exhibits a continuous spectrum; and yet that it has never yet been resolved into stars. Now, the surmise of Mr. Monck is that our inability to resolve it arises from the fact that it consists of a stupendous mass of discrete particles too minute to show as separate ones with any conceivable optical power, and that through the incalculably vast area of space which they fill has come rushing a stream of meteorites which, rendered incandescent by collisions, have presented the effect with which we are all now so familiar. I am far from contending that this theory is free from difficulties; but I must repeat that it is a feasible one; nay, the only feasible one I have so far met with. Should it be correct, Mr. Garbett need not trouble himself to speculate upon the birth of suns or worlds, as it is not the nativity of either the one or the other that terrestrial observers have been witnessing.

Whether the grave defect in the telescope of "Beginner" (query 57966, p. 210) has its origin in his object-glass or eyepieces, it is impossible to say without actually seeing and testing the instrument. A 4in. refractor on a fine night ought to give a perfectly clear and sharp star disc with a power of 320. Has your querist no practised observer among his friends who would test his telescope and see where the fault lies? In connection with the "100-to-the-inch aperture" superstition,



This, I think, is a capital plan, but it is omitted in the present case. I should certainly adopt the plan and make both ends equally available for this purpose. I have omitted to notice the mode of regulating the advance of the upper slide when used for ornamental turning. I have observed that the head of the upper screw passes through a collar which can be slid out or in and fixed by a small bolt. This collar encompasses the screw beyond (*i.e.*, on the winch side) of the cylindrical head, which is graduated. This head, therefore, acts as a stop in two directions, coming against the collar when the top slide is drawn back and against the body of the rest when it is drawn forward. The sliding collar consequently limits the traverse in both directions. The graduated screw draws back the tool to a given distance, and by thus determining its distance from the work at the commencement of the lever action determines the depth of cut, as it does also when the screw itself is used without the lever. I certainly consider this a very cleverly-devised step-action. The head of the tenon which drops into the socket of the sole is graduated, and the sole is made to work in a saddle which insures its rectangular position with the bed. The rest has a vertical rise of about a couple of inches, to enable it to be used with lathes from about 4 to 5½in. centre. As to price I can say nothing; but I believe the rest is not at all expensive, and it will certainly do all that is likely to be demanded of it. Had it been finished in time for the Inventionaries, it would certainly have attracted the attention of amateurs.

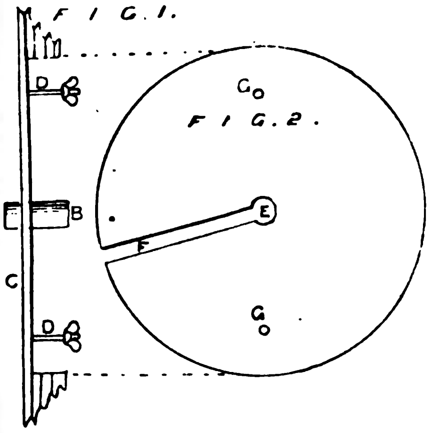
I have added a few rough drawings, not to scale, but sufficient to explain the nature of what is new. A, B, C, D is the rest in profile. A is the gunmetal receptacle, which is removable, the cross section being shown at S. C D is the main slide or T-piece fitting into a low pedestal on the foot T, which is chamfered to fit saddle. The arms which carry the leading screw are cast on this part, one being shown at D. F is a pedestal for lever, and this is made like P Q R, and slides in a groove, E, and it is secured by a bolt, S, working in a T-shaped groove. This allows not only of the easy removal of this pillar but also of its adjustment, according to the position of the slide, so that the lever may work nicely. The part H is the collar-plate of the forward screw, and I have repeated it at K, L, M. As now drawn out it allows of a traverse of the tool-slide from *a* to *b*. The graduated head of the screw *a* is stopped by the body of the rest at *a*, and by the upright part of the collar-plate at *b*. The fluting stops for the main slide are made in the usual way. I ought, perhaps, to mention that Mr. Brown will not at present supply smaller rests than this which I have described; but patterns are in progress.

O. J. L.

LATHE FLYWHEELS.

[25018.]—As I am about to make a stand for my lathe, I have read the articles on flywheels with great interest. Your correspondent, "A. Liverpool," says that the materials oftenest turned should decide the weight of the wheel; but it seems to me that this rule would not work well with an amateur's lathe which may be required to turn various sizes at different times. It is evident that for light turning in ivory or wood a very light flywheel is best, while for heavy drilling and boring a heavy one is a necessity. As it would be very inconvenient and expensive to keep several different sizes of wheels, I have designed one, the weight of which is easily adjustable, and can be cheaply made.

It consists of a light flywheel in shape something like a dish, Fig. 1. It has a very thick rim, on the outside of which are turned the grooves for the driving band, and a boss in the centre, B, where it is keyed on to the axle. Instead of spokes, there is a flat disc, c, from which, about 3in. from the rim, project two ½in. screws, D, D, provided with wing nuts. Fig. 2 is one of the weights. These are made of ½in. iron plate of the shapes shown. The round hole, E, in the middle fits over the boss, B, of the flywheel. The slit F is to allow it to be put on without dismounting the axle. The two holes G G are for the screws D D of the flywheel. By means of the weights the wheel can be easily adjusted to any kind of work. I should like Mr. Evans, or anyone competent on lathe matters, to express his opinion of this, as I am thinking of making one for my lathe.



H. Rey.

WHEEL CUTTER.

[25019.]—I SHOULD be glad to hear more from Fred. Baker as to the cutter he illustrates, and the other tools he mentions. As he invites us to discover the defect, I will say I suppose it may be in that when it is required to swing the pulley ½ round, there not being room for it behind, it must go to the front of spindle, where it may be in the way of the work.

I should like to hear more about those little bevel wheels, which seem to have worn so well at such a great speed. Are they of steel, and how were they cut? Do they not make a great noise? I should much prefer to employ two guide pulleys for the band, and dispense with the gearing. Why, too, did he not slot the spindle and let the tool pass through in the usual way.

F. A. M.

BALL BEARINGS.

[25020.]—MR. WYATT (24982) is doubtless right in saying that ball-bearings for a bicycle are better than plain, but he seems to misapprehend why they are so. To begin with, they do not require a fraction of the lubrication needed by a plain bearing. I have ridden a 56in. machine fitted with Æolus balls constantly for two years, scarcely missing a day, and I have known my bearings run for three weeks or a month with only one oiling to start with. The chief difficulty with the bearings of a bicycle or tricycle is, of course, the dust and dirt from the roads that find their way into them. Now, with a plain bearing, however hard, this dust plays havoc, soaking up the oil and eating away the wearing surfaces in a very short time. I consider that a ball-bearing can be so constructed as to practic- prevent the entrance of dust, and e excluded, it cannot produce the same as in the plain bearing, simply becau of the balls is entirely a rolling and friction.

Again, in a plain bearing there i adjustment for wear except by rem of the bearing, and filing or grindin the lugs so as to allow the two halv to come more closely together. A means whatever of adjustment which is an important matter in cause it makes the steering uncert ball-bearing (*e.g.*, Æolus) both the justed by simply tightening a screw.

Mr. Wyatt is quite right in s friction is so inconsiderable in eith may be neglected entirely. But that in face of the extra cost enta bearing, single or double, has bee versally adopted by makers of tricycles alike, seems to me a sufficie everything being considered, it is the for the purpose.

THE TOTAL SOLAR EC SEPT. 8, 1885, AS SEEN ZEALAND.

[25021.]—I HAVE just received fr ing, of Napier, N. Z., a detailed a observations on the above phenom some newspaper paragraphs contain to the same subject. I make extracts. Mr. Harding writes from C

"There is unfortunately but littl re the eclipse of yesterday from this sun behind a dense mass of clouds e the horizon some 20° in height; oth passing over the upper portion of t from the south. The sun did not till after 7 o'clock, when it could one-half obscured through a break The beginning of totality could except for the peculiarly *blue ting* on every ouject. We were watching clouds for the reappearance of t suddenly, within one minute of ti eclipse, I saw a most beautiful c think it must have been the very firs totality.

"Two miles to the north of us, in t Valley, the observers had a good vie of totality, and they say it lasted abou thus verifying your calculations. the case about two miles to the so four miles inland to the west. I impression that a considerable numb would have visited Castle Point f On the contrary, no one came here b

From the New Zealand *Evening* that at Wellington the eclipse was most favourable circumstances. Th Victoria was the spot most favoure from the city, and, by a quarter pa minutes before the beginning of could not have been fewer than 30 congregated. When the sun made it was already about one third ecl period of totality approached, the ing with hurricane force. When b line on its right edge represented al seen of the sun, the black disc of th clearly visible, with a very faint w the edge of the [illegible] the most imp the phenomen and sea from totality. In te day, which pre of the sun's disc was visible, darkened to the obscurity of a moonlight night. Viewed through a good glass, the corona afforded a glorious spectacle; the longest rays were those springing from the N.W. and S.E. Next to the corona, the red spots or flames were the most interesting objects of observation. One very large red prominence was conspicuous just to the right and above the longest ray of the corona, and about 30° west from the sun's northern pole. Two bright red spots in close proximity were also to be seen on the S.E. edge, almost diametrically opposite to the large one. The period of totality was computed at 1m. 40sec. The time of first contact was set down at 6h. 31m. 38sec., and this, compared with my prediction of 6h. 40m. 15sec., allowing 9m. 12sec. for difference of local mean time from that of the meridian of 172° 30m.—which gives the standard mean time of the colony, shows a difference of only 35sec. The time of last contact was noted at 8h. 46m. 16sec., which, by a like process, shows an error of 52sec. These are very small discrepancies, considering all variations of position and chronometers, and personal peculiarities of observation.

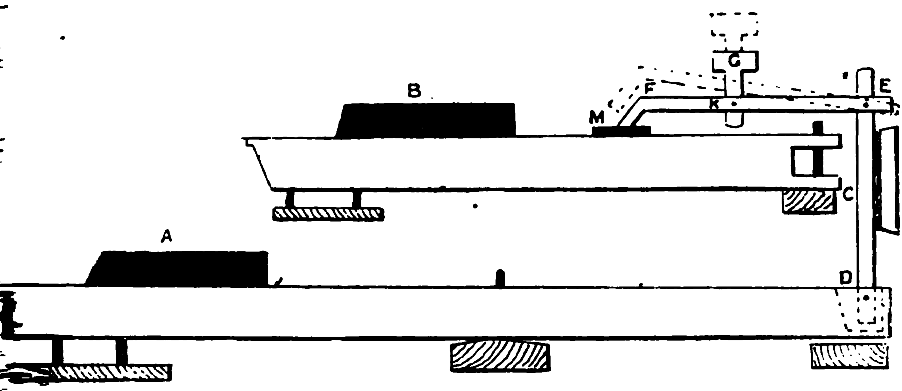
The eclipse was well observed at Masterton, Collingwood, Nelson, and Blenheim; but clouds intercepted the view at many other places.

James Pearson, M.A., F.R.A.S.

Fleetwood, Nov. 9.

AMERICAN - ORGAN MANUAL COUPLER.

[25022.]—HAVING in course of construction a [illegible]rge two-manual American organ, I send a sketch which will explain the method I have adopted in arranging a simple and effective manual coupler action. In reference to sketch, A shows the keys [illegible] lower manual, and B those of the upper manual. [illegible] lever, C, is pinned to each key of the lower manual at D. A series of bent levers, as shown at [illegible], actuate the keys of upper manual when the coupler is in action. The levers C are also pinned [illegible] the upper end to the levers F, as shown at E. [illegible]he levers F work from the centre on an action



[illegible] part of which is shown at G. The dotted [illegible] show the position of the levers F, when the [illegible]ler is out of action. The coupler is brought in out of action by the simple rise and fall of the [illegible] rail to which the levers F (which actuate [illegible]pper manual keys) are pinned in the centre, [illegible]own at K. A small bit of felt or leather [illegible]ld be secured to each key where the end of the [illegible] F rests. A strip of wood is secured at the [illegible] of the levers C, so as to steady them when the [illegible]ler is not in action. The side near to the [illegible] C should be covered with felt.

[illegible] sketch merely explains the action for one [illegible] and will, of course, apply to all the keys [illegible]ghout the lower manual. The strip of wood [illegible]own at H, and the felt on which the lever F [illegible] at M.

G. Fryer.

[illegible] BLOWPIPE AND COMMERCIAL SCIENCE.

[illegible]23.]—I AM pleased to see that my descrip[illegible] blowpipe and apparatus (letter 24957, page [illegible] has attracted the attention of Col. Ross, [illegible]gh I think he must have glanced over my [illegible]ption very hurriedly, and without studying [illegible]gram, or he would never have written in the [illegible] expressed in letter 24980, page 204, "E. M." [illegible]rst place, Col. Ross says that "the late [illegible]riffin took to him many years ago a sp. gr. [illegible]n the principle described" in my diagram. [illegible] to Col. Ross's own statement, this [illegible]ve been the case, as he goes on to say [illegible] and 'pans' were made of alumi- [illegible]ectfully to call his attention [illegible] to [illegible]nt screw-thread for balancing the *pan* in air and water. 2nd. Col. Ross thinks correct Al plate reactions can not be got with a Herapath blowpipe. Had Col. Ross been more careful in his examination, he would have found my blowpipe very different in construction to a Herapath. The blast tube of my blowpipe *slides* airtight through tap of gas tube, and can be pushed inward until the nozzles of both tubes are lineable, or it can be drawn back so that the nozzle of air tube may be 1in. down the inside of gas tube. By this arrangement, and the ease with which the proper proportions of gas and air can be adjusted by means of the regulators figured, this blowpipe will produce a *perfect pyrocone*, and may be varied at will of operator to suit the especial requirements of the case in hand. When I say a perfect pyrocone, I mean a non-luminous cone of blue flame from 1 to 3in. long, having a base equal to the diameter of the gas tube, from which it is produced, and an *unbroken apex* as fine as the point of a needle, this cone being surrounded by an outer envelope of a violet tinge. I think Col. Ross will not deny that the most delicate effects of oxidation, peroxidation, and reduction obtainable on Al plate can be produced by a pyrocone of this quality and form. I may say that the apparatus is so steady in practice that a flame of any desirable length may be kept up with ease, which in my experience is not the case with any other apparatus. The pyrocone, being under such perfect control, allows of the tip of either the peroxidising or of the reducing flames being concentrated exactly on the assay itself, and not on the Al plate. It is on this point I have found its immense advantage over common blowpipes. While on this subject I may be pardoned if I give a word of caution in regard to the fusibility of Al plate. I obtained from a well-known firm of refiners a piece of Al plate of the size and shape recommended by Col. Ross, so that I could practice the bare plate reactions of metals and alloys figured on table 4th of his book, "The Blowpipe in Chemistry, Mineralogy, and Geology."

At page 100 it reads as follows:—"I found in 1871 that my 'aluminium plates' *resisted the utmost heat of the blowpipe which I was able to bring to bear upon them.*"

Myself not having previously manipulated with aluminium, but was aware the textbooks stated its fusing point to be between those of zinc and silver, yet on reading the above sentence I became so mystified that on attempting to pyroxidise a small fragment of Pb + Sb, I found my Al plate became blistered and shrivelled around the assay. I then tried to oxidise a small pellet of grain tin, and actually melted a hole in the ledge of my plate, although holding the assay in the oxidising flame quite 2in. away from the blue tip of the reducing cone. I at first attributed this misfortune to the power of the blowpipe I was then using, which was one I use for my ordinary dental work, and is worked by a blowing apparatus composed of a cylinder of galvanised sheet-iron, weighted at the top, working gasometer-fashion inside a 36-gallon cask. This blower delivers the air under great pressure at the blast tube. Mistaking this for the cause of my Al plate melting, I tried the same experiments with an ordinary mouth blowpipe, and to my surprise I again melted a hole in the plate. Thinking my aluminium plate might be wrong, I wrote to Mr. Letcher to supply me with one of the same kind supplied to Col. Ross. Of course, as soon as it arrived I was anxious to try if it would stand the heat better than my previous one. I tried the same experiments, using the mouth blowpipe for the purpose, and supporting the plate in my left hand by the holder with which it was sent *à la* Ross, when lo! and behold my assay dropped clean through the plate, having melted a hole about the size of a mustard seed. After this mortifying misfortune I put the Al plate aside, remarking at the same time that the statement made in Col. Ross's work was very misleading, and ought to be odified.

I may here remark that since I made my new blowpipe I have tried all the Al plate reactions figured in Col. Ross's book, and owing to the perfection of the coned flame, resulting from the ease with which it is adjusted, I have successfully gone through them without the slightest damage to the aluminium plate, and obtained the most delicate and surprising results. I see (3rd) that Col. Ross does not believe in a fixed support for Al plate. I discarded the brass tweezers wrapped round with lint, as they were continually burning my hand, however, not so deep as to leave a scar as shown by Col. Ross on his left hand from similar cause.

In my plan of supporting Al plate it is under the control of left hand. When working the blowpipe, stand fits into a socket in one end of case, the Al plate stand fits into another socket in the lid, and the lid slides to and from the blowpipe, and is just as easy to push to and fro with the left hand, far superior in steadiness, and certainly less vexatious than the brass lint tweezers support. The quotation from Berzelius is not applicable in this case, as the left hand is always ready and has its work to perform.

4th. Col. Ross gets rather humorous here; but if he does not see that the 4ft. length of indiarubber tubing is intended to reach from the bellows on the floor to the blowpipe on the bench or table, perhaps I had better further explain, as there may be other novices in this matter besides himself. In the first place, put down the box or case on the table, take the key out of your pocket and unlock the lid, slide off the lid entirely and unpack all the paraphernalia, then take the indiarubber air-bag and adjust it on the blowpipe, and also one end of the 4ft. length of fine indiarubber tubing, then place the blowpipe in its socket on the case. Now get your bellows, slip the catch, and they will spring open. Put the other end of 4ft. length of fine tube on the short brass pipe on underside of bellows, and they are ready for work. Now take your gas-tube, place one end on the blowpipe, and the other attach to any convenient gas bracket. Now slide the lid of case back into its place, and put the crumb tray under nose of blowpipe, and if about to make use of Al plate, place it in the socket on the lid. Now put the case with blowpipe, &c., in front of where you intend to sit. Then place the bellows on the floor near your right foot, with the pointed end towards you, and if you have ever worked the sewing-machine for your wife you will need no further instruction how to tread the bellows.

As I did not give dimensions of case, I will give them here. It is made from ⅜in. baywood, and is outside measurement as follows:—9in. × 4½in. × 4in. deep, fitted inside at one end with a small drawer for test tubes, assays, &c. All the things figured on page 185 "E. M." go inside, and there is room for any other small articles it may be desirable to add. The case is carried by a brass handle at one end exactly similar to a microscope case. I hope this is plain.

B. C. R.

PYROLOGY.

[25024.]—I WAS delighted to observe in to-day's "E. M." a letter from Mr. W. H. Furlonge, of Port Arthur, Canada, on this subject, which seems to me to give ample evidence of the really wonderful manner in which he is turning it to account in his profession of mining engineer among the splendid metalliferous deposits of Lake Superior.

His failures—minimised almost to a point, when we consider that he has not yet studied this subject (Pyrology) by the light only of my last little brochure, under many difficulties, as the absence of gas, &c., quite two years — will, I am convinced, only act as incentives for further progress to an energetic, original mind such as his; and I am equally convinced that he will, before long, rise to the head of his profession in Canada, and to a distinguished place as a pyrologist in Europe and America—that is, if he will stick to the good old practical "E. M." as his medium of publication, and not be led astray by the coveted, but most fallacious, "honour" of orthodox interment in the sarcophagan "journals," or "horals" of any scientific "society," by which so many "good men and true" have been totally lost to the practical world of science.

His difficulties—as illustrated by "Labradorite" —may, I think, be summarised under one head or cause: viz., that of having an insufficient pyrocone for the boron trioxide reactions. I always use now Lombardi's hot-gas lamp, and find no difficulty whatever in obtaining by the method laid down, a reaction for lime in my Labradorite specimens. When I can find time I will send him some beads in which lime has been thus separated and shown distinctly as calcium phospho-borate. I have still some difficulty in distinguishing between the reactions of lime and magnesia (except where they exist in equal quantity, as in dolomite) because the former borate absorbs the latter.

Perhaps, also, Mr. Furlonge has formed too exaggerated an idea of the representation of 10 per cent. of lime (as in Labradorite), in a mere trace of the powdered mineral. The lime balls must be carefully looked for through a good lens, and if not thus found, the bead should be boiled, and the residue treated in a fresh bead; a trifling labour when compared with those constantly occurring in analytical chemistry.

I am led to believe an inefficient pyrocone to be Mr. Furlonge's chief difficulty, because he says "the alkaline aluminous silicates [comprised almost entirely under the zeolitic series in mineralogies] can only be fused partially, if at all, in the majority of cases." Now, according to Prof. Brush (Dana's "System of Mineralogy"), Prof. Cornwall, of New Jersey College, and other mineralogists, these silicates are almost all fusible B.B., and afford a jelly at first to HCl, just as they do to boric acid B.B. But Mr. F. may say "I cannot obtain gas out here." In this case he ought to devote his abilities, which are great, and his opportunities, which are considerable, to the construction of an oil, fat, or petroleum lamp capable of producing as energetic a pyrocone as a hot-gas lamp. I believe the thing, though difficult, is to be done.

As regards his interesting remarks on the rose sublimate obtained from gold + soda without lead, Mr. W. M. Hutchings, of Freiberg University, says (*Chemical News*, Nov. 16th, 1877):—"I believe Col. Ross was the first to give gold among the metals whose sublimates can be obtained with the common blowpipe, owing to the fact that it can be easily produced and seen on aluminium, though not at all on ordinary charcoal. Ross appears only to have produced it from an alloy of gold + lead; but I find that a very fine gold sublimate can be obtained in two or three minutes by strongly heating a little ball of perfectly pure gold on a charcoal slip on the Al ledge." Hutchings supposed this plumbo-aural sublimate "to be simply metallic gold placed over that of lead oxide"; but it can be easily proved to be a true oxide,* as follows: Dissolve some of it, scraped off the Al plate in a bead of glacial phosphoric acid B.B., holding the bead carefully in P.P. at *precisely* ½ an inch from the blue tip of the pyrocone; the whole bead will be tinged on cooling a magnificent purple colour ("purple of Cassius.") Now hold this purple bead in O.P. at the tip of the blue; a "dirty" greenish-brown oxide of gold will be suspended through the bead, showing a faint blue colour by transmitted light; on account, I suppose, of the hydrogen of that part of the pyrocone disposing of two atoms of oxygen of the oxide molecule. This brown oxide of gold appears to be analogous to the greenish-brown oxide obtained chemically from the aural monochloride, and cannot be reduced in the bead to metal by H.P., on account of the large quantity of oxygen in the flux; but if some of the rose sublimate taken on the surface of the hot bead be treated with H.P. in the first instance, yellow flakes of gold are at once produced, and these can be changed or oxidised to the purple colour, by the ½in. P.P. and fresh P_2O_5 as before.

Nov. 13. **W. A. Ross.**

ELECTRIC CLOCK.

[25025.]—There have been several letters and replies to queries at various times in the columns of the "E.M." on the subject of electric clocks, all more or less interesting; but so far as I can recollect, in each case a battery, requiring at least occasional attention, has been used. As I have been successful in making an electric pendulum which is driven solely by a water battery, I thought a short description of it might be interesting to some of our readers. My clock is really a modification of Bain's electric regulator, which he invented, I think, about 1847; but I believe he almost invariably used an earth battery to drive his clock with, and as the current from this was apt to vary, and in many cases fail altogether through lack of moisture, his clock got an unnecessarily bad name, and is now looked on as a thing of the past. In Bain's regulator, the pendulum consists of a wooden rod suspended on two steel springs, insulated from each other, and from these wires pass down the back of the rod to the solenoid which swings over the N. poles of two permanent bar magnets fastened to the back of the clock case. In making my pendulum I reversed the order of things, and employed two solenoids and one permanent magnet. I used an ordinary seconds pendulum, and made the bob out of 2in. brass tubing. There is also a ½in. brass tube passing through bob to take pendulum rod, which has the usual screw and nut to adjust for time. The bob was filled with about 6lb. of melted lead, the cap soldered on, and then polished up in the lathe and lacquered. About 1in. above bob, and at right-angles to rod, through which it passes, is fixed a permanent bar magnet, 7in. long and ⅜in. in diameter: this projects a little over 3in. on either side of the rod, the latter being about ½in. in diameter. The two solenoids are fixed to the back of the clock case in such a manner that the magnet on pendulum rod can swing freely within them without touching anywhere; and in order that it may do this, they must be fixed slightly out of the horizontal. The solenoids are formed of two reels 2⅞in. long, with a ⅝in. hole through them for magnet to enter, and there is nearly ⅛lb. of 28 s.c. wire on each reel. I believe that 34, or even 36, would be better for the purpose; but not having a sufficient quantity of either by me when I made my pendulum I used 28. The solenoids must, of course, be connected up to get like poles facing each other. When the pendulum is at rest the ends of the magnet should be just half-way through the solenoids, and when it has got its full swing it will just clear the end of each reel. The wire passes from one reel direct to the copper of the battery, and from the other one to the contact breaker, and then on to the zinc. There are obviously many ways of making the contact breaker; the great thing to aim at is a good contact with as little friction as possible. In my clock the current is interrupted by a little brass lever about 3in. long, placed vertically, and pivoted at the bottom with a fine steel pin. It has a rather wide fork at the top, standing out 2in. from lever, while the pendulum rod catches at each beat and carries past the vertical, when it drops by its own weight on to two banking pins. This little brass lever is made like an eccentric, and when it drops to the right it presses down two very fine steel springs, tipped with platinum, and placed one above the other on a piece of ebonite, about 1/32in. apart; these it joins, and the current passes through them until the pendulum has very nearly completed its oscillation to the left, when it pushes the lever with it over the vertical, the current is then broken, and the pendulum swings again to the right by gravity.

The battery is a large earthenware jar, which I stole from the larder, about 2ft. high and 1ft. 3in. wide, and the electrodes are two large pieces of copper and zinc. The liquid is ordinary spring water. The train of wheels which drive the pointers is a three wheel one with pinions of 10in., and the dial is 15in. in diameter. The power is transmitted from the pendulum to the train by what I believe our horological friends call a "step and fetch it" motion—*i.e.*, a lever on the pallet arbor, working on a ratchet wheel and click on the 'scape wheel arbor. I found it necessary to counterbalance both the pointers very accurately, as before I did so the pendulum used to bump against the selenoids when the minute hand was coming "down the hill," and lag a little when it was going up. I started the clock a little over two months ago, and it has never been stopped since, excepting when I have had to regulate it. It has been now going for the last month without being altered at all, and is about fifty seconds slow. I have not put the case on yet, and my workshop (where it is mounted pro tem.) is at times decidedly dusty.

Shall be pleased to give any further particulars.

Acolyte.

THE DEWING OF MIRRORS, &c.

[25026.]—It is one of the advantages of the English Mechanic that we get the experience of others on the various points connected with our pursuits. Dr. Ferguson (letter 24968) seems to be still troubled with the dewing of his mirrors, and my experience in this may be useful to your readers.

My 12½in. Calver reflector has been in my house for 2½ years (a square Romsey) without requiring resilvering, and the mirror has only dewed once. This was from everything being left open—mirrors, shutters, doors, and windows—for about two hours while I was absent, and during which a very thick fog came on. I at once took the mirror off and dried it gently at a fire.

The cause of dewing is, of course, the mirror being colder than the surrounding air. This is always the case in the morning, as, after the cold night, the air changes more rapidly than the mirror. With my 10in., I used to find that when I opened the telescope and took off the cover of mirror in the morning, it always dewed, and it struck me that this might be the cause of it. I, therefore, now never open it until the house is warmer than the external air, with the result that it never dews at all. The same applies to my flat, which is fitted with a close cover, and is never removed from the telescope. I do not remember that it has ever dewed since I had it.

When observing of an evening, as the air is getting colder, the temperature of the house is, say, 1° warmer than the external air, and as the mirror gives off its heat more slowly than the air, it seems sufficient to prevent dewing.

I understand Dr. Ferguson's house to be simply a roofed covering on wheels, which he runs off and observes in the open air. I am not prepared to say that a reflector is not better in the perfectly open air, as it is difficult to test it. With the precautions, however, that are taken with a good "Romsey," in which—1. The house stands on stones, raising the floor 6in. above the ground, with free current of air under, and also has, say, 2ft. of cinders under the floor up to the ground level. 2. The shutters are 4ft. by 9ft. 6in., equal 38 sq. feet. 3. Walls are of ¾in. matched boarding, with braces and posts *outside*. 4. The roof is painted canvas, resting on rollers, and has ¼in. air space all round for ventilation—it so closely approximates to the open air that the difference is probably practically nothing, and the result in definition, &c., is all that can be desired. The comfort of being sheltered from the wind, which is almost the only difference, is so great, that it renders observing really pleasurable; without the house, to many, it is not only not pleasurable, but not endurable.

On the question of refractors and reflectors, I have only the experience of a 4in. Wray, which is as fine an o.g. as it is possible to have; but it does not do to compare it with 6½in. of my mirror, taking the companions of Polaris, Vega, or Delta Cygni, as examples. With regard to aperture, I see more and better with 10in. of my 12½in. mirror than I saw with the full aperture of my 10in. mirror. I never want any stops on the planets, the moon, nebulæ, or clusters—which are simply superb—and the 10in. does not compare in these with the 12½in., as there is half as much light again, bringing out exquisite details and distinctness. On double stars I can work with best results with larger aperture than I could with the 10in. The stops are, of course, only wanted when the air is unsteady, not from any defect in the mirror. It is easy to see that the extreme delicacy of a reflector is more likely to be affected by this, especially as the rays traverse the open tube twice, than the rays of light passing once in a closed refractor.

Fordingbridge. **T. Westlake.**

GRINDING AND POLISHING GLASS SPECULA.

[25027.]—I commenced this letter some four or five months ago, but thought I would wait till Dr. Royston Pigott had finished his articles on the Cassegrain, and then give my ideas of how best, practically, to make the mirrors for that form of reflector, as the Cassegrain seems just now to be to the front, and then proceed with my remaining letters on the grinding and polishing of glass specula; but as it appears it will be some time before the Doctor will finish his really interesting and important contributions on the reflector, I think I had better proceed with my subject, though I shall be adding to the space occupied by astronomical subjects in our columns, and I certainly think we astronomical contributors have quite our share of the space allowed in the correspondent columns—I often wish that less space was taken up with merely personal matters of a disagreeable character.

It is very gratifying to me to know that my labours to discover and make known for the good of others interested, the laws that govern the grinding and polishing of glass specula, have not been in vain, and that my letters have so plainly described the various processes and explained the laws that amateurs on the other side of our globe can at once follow my descriptions, and repeat my experiments with success and pleasure to themselves. My sincere desire has been to improve amateur astronomers and their instruments. I am very glad Mr. Wigmore has mastered the shadow and zonal testings: this is most important, for anyone who has can judge of the excellence of a mirror at once and without looking at the stars at all, and then, as he has freely received help from our columns, he ought to be willing to freely give his assistance to others in the way of testing specula for them, and the anxiety that an amateur has in parting with several pounds, often a considerable sum to him, in purchasing a speculum as the foundation of a telescope for himself will be lessened, as he will not have to take it entirely on the word of the seller; of course, I do not here refer to makers of world-wide fame. I am glad to bear personal testimony to the very kind feeling that exists among genuine amateurs, and the pleasure it is for one to help another. There is a kind of freemasonry in this matter which every amate[illegible] who has received help, and especially if he [illegible] given in return to others, feels he is a membe[illegible] and would like to give personally the grip of [illegible] nition to all his brethren.

As to glass discs, Mr. Wigmore cannot d[illegible] better than write to Chance Brothers, Glass Wo[illegible]ks, near Birmingham, England; this address will [illegible] nd them —they are most obliging, and as cheap as [illegible] any other firm. The late Mr. Scott, of Sunderla[illegible] a sincere lover of the reflector, wrote to me ju[illegible] st before died, telling me he could not get discs [illegible] cheap before, so that I believe Chance B[illegible] others cheap as anyone else now. I would [illegible] advi[illegible] write for discs to particul[illegible] should be well annealed; t[illegible] a certain kind of flexure, w[illegible] thing to say upon in a future great importance of this matter has been quite overlooked; discs should be so annealed as to show no internal strain when examined by polarised light;—but more about this further on.

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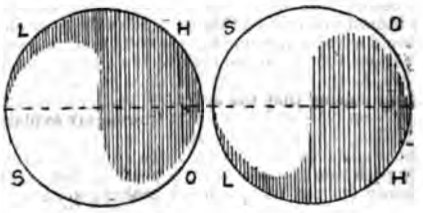
* "Trioxide, or Auric oxide, Au_2O_3.—When magnesia is added to auric chloride, and the sparingly soluble aurate of magnesium well washed and digested with nitric acid, auric oxide is left as a reddish yellow powder, which, when dry, becomes chestnut brown."—"Fownes." 12th. Edition (*by Watts*).

I will now explain to the amateur how to detect flexure by the shadow test. But I may observe if he has a well-annealed disc, and has worked his mirror supported as I have directed and surrounded with water, he need not fear flexure; but it will be useful for him to know how to detect it, for two reasons: 1st. He ought to test his speculum in its mounting for the telescope, and be able to assure himself that his way of mounting does not in the slightest way bend his speculum, for this would be no better than having a speculum with flexure in it to begin with, and then carefully mounting it so as not to bend it; in either case he would have a bent speculum to observe with, therefore the importance of being able to detect flexure during the making as well as after mounting. I will explain ultimately what I believe to be the best mode of mounting. 2nd. It is important the amateur should understand how to detect flexure in any of the specula he may be requested to test for his friends, and this I believe any genuine amateur will take a pleasure in doing; and let me tell him he will be the gainer as well as his friends, for he will get an extended experience, and learn the characteristics of the various makers, so that he would be able with tolerable certainty to name their work from testing, and the amateur cannot have too much experience in testing: it will raise his standard of excellence at which he aims, and make him dissatisfied in his own work with anything less than perfection. I can safely say that out of the scores of specula that I have tested, I have been benefited by each one by learning something from it.

In proceeding to describe how flexure is to be detected, I suppose the amateur has mastered and practically followed on his own specula all I have told him in my previous letters on the subject of testing, and I am going to lead now only a little further. He knows very well from his past experience that, according to the position of the shutter along the cone of rays, the shadows come on differently for the parabola, or any other figure, in fact; therefore, to simplify the matter we must ascertain which is the best place along the cone of rays to detect flexure at, and then always to put the shutter there, and test from that place: we have then only the shadows from one place to remember and compare. Now the best place along the cone of rays is at the focus of the outside zone—viz., No. 1 zone. All, then, that the amateur has to do is to put No. 1 zone on, and alter the position of the shutter along the cone of rays till the shadows come on equally on each side of the zone; then remove the zonal stop and examine the shadows as they come on when the shutter is passed over the cone of rays. Now the great thing to observe in this is whether, as the shutter advances, the shadows come on exactly the same, even to the most delicate shadings on the upper half of the speculum, as on the lower half at the same time. Of course the difference will be very small in the shadows, even where there is decided flexure; but the practised eye will see it, and it is therefore only by the aid of a testing apparatus which allows the shutter to be regularly and slowly passed across the cone of rays that flexure can be detected, and it is necessary to have the motion of the shutter under control so as to be able to spot it at any point to carefully compare and examine the shadows—to study them and their indications in fact. Now it is when the shadow has reached the centre of the speculum, that the flexure becomes most visible, through the difference of the shadows on the upper half as compared with the shadows on the lower half of the speculum. I will describe the appearance of the simplest form of flexure—i.e., when the flexure is along one diameter only, so as to make the focus of this diameter longer or shorter than the focus of the diameter at right angles to it. It may be roughly illustrated by supposing an eggshell cut through its longer diameter, and the concavity of one half examined, when it will be observed that the radius of the curve, and consequently focus of the shorter diameter of the shell, is shorter than the radius of the curve and focus of the longer diameter of the shell; such flexure may be produced temporarily by laying the back of a speculum on a straight-edge; the centre of the speculum being on the straight-edge, then pressing down with the two thumbs the two outsides of the speculum, this would bend it so that the focus from thumb to thumb would be lengthened, and thus made longer than the focus along the line of the straight-edge. This is a [illegible] easily got by bad supporting while polishing, or bad mounting, and it is all the more important to be able to detect it, because when the [illegible] is under testing with the diameter of [illegible] longer focus, either parallel or at right [illegible] of the shutter, the sh[illegible]s come [illegible] there were no [illegible] and [illegible] accidents [illegible] first time [illegible] and then be led to think, because the shadows come on exactly alike above and below the horizontal diameter of the spec., therefore, it is free from flexure. In this way any one wishing to sell such a speculum may offer to show to the amateur astronomer the speculum under testing, and by putting it with its longer or shorter focus diameter either parallel or at right angles to the edge of the shutter, then telling the amateur to see for himself that there is no flexure, by noticing that the shadows come on exactly the same, and at the same time above the horizontal diameter as they do below the horizontal diameter; therefore, having Mr. Wassell as an authority, there can be no flexure. But, stop; let the amateur go to the speculum, and with a lead pencil put a mark on its edge exactly at the top, and then turn the speculum round so that this mark is 45° from the top either to the right or left. Now let him ask that the speculum be brought under testing again for his examination, with the shutter at the focus of the outer zone, and now the amateur will see as he passes the shutter over the speculum that the shadows come on a little differently on the upper to what they do on the lower half of the speculum, and according to the amount of the flexure, so the difference of shading will be greater or less. I represent, in Figs. 1 and 2, the appearance of the shadows when the shutter has passed half over the cone of rays (shown by the shadow just having reached the centre of the speculum) where the flexure is most seen. The Figs. represent a bad case of simple flexure. There are cases, of course, of bad compound flexure in which the shadows assume no regular shape, but are yet different on the upper half from those on the lower half as the shutter is passed over the cone of rays. But to return to the above supposed simple case of bad flexure, I advise the amateur to study carefully how the shadow comes on from its first appearance, and as it advances right across the face of the speculum, lingering over the examination of the shadow when it has reached the centre of the speculum, when it will be as in Fig. 1 or 2. Now let me warn the amateur that the difference of shadings in the upper and lower half of a speculum will be very small even in a speculum that is so bent as to be utterly unfit for delicate observation; therefore, he must notice and criticise the slightest difference, and linger over its examination. But with a little practice even very slight differences can be seen, especially if we are looking out for them, and this is what I am directing the attention of the amateur to in his testing for flexure. It will be evident to the amateur that only by an apparatus similar in effect to the one that I have described in my letters on testing in these columns can delicate testing be effected. The apparatus must allow the shutter to be steadily and under control at any point to be passed over the cone of rays, and to stop perfectly still at any point for careful and sometimes prolonged examination of the shadows, it is only thus aided that such delicate differences of shadings can be even seen, but which would utterly condemn a speculum; but the great point is to be able to put the shutter with certainty, at the point where flexure shows itself most, and to be able to maintain it there for the study of the shadows, and any pretence to decide the character of a speculum as to flexure without such aid is either misleading to others, or self-deceiving, neither of which any respectable maker, or sensible amateur, would allow the least chance of; therefore, the importance of adopting such an apparatus as will tell with certainty the exact figure of the speculum under examination, and although it will probably reveal imperfections that we never dreamt of before, it will lead us by emulation, or a desire for perfection, to improve our methods of working, till the newly-discovered imperfections become so reduced as to be invisible to the most delicate testings; and the amateur ought to rest short of nothing less.

I will now explain Figs. 1 and 2. The diameter of the shorter focus is from S to H, the diameter of the longer focus is from L to O; now, it will be observed, that the shadow in each Fig. along the horizontal line has only just reached the centre of the speculum, while the shadow in Fig. 1 at L has no corresponding shadow at S. The shadow on the lower half of the speculum has hardly reached O, much less extended to S, so as to correspond with the upper shadow. I am conscious, while writing this, how imperfectly a woodcut can represent the delicate shading, varying in intensities, too, as seen in the actual testings. All I feel I can do is to draw the general outline, and explain principles for the guidance of the amateur. In Fig. 2 the longer and shorter focus diameters are at right angles to Fig. 1; the difference of the shadings will be easily seen and understood. Here the upper and lower shadows are simply reversed as to those in Fig. 1. Here in Fig. 2 the shadow has scarcely reached O, while it has completely covered H, the corresponding part on the lower half. It has reached L on the lower half, but has not reached S on the upper half. It ought to have [illegible]rved round past S on the upper half, as it has curved round past L on the lower half. The amateur will easily understand how all this comes about with a bent speculum, by remembering that the rays from the shorter focus diameter will have crossed one another before they have reached the shutter, the shutter being at the focus of the horizontal diameter, which will be longer than the focus of the diameter S H, but not so long as the longer focus diameter L O. The rays of S and H having crossed, will continue their course on opposite sides of the centre of the cone of rays. The shutter is supposed, as in my apparatus, to advance from the left-hand side. Now, with these conditions, it is evident that the rays from S will miss the shutter and enter the eye, and thus S will appear illuminated; while the rays from H, having crossed the centre of the cone of rays, will strike the shutter, which is on the left hand of the centre of the cone of rays, its edge only being on this centre. The rays, I say, will strike the back of the shutter, and be lost to the eye, therefore the part H, from which they proceed, will appear dark. Let the amateur master this, and then go on to the understanding of the course of all the other rays. There is no mystery about these shadows, and when understood, enable us, with a proper apparatus, to look into, if I may so speak, the shape of every part of the surface of the speculum. The reason why the shadows on the upper half of a bent speculum are not the same in this position as on the lower half is, of course, because its surface is not symmetrical on the two sides of the horizontal line. Now, with a perfect speculum, the two sides are symmetrical in whatever position the speculum is placed. Thus the part L (Fig. 1) is not the same focus as the corresponding part S on the lower half of the speculum; therefore it gives a different shadow. If the speculum were symmetrically parabolical in all diameters, as it should be, then, of course, the parts L and S, and H and O, would be the same focus. Now, if we suppose the longer or shorter focus diameter to be placed horizontal, then it is is evident that, reckoned from the horizontal diameter above and below, the speculum is symmetrical, and therefore the shadows are both alike. I am, of course, still supposing a simple case of flexure. We have then four main positions in which the speculum with a simple flexure may be put—viz., two when the longer or shorter focus diameters are parallel to the horizontal lines, and two more when they are respectively at an angle of 45° to the horizontal line. In the former two positions the simple flexure is not visible; in the two latter positions the simple flexure is most visible. Now, between these two sets of positions the flexure, if it be small, will hardly be visible. Now, let us suppose the amateur happens to place his speculum with its, say, longer focus diameter 22° from the perpendicular line, he carefully tests for flexure by watching how the shadows come on above and below the horizontal diameter. He cannot discern any difference, and then judges that the speculum is either without flexure, or that the longer or shorter focus diameter is either horizontal or perpendicular, so he proceeds to turn his speculum round 45°, and tests again, and still does not see any indication of flexure in the difference of shadings in the upper and lower half of the speculum; but it is evident that, in moving the speculum round 45°, that he has only put the longer focus diameter about 22° from the horizontal diameter, and this is still midway between the position where the flexure is most, and not at all seen, and in this position a slight flexure may not be visible. The amateur must not depend, therefore, on one move of 45° from his first position; but he must divide this 45° into four or five moves of from 10° to 12° each, testing carefully after each move, and then, if he sees no indication of flexure, he must proceed to test in like manner the next 45°; then he will have passed the speculum through all the influencing positions it is capable of. To proceed further would only be to repeat in effect the positions he has already tried. After this series of testings he may be sure there is no detrimental flexure. I must further observe that, if the flexure be considerable, it will probably show itself when setting the shutter to the focus of the outer zone, for the shadows in the zone will perhaps commence at or near the top or bottom of the zonal space—at the top if the speculum be i[illegible]

FIG. 1. FIG. 2.



the position of Fig. 1; and at the bottom if it happens to be in the position Fig. 2, and not come on all over alike the zonal space, as it should do.

In the above example I have supposed the simplest form of flexures; but, of course, there may be compound flexures, in which the figure is not symmetrical on any diameter; but by carefully turning round the speculum a little at a time, as above directed, and testing after each move, the real character of the flexure will become manifest.

I may here explain that the shadings in the Figs. 1 and 2 represent the way the shadows should be seen, as required by theory, and would be actually seen if the flexure were great enough; but in actual practice the flexure is never so much as to allow the shading from L to the horizontal line to be intense enough to be seen when the shadow has only reached the centre of the speculum, as shown in Figs. 1 and 2. Nor will the thin streak of light from O to the horizontal line be visible, it being so faint as to be confounded with the adjacent darker shading, so that in slight flexure the shadow seems to commence at O and end at L when the shutter is half-way across the cone of rays; but, of course, the shadows alter all the while the shutter is passing across the cone of rays. The figures only represent the shadows in one position of the shutter; the amateur must study them in all positions of the shutter. What I have written will direct him how to proceed; the more specula he tests the better, and with practice he will get certainty and confidence. **H. A. Wassell.**

Addenbrook Villa, Love-lane, Stourbridge.

HYDRAULIC RAMS: ACTION OF THE OPENING OF LIGHT WASTE-VALVE EXPLAINED.

[25028.]—I HAVE noticed that "W. A. S." all through his letters seems to entirely ignore the idea that rams will work when the waste-valve is made to balance the statical pressure in the trunk of the ram. Why he does this I cannot understand, as it is a certainty that there are rams to this day made to work as they were originally intended to, viz., with heavy waste valves, and the following, in his letter (No. 56969) is one part, which I, as before said, have taken exception to, viz.: "It is indeed marvellous that so admirable a machine should have been so much neglected by our writers on hydraulics." I do not wish to be at all personal to "W. A. S.," but really he must pardon me for again stating that the action of the hydraulic ram has been over and over again thoroughly explained by English authors, and the principles are thoroughly understood by more than one firm of English ram makers, though possibly they do not choose (to use one eminent maker's own words) "to give to the world the secrets of their success," which I say is no secret. Strictly speaking, so far as regards the original question upon the subject, by a "Melting Mechanic," if it is the cause which he wants, I do not see, with all our letter-writing, the question yet answered, nor did I intend to answer this question in my letter to "J. N.," but left it for "W. A. S." to do. Evidently "Melting Mechanic's" ram has two waste-valves; but we will treat the machine as having only one, and that being of the *light-valve class*, say a 5½in. valve weighing only 2lb., and working under a 12ft. head of water. This is something definite to go upon. Now, suppose the trunk of the ram to be its proper length, viz., sixteen times longer than the height of the fall of water, and its diameter two thirds that of the waste valve; here we have a 4in. trunk 192ft. in length; this, though apparently long, is the exact length which the trunk should be for this amount of fall, and is an item in ram-making which I myself established in the year 1868. Now assume this trunk to be filled with water, and the weight of the water to be 1,024lb., and this weight to have acquired the velocity due to the head; what will be the power of the blow struck upon the face of the valve when this weight is, as is the case in the ram, instantly arrested? This requires your particular consideration—remember your weight is 1,024lb., and the velocity added. Now, you must remember that water is very elastic, and slightly compressible, and that the particles glide over the surfaces of the pipe with perfect freedom, as a bar of iron through air suspended horizontally from a long rope. It is an established fact that water is very elastic, which is the chief point now to consider. Suppose the above weight of water to be in motion, and the valve to suddenly close; the water (*being impounded in the pipes*) under the valve face meets with a sudden resistance and becomes slightly compressed, and it also, being very *elastic*, *rebounds* from under the head of the valve as a ball would; which rebound or recoil puts the whole of the water within the trunk into a backward motion, and sufficient to produce a partial vacuum, when the valve instantly drops in weight equal to 15lb. to the square inch, plus weight of valve. Speaking of partial vacua in water pipes, I have *many times drawn my readers'* attention to the rattling of water when in any way suddenly arrested; but I should here perhaps say that there are two ways of producing this sound: one being due to the before-mentioned cause, and the other to another way of creating a vacuum—viz., by instantly closing a valve behind a column of water which does not, like the ram method, instantly cause the column to stop in its forward motion, but produces a vacuum according to the weight of water in motion, together with the amount of the fall. It, perhaps, is not generally known that even steam when under pressure will, when passing through long lengths of pipes and suddenly arrested, make the same chattering noise as the water does when suddenly arrested.

Now, this simple question about the action of the beat-valve is definitely answered. I suppose I must answer the question asked me by "W. A. S." respecting the 6in. valve and the 5ft. head of water; but I do not intend to work it out in the workshop, but only theoretically.

In the first place, theoretically, the area of a 6in. valve can be worked out as follows:—viz., square the diameter of the valve, and multiply this by ·7854, which will give the area 28·2744in.

Example.—6in.^{2} = 36 × ·7854 = 28·2744.

Next, for the weight of the valve we must know the weight of the water. Say that a 32ft. column of water equals 15lb. to the square inch (some say 33ft.), then a 5ft. column of water equals 2·34371lb. per square inch, which will give for the 6in. valve a weight of 66·26671128lb.

Perhaps "W. A. S." is not aware that the heavy waste valves work better under certain heads of water. Will "W. A. S." kindly examine the first three items in my table of the light waste-valve's action, which I forwarded for last week's issue, and give us his view why we get 7in. jet for the 9ft. trunk, and as many feet for the 36ft. trunk. Of course I ask "W. A. S." for his opinion as an amateur.

I noticed that "W. A. S.," in his letter (24944) speaks of experiments made on Douglas's ram with a glass bead to show the amount of recoil, and he states that the recoil is less when the water has no chance of exit into the air-ball (air-chamber). This is only natural, because when the water is made to play upon a more elastic substance than itself, that substance being more compressible gives an additional spring, which allows the water to take a longer swing, and, like a lengthened clock pendulum, the waste-valve is naturally slower in action; but make every thing, as in some of my experiments of 1868, tight, and free from "air-pockets" or air-chambers, and you will find the recoil reduced to its minimum, and the beat will be in proportion to the lift which you give the valve. Now insert near the waste-valve a small tube or hole and set the ram in motion; this, in proportion to the size of the hole, will interfere with the amount of recoil; but instead of the hole, insert a piece of tube, say, 6in. long, and half the diameter of the trunk, so as to form an air-chamber, and you will find the recoil wonderfully increased.

"W. A. S." speaks of a certain amount of extra recoil being given when the air-ball (air-chamber) was used—viz., 2¾in.; but by plugging the water-way into the air-ball the recoil was reduced to 1⅝in., which clearly showed that the valve to the air-chamber allowed the water to back, which, in some *badly-made* rams, is of great importance; yet in his last letter he uses these words: "The case of a ram working into an air-ball and delivery-pipe is different from that of a ram working with no vent at all. In the former case elasticity cannot to the same extent be called into play; yet in my experience with the American ram (24944) the recoil was decidedly greater—i.e., with less help from elasticity there was a greater recoil." This seems contradictory, because instead of less elasticity he actually gets more—viz., from *the air imprisoned in the air-chamber*, the air-chamber valve not being able to imprison all the water which at first advanced into the air-chamber; therefore "W. A. S." in one part of his writings admits that a greater recoil takes place when the water is affected from the air-chamber, and in almost the same breath he says, "with less help from elasticity there was a greater recoil." I should say that this was not intended. There is also another peculiar remark in "W. A. S.'s" last letter. I refer to his words, "I should dispense altogether with the secondary air-chamber, also with such abominations as springs to assist the drop," which I take exception to for the following reason: that my experience with John Blake's patent rams tells me that the spring is a wonderful improvement towards maintaining a continuous recoil in the ram, which, under certain conditions, I am prepared to prove will cause the ram to work when all other contrivances have failed, and I would ask "W. A. S." whether he has seen the practical effect of rams working with springs and compared them with those working without? I write this for the simple reason that "W. A. S." is the first man I have met in my travels who has said that this improvement is an abomination, when, *de facto*, it is, practically speaking, as useful an addition for assisting recoil in some cases as was Montgolfier's waste-valve to Whitehurst's machine for producing continuous action. So far as proving the amount of recoil I, in conclusion, should remark that anyone can prove the amount of this in a far easier manner than by the use of glass tubes. I generally do this by the use of cotton waste or lamp-wick tied upon the end of a stick and placed at the entrance to the trunk-pipe, which will, if held at the opening, wave backwards and forwards, and indicate the amount of recoil far better than the use of pressure or vacuum gauges, or even beads. In fact, no one can arrive at the amount of recoil by the use of the before-mentioned gauge, for the simple reason that the recoil is materially affected by such apparatus, proportional to the water way to the spring tube, piston, or diaphragm of the gauge, and the bead will not move with the accuracy of the lighter substance which I employ—viz., cotton waste, or such like light substance. In fact, I have within this last twenty minutes tested the effect of the three methods on a trunk pipe 45ft. long, with a fall of about 3ft., and I produced a recoil of 12in. by the cotton waste, which by the gauge registered from 3in. to 5in. only, and with the bead 8in., showing the sensitiveness of the cotton waste over that of the gauge and also the bead. Of course, I should remark that my ram which I made this test with had the water way to the air chamber valve shut off, as at Fig. 373, in my "Practical Notes on Plumbing," and an air-pocket or chamber fixed near the waste valve for the sole purpose of assisting to produce this long recoil. Perhaps "W. A. S." will be inclined to think that I am monetarily interested in rams, my having spoken of the immediate test, or by my reference to Blake's patent ram; but this is not so, as previously in my "Practical Notes on Plumbing" I explained that I had retired from the manufacturing department in 1876, though I am at any minute in a position to test the action of a ram with any fall or length of trunk, and working under any conditions. I trust that I have now satisfactorily to "W. A. S." said sufficient for him to see the cause of the recoil.

P. J. Davies.

[25029.]—IT strikes me that there is one element concerned in the recoil of a ram that "all" of your correspondents seem to have overlooked—viz., when the shock takes place, it lifts the valve in delivery pipe, and, in forcing in its charge, it lifts the column of water in said delivery pipe, and the valve is shut by the return of said column, as, with or without an air-chamber, this valve must be violently, so to speak, opened, and violently shut again; and this, I take to be, of far more importance than the (query, in a practical sense) asserted expansion of the pipes, and contraction of same. **A., Liverpool.**

[25030.]—SINCE I wrote my last letter to you upon the above subject, I, by hunting up, have met with one of my old pocket-books, which contains some very interesting notes about the action of the waste valve, also the strength of the impact under different heads of water and lengths of trunk piping; and as the same have not yet been published, I think now is the time to do so, especially as so much is being written upon the waste valve question.

In the first place, I should say that these experiments were carried out at Well House, Muswell-hill, Hornsey, by myself in the year 1868, to test a ram which I fixed there for Mr. C. Nicholson, J.P., but which was some years afterwards done away with when the street water was to be had.

The ram which we experimented with was my own make. The trunk and pulse, or waste valve, was only 4in. bore throughout, but worked with two or three kinds of pulse valves, the one from which these experiments were made being the conical spindle valve only. The ram here referred to is simply the trunk body waste valve, and a jet pipe fixed on the top of the body where the air-chamber valve is usually fixed, which enabled me to test the working with better results than I could with the air-chamber fixed.

The table on next page will explain itself if read with the notes below. Of course I only give parts of the original, as to send you every experiment would occupy two whole [illegible] of the "E.M." for no purpose.

EXPLANATION OF C[illegible] F TABLE.

*1. The valve will always [illegible], but not shut; if [illegible] did, it was very uncertain [illegible] how long would remain so.
2. Very strong jet.
3. Very uncertain—will [illegible] and then stop. No jet on.
4. Works well with jet on [illegible] valve dow[illegible]
5. Valve will [illegible]
6. Began to [illegible]

TABLE SHOWING EXPERIMENTS WITH WASTE-VALVE AND JET.

Fall of Water.	Length of Trunk and Ram.	Lift of Waste Valve.	Number of Beats per minute.	Height to which Water was squirted through jet pipe.	Remarks. (The figures refer to the figures below.*)
ft. in.	ft.	in.		ft. in.	
0 6	9	1/8	126	0 7	47
0 6	18	1/8	56	4 6	4
0 6	36	1/8	40	7 0	10
0 6	45	1/8	16	—	41
0 12	9	1/4	80	8 0	
0 12	18	1/4	0	—	7
0 12	36	1/4	28	9 0	
0 12	9	3/8	64	8 0	1
0 12	18	1/16	40	6 0	
0 18	9	1/8	52	8 0	2
2 0	18	1/8	200	—	8
2 0	36	1/8	120	—	jet closed
2 0	60	1/8	0	—	27
2 0	18	1/4	80	7 0	9
2 0	36	1/4	44	—	jet closed
2 0	36	1/4	48	8 0	14
2 0	60	1/4	0	—	25
2 6	36	1/8	144	—	jet closed
2 6	36	1/8	144	5 0	
3 0	45	1/8	96	18 0	34
3 0	45	1/4	32	20 0	33
3 0	45	1/4	28	—	36
3 0	45	3/8	24	—	37
3 0	45	1/2	20	—	38
3 0	45	1/2	20	—	39
3 0	45	3/4	20	—	40
4 0	36	1/8	156	8 0	18
4 0	36	1/4	64	8 0	17
4 0	36	1/4	56	7 0	16
4 0	36	1/2	40	12 0	15
4 0	45	3/16	96	20 0	—
4 0	45	1/4	40	20 0	29
4 0	45	3/8	40	20 0	30
4 0	45	1/2	36	20 0	31
4 0	60	1/8	108	17 0	32
4 0	60	1/4	36	20 0	21
4 0	60	3/8	32	20 0	20
4 0	60	3/4	28	19 0	19

7. Will not beat.
8. Beat-valve requires a good pull up to stop it.
9. Stops with valve up.
10. Very regular in its beat, and continuous; full jet of water, and water waved back 1in. in ram.
11. Continuous in action.
12. Very uncertain in action.
13. Fine jet, for so small a lift, does good work, and very regular; with little waste.
14. Sucks back 4in., also makes a good suck at the jet pipe, *quite audible*.
15. Forty beats per minute, and then quickens to double; there also appears to be a double rebound, very irregular.
16. Works about five beats and stops.
17. Works well and regular, with very sharp blows.
18. Very continuous and regular.
19. Very good and regular, regurgitation or recoil 4in.; powerful jet moves the pipes, rams, and all—if firmly fixed it beats 28 only.
20. Very good and regular.
21. Do. do.
22. Very regular, will not stop; very little water required for so good a jet.
23. Will open very quick, but will not raise the waste-valve without pulling up.
24. Valve opens well, will not close.
25. Do. do.
26. Will not work with the jet open.
27. Will not work, valve will not open.
28. Waste-valve fixed horizontally, ¼in. lift, when pushed open it closes with three snaps or recoils twice; sometimes it will recoil five times, and close after quickened strokes.
29. Works very well with regular beats, and good, strong, thick jet; the recoil is intense.
30. Strong beat, but stops; no certainty of action.
31. Beat well and regular.
32. Powerful and irregular, went down to 28 strokes.
33. Powerful beat.
34 and 35. Very regular and good results; also worked well with air in plug-pipe instead of water, which acted as the second air [illegible] to give a long recoil, which was [illegible]

[illegible] 6in. recoil.
[illegible]in. recoil.
[illegible]. recoil.
[illegible] thi
[illegible]

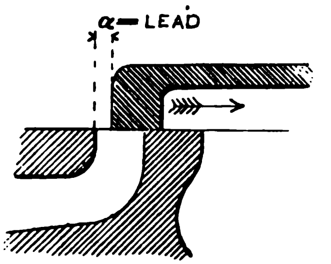
40. On letting go the air from the jet tube (*quickly*), the waste valve, if up, will start itself, proving how easy it is to put the water within the trunk of the ram into motion.
41. The valve will just rise.
42. Do. do.
43. Do. do.
44. I put a ¾in. indiarubber tube over the end of the jet pipe to prove the height to which the spurted water from jet would rise without a valve to keep it in the tube. The effect was that although the force from jet into the open air, or even into the tube itself, was at the moment of impact very considerable, yet the draw from the recoil will take all this water back into the body of the ram, or even more if put into the tube when standing about half the height of the fall.
45. The jet tube or pipe should be fixed as near to the waste valve as convenient, and the jet kept as near to the body of the ram as can be, showing that the air-chamber valve should not be fixed too high; *the nearer to the body of ram the better the result.*
46. When we had 45ft. of trunk and 3ft. fall the waste valve (with jet open) worked 32 strokes; but on closing jet it worked about 48 strokes, showing that the stronger the pressure in air-chamber the faster will be the action of the waste valve, notwithstanding the lift of the waste valve remains the same.

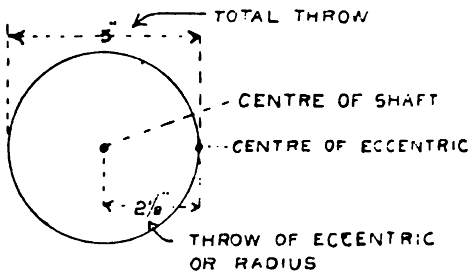
P. J. Davies.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[57336.]—**Eccentric for Locomotive Engine.**—Say which of Reynolds's books you quote from, and I will endeavour to make this clear to you. The travel of a valve is generally twice the throw of eccentric, but sometimes a lever is introduced between the eccentric rod and valve rod; this seems to be so in the first case you mention. Lead ⅛in. means that the steam port is open an eighth of an inch when the piston is only just going to start from the same end of the cylinder to which the port belongs. (See sketch.)





The eccentricity or radius of an eccentric as mentioned by you is the distance of the centre of the eccentric from the centre of the shaft to which it is keyed. Then, as the shaft revolves, the eccentric centre naturally describes a circle, the diameter of which is twice the distance from eccentric centre to shaft centre.—BOWLING.

[57358.]—**Putting Bars in Lancashire Boilers.**—Give the bars plenty of room, not less than ⅛in. to a foot each way; if they fit tight when cold, they will either lift up in the middle or bend like a rainbow when hot.—J. R. D.

[57459.]—**Intermedial Engine.**—The sketch in Evers's book seems to me to be self-explanatory. There should, however, be a joint in the piston-rod just above its connection with the piston.—BOWLING.

[57618.]—**Loss of Taste.**—Many thanks to "Medicus" for his notice of this query. It was not caused by the complaint named, but simply from exposure to damp. I can tell the articles named well enough, only I have a more distinct taste of them at one time than another. The sense appears to be most lost regarding the flavour of tobacco, which has not much favour with me now, although I formerly enjoyed a smoke very much. His further reply will much oblige.—J. A. P.

[57707.]—**Creasote from Coal-tar.**—The [illegible]erist asks how to get a solution of creasote (not [illegible]sote) in warm or cold water. Creasote is only [illegible]ly soluble in water, but dissolves in solutions [illegible]ixed alkalies and of ammonia. It is freely soluble in alcohol, ether, bisulphide of carbon, benzene, and acetic acid. The querist will, perhaps, see what he can do from the above; but practically creasote is not soluble in water.—S. R.

[57661.]—**Chemical (U.Q.)**—When calcium hypochlorite is mixed with oxalic acid in aqueous solution, carbon dioxide is evolved and calcium chloride formed. The equation would be somewhat as follows—

$$\begin{array}{cccccc} Ca(OCl)_2 + 2\left\{\begin{matrix} COHO \\ COHO \end{matrix}\right. & = & CaCl_2 + & 4CO_2 + & 2H_2O. & \\ 143 \quad\quad 180 & & 111 & 176 & 36 & 323 \end{array}$$

The numbers show that if mixed in equal weights some of the calcium hypochlorite would remain in excess.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-upon-Tyne.

[57714.]—**Blueing Steel.**—Try dipping ends in oil before immersing in lead bath.—S. R.

[57727.]—**Magneto-Electric Machines.**—The machine described in the No. for Nov. 7th, 1879, is an electro-magnetic motor devised by Deprez. If you want something for shocks, you would do well to try another device.—RICARDO.

[57728.]—**Printer's Ink.**—"W. H. T." can procure illustrated descriptions of machines for grinding colours from the makers. I think that in the exhibition just closed there was only one machine of the kind.—S. K. E.

[57730.]—**Lantern Microscope.**—Presuming that this querist wants a lantern microscope (not a micro-lantern), I would suggest that he should look up his back numbers—No. 995, p. 152, wherein he will learn that there are many ways of making a lantern microscope, and Nos. 1026 (p. 259), and 1028, in which Mr. Lewis Wright's device is described.—S. R.

[57734.]—**Lathe Flywheels.**—"H. C. B.," p. 207, appears to take me for a neophyte as regards the "E. M." Now, on referring to my notes, I find that my first communication to "Ours" was in the year 1872, and as I have taken it regularly since that time, I am perfectly *au fait* with the pros and cons. of all contributors. But amateur arrangements are one thing, and practical mechanics are something different, and, as an illustration, I may just instance the case of "O. J. L." teaching amateurs how to square up a scantling, by going continuously around its sides with a square, when any practical man must know that no square is, or ever was, perfectly square, and that he never did, or will, succeed in planing any piece of wood so accurately as that a square would coincide with its starting point if carried continuously around the timber. I will venture to assert that "O. J. L." has not a square in his possession that would stand any reasonable test as to its truth. Now, as to flywheels, I agree with "J. K. P." (letter 25002, p. 223). My lathe is, say, 5in. centre, flywheel, say, 26in. diameter, and weight I judge about 90lb. to 112lb. I may here give a wrinkle to those who are open to learn. Drill the centre holes in crank shaft, say, ¼in. deep by ⅛in. bore, and when putting in position fill up with neatsfoot oil, and get quickly into place, or insert a soaked piece of cotton wool. Many a pivot burns because it is so good a fit that no oil gains admittance to the interior. Finally, I would like to ask "J. K. P." if he does not prefer a connecting-rod, with a piece of hard wood on the end grain in it, to the large pulley and chain for the crank connection to treadle.—A., Liverpool.

[57737.]—**Bisschopp Gas-Engine.**—A water coil round this engine would not be appreciated by the inventor, for the engine is supposed to be designed to do without that serious source of loss.—ESSAR.

[57748.]—**Boring.**—This querist should use a boring tool known as a diamond borer. The head is set with bits of bort, which will cut into anything he is likely to meet with. An improved method of setting the diamonds in the head will be found in No. 503.—NUN. DOR.

[57759.]—**Ancient Lights.**—Twenty years' enjoyment is still necessary to found a prescriptive right to light. This is by the statute 2 and 3 Will. IV. c. 71., sec. 3. As regards land itself, twelve years' possession is now sufficient, by virtue of the Real Property Limitation Act, 1874.—KAPPA.

[57790.]—**Rusty Boiler.**—In further reply to "J. W.," I am sorry that I do not know the kind of oil used. It is the mixture which is heated to 400° F., and the pipes are left in till of about the same temperature, and then allowed to dry. I have inquired of some friends as to the suitability of the mixture for hot water; but I think it would give the water an unpleasant taste. It is Dr. Angus Smith's patent.—BOWLING.

[57806.]—**Legal.**—Where property is to be given to a wife for life, and then afterwards to a daughter absolutely, it is usual and proper to have one or more trustees, the wife being made executrix only. If the querist is contemplating making his own will, he is strongly recommended to abstain from doing so. It is better to incur a present expense of one or two guineas and have a will prepared by a respectable solicitor, than that a hundred times as much should be spent after the testator's death in litigation, which is the usual outcome of amateur will-making.—KAPPA.

[57810.]—**Dynamo.**—TO MR. BOTTONE.—The dynamo that I have made is the same as described by you in 1007, only I have made it smaller, being 3in. wide by 16in. high, the pole pieces being 8in. high, and the arms 8in. long by 1¾in. thick, made out of soft cast iron, and the armature being 7½in. diam. by 3in. wide. 1in. thick, with twelve cogs made of cast iron and wound with 2¼lb. of No. 18 c.c. wire wound in twelve sections, 29ft. in each section, and the fields are wound with 10lb. of No. 16 c.c. wire. I want to convert it into a compound-wound machine, and to use No. 16 as the series coils. So if it will not be asking too much from you please say how much and size of wire to use for the shunt coils, and kindly oblige me with the sketch, and with the way to connect it up.—W. H. H.

[57813.]—**Gramme Dynamos.**—With all due deference to our friend Mr. Bottone, I must beg to differ from him. The sketch was taken from a dynamo which at present time is lighting the lamp under which I am writing this note. Perhaps Mr. Bottone has not noticed that the sketch is, by some mischance, shown upside down, and appears to be intended for bolting to the roof. I am, however, always willing to be instructed. Not having had the sixteen years' experience of our worthy friend, it is just possible that I have made a mistake. Meanwhile, the original querist may go on with the machine in the confident belief that the machine will act properly, whether the spoke is at the top or at the bottom, providing he connects it up so that the current flows in the direction I have specified.—W. H. EAVES, Coventry.

[57818.]—**Legal.**—If an employer holds a sum of money as security for the fidelity of an employé, and then becomes bankrupt, the employé will only rank as an ordinary creditor, and can not obtain back the sum deposited in full, unless it has been specifically appropriated by the bankrupt. In the case in question, it seems the employer is trading with the money, as he allows four per cent. interest.—KAPPA.

[57826.]—**The "Genesta."**—The racing season of 1884 was far in advance of previous years. *Genesta* has won about £860 with 7 firsts (including one sail over), 14 seconds, and 5 thirds. *Marjorie* has twice been placed second and once third to *Genesta*. In one race *Marjorie* ran ashore, or the result might have been different. *Marjorie* has won about £920 with 10 firsts, 7 seconds, and 4 third-class prizes. *Genesta* has been twice placed second and twice third to *Marjorie*. *Irex* has won about £700 with 8 firsts, 4 seconds, and 11 thirds. *Genesta* has been three times placed second and once third; *Marjorie*, 1 second and 1 third to *Irex*. *Genesta* has sailed in 34 races—won 7, lost 27; *Marjorie* has sailed in 35 races—won 10, lost 25; *Irex* has sailed in 25 races—won 8, lost 17. Dimensions of *Genesta*:—Overall length, 91ft.; L. W. L., 81ft.; beam, 15ft.; draught, 13ft.; outside lead keel, 70 tons; racing sail area, 7,388; tonnage Y.R.A., 80·14. *Genesta* is a Glasgow-built boat. Shall be glad to forward any further particulars.—PHATSAM.

[57864.]—**Magneto-Electric Machine.**—TO MR. BOTTONE.—"P. C., Hornsey," is mistaken. I do not mean the Brush Co.'s machine. If your correspondent will turn to Dredge's "Electric Illumination," he will find described and figured the armature in question, in the section devoted to the description of Siemens's machines, directly after the figure representing the winding of the Alteneck armature. (I regret that, having lent my copy, I cannot refer this correspondent to the exact page.) With regard to "running resistance," it means running resistance, and if your correspondent will test the resistance of any armature by sending a current through the brushes (not through the field magnets) connected with a bridge and coils, he will find that the resistance is very different when the armature is running, to what it is when it is still.—S. BOTTONE.

[57894.]—**Dynamo.**—TO MR. EAVES.—I am sorry to say that after carefully reading your query I can see nothing that will better your machine except reconstruction of the armature. The armature being cast iron, becomes saturated very quickly, so any increase in the power of the F. M.'s will have little effect. I should advise you to make a new armature, using for core wrought-iron discs; every 1in. along the armature you might put a cast-iron disc, with projecting cogs on its periphery, this would not injure its efficiency, and would make it much easier to wind.—W. H. EAVES, Coventry.

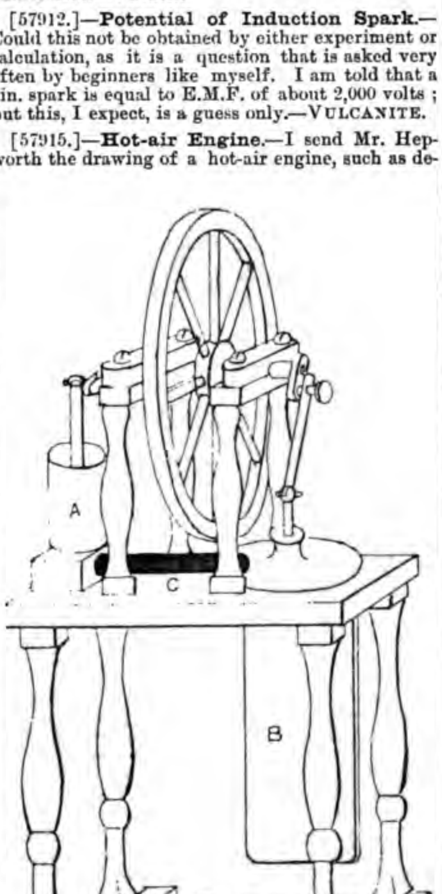
[57896.]—**Belts v. Pulleys.**—Put powdered resin between the pulley and strap.—BOWLING.

[57896.]—**Belts v. Pulleys.**—I have for years worked belts, and the best thing I could find to keep the belts from slipping was, as soon as they began to slip, to brush them with soap and water. Then put a little castor oil upon them; it will soften the belts and cause them to grip the face of the wheel. You can drive your load with a slacker belt to save the belt from too heavy a strain, and will work better and last longer. If "Mule Spinner" will try it, I am sure he will find it answer his requirements.—J. L. C.

[57897.]—**Indigo Dye.**—The best test is as follows: Dissolve some oxalic acid in warm water; let it cool. Pour some of the solution into a test tube, put in a bit of cloth, and boil over a spirit lamp. The result will be the same as a long-continued exposure to sun and rain on the roof of a house. This test does not burn the cloth like sulphuric acid.—VERAX.

[57912.]—**Potential of Induction Spark.**—Could this not be obtained by either experiment or calculation, as it is a question that is asked very often by beginners like myself. I am told that a ½in. spark is equal to E.M.F. of about 2,000 volts; but this, I expect, is a guess only.—VULCANITE.

[57915.]—**Hot-air Engine.**—I send Mr. Hepworth the drawing of a hot-air engine, such as described in my replies to previous queries; it is exactly similar in design to Stirling's original model. The engine should, however, have a water jacket round the top, for one third part of the length; the jacket is not shown to avoid complication in the drawing. The tube C connects the displacing cylinder B with the working cylinder A, and the engine is set in motion by placing either a Bunsen burner or a spirit lamp under the cylinder B, and running cold water through the jacket. When the heat is sufficient, on giving the fly-wheel a start, the air is alternately expanded and contracted by the contact with the top and sides of cylinder B, and acts through the tube C on the working piston A, which drives the fly-wheel.—J. SUTCLIFFE.



[57924.]—**Riveting China, &c.**—This noble art was fully described with illustrations in No. 908. Also in No. 343. Brass is the material generally used for stencils; but either that or thin zinc can be obtained at the metal dealers. Try some of the advertisers in this paper.—NUN. DOR.

[57929.]—**Legal.**—A right of way may be acquired against canal authorities as well as against ordinary individuals. It would seem that a right of way has now been established along the towing-path referred to, which cannot consequently be lawfully closed except by order of Quarter Sessions. If a number of workpeople are affected by the closing of the path, it would be well worth taking legal advice, as whether a right of way has or has not been acquired depends often on many questions of fact which it is difficult to get at otherwise than by a personal interview.—KAPPA.

[57940.]—**Legal.**—The first section of the Real Property Limitation Act, 1874, says: "No person shall make an entry or distress . . . to recover any land . . . but within 12 years," &c., and the eighth section says: "No action, suit, or other proceeding shall be brought to recover any sum of money secured by any mortgage . . . but within 12 years," &c. By the operation of the section first quoted, it would seem that the mortgagee referred to by the querist has lost his right under the mortgage deed to enter upon the land, or to sell it under his power of sale; whilst the other section prohibits the remaining remedies of a mortgagee, foreclosure and action on the covenant. In other words, the mortgagee, having slept on his rights for 18 years, has now no rights left to sleep on. I do not share the virtuous indignation expressed by "Sigma" in his letter to this query; and though, on the other hand, it must be admitted it is not always just to take advantage of legal rights, I certainly say of people who do not assert their rights for 18 years, thereby losing them, "Serve them right."—KAPPA.

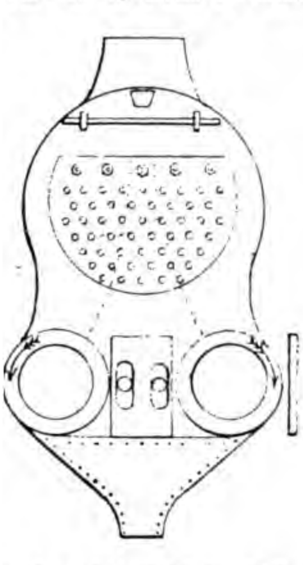
[57942.]—**Damping up Fire.**—My present method of damping a stationary plain cylindrical boiler is as follows:—The steam to be shut off from all pipes, to prevent waste during the night; the greater part of fire (not cinder) to be drawn, enough being left on one side, or back of grate. To cover the fire that is left in furnace with six good shovelfuls of slack, throwing it in one heap, so that you may clean grate in the morning without disturbing the fire, and when cleaned the fire is to be drawn over the bars. I always close both damper and fire-doors, or the slack we use would burn away before morning. A great deal depends on the quality of coal or slack you use. At times my fire does not require cleaning, only the first time in the morning; but with worse material it will require cleaning two or three times a day.—FIREMAN.

[57943.]—**Keyways.**—Write to Julius Roemmele for his circular explaining the use of his patent keyway gauges. Address—21, Belmont-crescent, Glasgow, or, care of Mr. H. Poths, 4, Sugarloaf-court, E.C. The price of a set of gauges from 1in. to 12in. is about £7. I have no interest whatever in the patent, but recommend it because it is so simple and good. Patent No. 4,982, A.D. 1881.—BOWLING.

[57952.]—**Electro-Motor.**—TO "SIGMA."—I am much obliged to "Sigma" for his kind reply to this query. I am sorry to say I have not his book on "Electricity," and I have no doubt if I had I should not now be troubling him. I suppose the "1,400 sp. gr." should read 1·400 sp. gr.? Am I right in supposing that if 1lb. of nitric acid will give 11 ampères for 10 hours in a certain battery, that the same weight of acid will give 22 ampères for five hours, if the resistance of that battery is halved, or the plates doubled in area? Also, if I use 50 per cent. of water with the acid, and increased the area of the plates to four times what they were at first, would the same result be obtained—viz., 22 ampères for five hours?—H. B.

[57997.]—**Ebonising Ornamental Wo[illegible] work.**—The ebony appearance is produced by use of a stain; white shellac is the varnish us[illegible] employed, but some prefer the best ru[illegible] varnishes. Whatever varnish is selected, it [illegible] be as near as possible transparent, as other[illegible] colour of the work will appear to be gre[illegible] brown. Not more than three coats should be [illegible] as successive coats of the most transparent [illegible] applied, will cause an opaque or clouded appearance. Experience and care are required to succe[illegible] fully rub an ebonised article, as the varnis[illegible] be rubbed almost to the wood, and, if rubbe[illegible] tion of the stain is removed, leavi[illegible] cial care should be used in rubbing. Instead of staining the wood a[illegible] sive coats of transparent rubb[illegible] varnish (or more properly s[illegible] often laid upon the surface [illegible] process possesses the ad[illegible] speedy, not occupying m[illegible] spirit varnishing; but, on hardening of the gum prev[illegible] entering [illegible] -coming s in a thin, hard, but very brittle coating surface, and is very readily broken and leaving spots of the original colour of that cannot properly be repaired. Shellac generally used for this finish, and is pre- adding to it drop black or perfectly pure :k, containing no grease or foreign sub- fficient to make it perfectly black. Apply coating of this to the work, and finish by e necessary number of coats of brown nd rubbing in the usual way.—J. W.

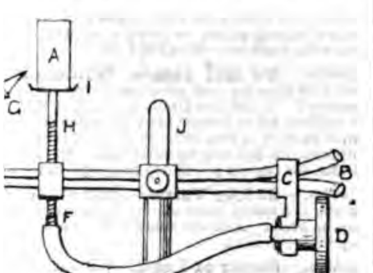
] — **Clearing Smoke-Box of Loco.**— will see by sketch the arrangement



ondon and North-Western Railway loco- the arrows denote the passage of ashes the cylinders and framing; it is very so long as the ashes do not clinker and he passages. For my part, I think it in- rith the draught by letting in air to the x.—EX-FIREMAN.

]—**Brass Mixture.**—You want rolled if you want to cast, try the following lb. of tin and 1½lb. of zinc to 10lb. of T. F. C.

]—**Limelight and Lantern.**—As ready of rotating the lime cylinder as any is as Make a spiral spring of steel or "hard rass, say of No. 18 or 20 B.W.G., wound ¦ or 5/16 spindle, and attach it to the lime latform, as shown below. As to the tele-



ding tubes, there ought to be no difficulty, " will go to any metal warehouse. I can magine that he has found the plan of id boring them to be attended with many s. A, B, F, G, H, I, and J show the usual arrangement. At F, the spiral or aft is attached to the rising screw of the der platform; C is a carrier or support er end, into which is fastened the milled utton D. This arrangement is simple nt, and allows of all necessary adjust- O SIGNATURE.

—**Telephone.**—The use of metallic discs in telephones is patented in the er-sweeping term "diaphragm." The ill unsettled is, What is a diaphragm? lephone free from patent rights is the telephone, first described in this XIII., and consequently known HANIC teler membr tre, wh f an

In a modified form it is Gillett's telephone—p. 186.—NUN. DOR.

[57994.]—**Gas-Engine.**—Give your engine more gas. The end of the pin which opens gas valve is worn; solder a little bit to the end and make it longer.—J. K.

[57995.]—**Astronomical.**—The following are the proper motions of the stars Mr. Arkwright asks for, with exception of 5 Serpentis, the proper motion of which is not given in Gledhill's "Handbook":—

Star.	R. A.	N. P. D.
δ Equulei	+ 0·08″	− 0·21″
P xiv. 212 Libræ...	+ 0·066s.	+ 1·72″
85 Pegasi	+ 0·064s.	+ 0·97″
ι Ursæ Majoris......	− 0·047s.	+ 0·28″
μ Cassiopeiæ.........	+ 1·97″	− 0·495″

—J. E. GORE.

[57996.]—**Metal Spinning.**—I should think a small round piece of iron with a centre to it with the back centre pressed hard against it would hold it sufficient. The chucks I have seen used have been boxwood, and the tools straight burnishers of different shapes. If you are a novice at it I am afraid you won't succeed.—EDWARDS.

[57999.]—**Land for a Charity.**—A gift of land to a charity must "take effect in possession for the charitable use intended immediately from the making thereof, and be without any power of revocation" (8 Geo. II. c. 36, s. 1). A gift of land to a charity must therefore be an absolute and irrevocable gift. The querist is perhaps aware that there are some few institutions to which land may be legally left by will, and that purely personal property may be left by will to charities to any amount, provided it is not directed to be laid out in the purchase of land, for this, in effect, would be the same as a gift of land itself.—KAPPA.

[58000.]—**Faulty Dynamo.**—Wide slits in the commutator would account for something of the poor working of this machine. I should think that the insulation is defective. To test this, touch the iron portion of the field-magnets with a wire attached to one of the terminals of the dynamo, while running. If it gives sparks, the machine leaks, and cannot work properly until this is remedied.—S. BOTTONE.

[58001.]—**Plating Dynamo.**—TO MR. BOTTONE.—A small dynamo would not do this work. Half an ounce of copper per 15 minutes means a current of 56 ampères, and no small dynamo will give this. Besides, unless a number of carbons were immersed into the plating bath at once, the density of current would be too great to get a useful deposit. The best result is got when about 2½ ampères act on each square decimètre of surface. If you wish to try your hand at making a small plating dynamo, get a set of 70-candle power castings, with laminated armature. Wind the armature with about 1lb. of No. 16 d.c.c. copper wire, in separate layers, bringing out all the ends to attach to one cheek of the commutator, and all the beginnings to attach to the other cheek. Wind the field magnets with 7lb. of No. 16 laid on in seven strands, connecting these strands in parallel.—S. BOTTONE.

[58002.]—**Piccolo.**—I am probably the party that "S. R. P." refers to. The cylindrical piccolo is a most unsatisfactory instrument, and not generally used. I would advise "S. R. P." to have nothing to do with it, as it is inferior to the taper-bore with covered keys. The reasons why would take up too much space. The holes in the cylindric piccolo are in the same positions as on the taper-bore; but the sizes are different, and I cannot give them at present.—VULCANITE.

[58004.]—**Coil.**—A good medical coil with one kind of wire can be made with four or six layers of 18 wire, silk or double-cotton covered. To give a shock which one man could not stand add an extra cell in series. If 18 wire is employed the extra cell may not be required; but it may be necessary with the finer 26 or 30, which offers a greater resistance. Giving a rough guess regarding the tin-foil sheets for your intensity coil, I should say 20 or 30 the size mentioned would be within the mark. But the best way to ascertain this regarding any coil is to connect the full battery power and the condenser temporarily, and add sheet after sheet as long as good results are obtained. Any size of sheet will do which will go into the cavity of the base-board. From 4oz. of 36 secondary the length of spark will not exceed ¼in., if it even attains this.—BOBADIL.

[58005.]—**Refining Gold.**—On referring to p. 460 of last volume, "F. L. N." will find several replies which may help him.—BOBADIL.

[58005.]—**Gold Refining.**—Gold may be refined in the dry way by melting it in a clay crucible glazed inside with borax, and passing a stream of chlorine gas through the molten metal a clay pipe. The chloride combines with the r to form chloride of silver, which rises to the ce, and any other metals present are converted into chlorides and volatilised. Gold so treated contains from 99·1 to 99·7 per cent. of the metal. The best way of obtaining chemically pure gold is to precipitate the metal from its solution by a reducing agent, such as ferrous sulphate or oxalic acid.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-upon-Tyne.

[58006.]—**Chain Sheave.**—The way to mark out the pattern of such a sheave has been described in Vol. XXXVIII. p. 255; but if you are not able to refer to it, I will describe the method again. You say your sheave is to contain 20 clips (link recesses) of 2¼in. centres. You also say that the chain either gains or loses when you try it round. This need not happen if you follow my instructions. Lay out the chain straight, and measure the length of 20 links. We will assume that the length is exactly 20 times 2¼in. This will represent the circumference of the link centres around the wheel—viz., 45in. or 14⅜in. diameter. Mark the diameter ⅛in. larger than this, or 14½. Divide it into 20 equal parts, drawing radial lines to the centre from those points; also at each point of division draw a tangent line which will represent the longitudinal centre of a link. The size of the link is 7/16in. Parallel with these tangent lines, therefore, but 7/32in. nearer to the centre, draw 20 other tangent lines. These will represent the bottoms of the recesses in which the links are to lie. Strike the hollow curves which retain the links endways, giving, say, ⅛in. clearance at each end and all round. Give ¼in. bottom clearance for the vertical links. Mark out the pattern all round thus, and work to the lines. When worked, try in the chain all round. Now, if you find that the links lose, you can estimate the exact amount necessary to be cut out of each recess, and will, in all probability, get an exact fit on easing out an equal and measured amount from each recess.—J. H.

[58007.]—**Worm-Wheel.**—I imagine you mean the worm, and not the worm-wheel, since a worm-wheel of 5in. diameter would not quite contain eight teeth. The worm, therefore, being 5in. diameter at pitch line, would be 3½in. at root and 6¼in. at point. The circumference of 6¼in. is 19⅝in. Mark, therefore, a series of diagonal lines on a slip of white paper, having an inclination of 2in. in 19⅝in., marking as many inclined parallel lines as there are to be revolutions of the worm-tooth. Also a second series of parallel diagonal lines at a distance representing the width of the tooth points. Glue this paper around the pattern block (turned to 6½in. diameter), and you obtain the bevel at the points of the teeth. By marking the interspaces out with a templet, guided from the tooth points, you obtain likewise the bevel at the root.—J. H.

[58008.]—**Fungus on Fish.**—Put a little salt among the water in stone trough. Take out the fish once every day and immerse in a strong salt brine. About five years ago I got a little gold fish, one of 200, all 199 died of fungi. Mine was cured and lived about three years.—J. K.

[58010.]—**Tar Solvent.**—Simply warm the pipe so that it is too hot to bear your hand on it; then apply the tar with a brush (cold). The tar does not require boiling.—EDWARDS.

[58010.]—**Tar Solvent.**—"Dromio of Syracuse" should *not* dip his wrought-iron pipes, almost red hot, into gas-tar. The cheapest solvent is creasote oil. Thin down the tar with above oil. Make your pipes nicely hot, and dip,—J. M. HAMLET, Bootle.

[58010.]—**Tar Solvent.**—I don't see why you make your pipes so very hot. I would only heat them until they were painful to the fingers. You can thin the tar, if necessary, with turpentine. What is sold as black varnish also can be used with a very moderate heat successfully.—A., Liverpool.

[58011.]—**Lubricating Oils.**—There is no hard and fast test for oils which is reliable for ordinary users. The test spoken of by Mr. Walker is quite useless. Oils vary so much in the cold test that an exceedingly poor oil will give good results on glass; but exceedingly poor results on the machinery. For instance, sperm oil is about the best lubricant we have; but this oil would occupy but a poor place compared with a cheap oil, say, at 1s. 6d. per gallon, if tried on the glass. I have for about twelve years been engaged in the testing of oils for all purposes, and find that experience is the first requisite, also to take into consideration the cold test, gravity, viscosity, and flashing point—this is as far as mineral oils are concerned; other oils should be tested for gum. This is a matter that can only be done thoroughly by an experienced person. In reply to "Rera," put a few brass turnings in a small quantity of the oil to be tested for acid, if in two or three days it turns green, acid is present. If Mr. Walker cares to advertise his address I may help him further.—GREASE.

[58014.]—**Astronomical Objects.**—"Dear Dirty Dublin" "can" see the planet Neptune by the aid of a 3in. o.g.; but he will only appear a very small blue-green disc about the size of a 7 or

8 mag. star in appearance. I should think his 3in. o.g., if good, would bear a power of 220 to 250 on double stars in steady air. Try 12 Lyncis; 2 Camelopardus; 52 Orionis.—H. A.

[58014.]—**Astronomical Objects.**—"Dear Dirty Dublin" may note in regard to "Neptune" a remark of Proctor's: "I am certain no observer can mistake him for a fixed star with a 2in. aperture, and a few minutes' patient scrutiny in favourable weather." Tests such as those asked for have been given frequently in back numbers, and in the valuable papers of "F.R.A.S.," in *Knowledge*, on what is to be seen with a 3in. telescope. By the way, can the querist divide Rigel? Because there are plenty of "three-inchers" knocking about that fail on this double, albeit (to quote Proctor) "a 3in. aperture will certainly show the companion." Has "D. D. D." the "Half Hours with the Telescope" of the author just named? If not, it would, in the absence of "Webb," and on account of the capital views of double stars, &c., be found of great utility. In regard to power, 3in. should bear 300. Chambers, in his list of useful eyepieces, gives 200 as highest; but elsewhere he notes that he had used 240 on a 3in. Cooke when the atmosphere permitted for stars less than 3in. apart.—ARTHUR MEE.

[58019.]—**Musical.**—It is not easy to say precisely what is concert pitch, for it has been slowly rising for upwards of 100 years, and is probably still doing so. In France a standard pitch was adopted in 1859; but the English concert pitch is now higher than the authorised one in France. Taking treble C = 536 vibrations as a starting point, the vibration numbers required are, according to equal temperament, as follows:—G (real) 201, G sharp 213, A 226, A sharp 239, B 253, C 268, C sharp 284, D 301, D sharp 319, E 338, F 358, F sharp 379, G 402. These are given to nearest integer.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-upon-Tyne.

[58020.]—**Screw-cutting.**—If you have wheels you can calculate thus: Your leading-screw is 2 to inch, and screw wanted is 16 to inch; add 0 to each, which will make 20 for mandrel and 160 for leading-screw; but if your wheels only go to 120, then it must be compound gear, or, in other words, four wheels. You will then calculate as above to cut eight threads, for which you will add 0 to 2 and 0 to 8, which give 20 and 80. You now have 20 on mandrel and 80 stud. Now, since twice 8 is 16, all you want is 30 on stud and 60 on leading-screw, or 25 and 50. Then to calculate one thread in 4in., your leading-screw must make eight turns for one mandrel. Then 80 on mandrel and 20 on stud would give you two thirds to 4in., and divide that by two, which would be 60 on stud and 30 on leading-screw.—W. SHIELD.

[58020.]—**Screw-cutting.**—First take the pitch of screw; ½in. means 2 threads to 1in.

Pitch of screw 2 threads to 1in.
„ wanted 16 „ 1in.

$$\frac{2}{16} \times 5 = \frac{10}{80} = \frac{2 \times 5}{10 \times 8} = \frac{20.50}{100.80}.$$

Here Lathe spindle
20 centre stud
driver 100 leading screw
50 80
driver driver

No. 2, ½in. pitch, same as above.

Pitch of leading screw 2 threads to 1in.
„ wanted ¼ „ 1in.

To make this equal, multiply both by 4, as there must be 4in. to one thread or turn of screw.

Pitch of leading screw 2 threads to 1in.
„ wanted ¼ thread to 1in.

$$\frac{2}{\frac{1}{4}} \times 4\ \frac{8}{1} \times 10\ \frac{80}{10} = \frac{10.8}{2.5} = \frac{100.80}{20.50}.$$

Lathe spindle
80 centre stud
driver 50 leading screw
100 20
driver driven

—WESTWOOD.

[58022.]—**Rust in Soldering.**—Just rub the material to be soldered with an ordinary composite paraffin candle, and you will be surprised.—ZAMA.

[58022.]—**Rust in Soldering.**—If "Jason" will after having, I presume, used spirits of salts, immerse the article in question in turps, no rust will appear.—READER.

[58022.]—**Rust in Soldering.**—The best way is to tin the pieces separately, and carefully wash and clean them (with soda and water, if necessary). They can now be joined without any further addition of soldering fluid.—OS.

[58022.]—**Rust in Soldering.**—If tinning the wire all over is no detriment to the job, I should do so; but I think if the spirits is wiped off in the usual way with a wet rag, and well cleaned with a dry or oily one, it would not rust. It must be *done* while it is hot.—EDWARDS.

[58022.]—**Rust in Soldering.**—When you attempt to unite steel and brass together by means of acid and a copper bit, you are bringing together the elements of a good galvanic battery on a small scale. Had I this to do, I would first tin the steel wire and instantly wash it well; also ditto with the brass, and then unite the two by means of a little resin.—A , Liverpool.

[58023.]—**Straightening German Silver Wires.**—Something depends on the length and degree of hardness of the wire. Soft wire can be pulled perfectly straight in the vice. If the wire is any way hard, I should fasten one end, and lead the other over a small pulley, and hang on sufficient weight to pull it out.—OS.

[58023.]—**Straightening German Silver Wires.**—Pinch the above named truly between the dies in a die chuck, then procure a piece of oak, making a small hole, a little larger than the wire; now place the wire through hole, revolving the lathe at a rapid rate and so moving the piece of wood up and down, catching the wire in the corners. Size of wood 1in. square, 1ft. long.—READER.

[58025.]—**Wimshurst Machine.**—TO "EVENO OAKLAND."—Cartridge paper sectors are no good; use either tinfoil or brass. The lacquer can be bought at any varnish dealer's. The tinfoil is not supplied with the Leyden jars. It can be bought at any pewterer's, and it is attached to the jars with good stiff paste. The several sizes of the balls used in making up the machine are shown relatively the one to the other in the illustration given a few weeks back in these pages; nevertheless, the sizes may be such as to suit the taste of the maker.—J. W.

[58026.]—**Setting Slide Valve.**—I imagine from your question the eccentrics are already keyed on the shaft, and the link-motion and slide-valve fitted; if so, simply put your link right down, and the engine on the top centre. Measure the lead; then, keeping the link down, turn the engine on the bottom centre, and measure that lead. These leads should be the same; if not, make them so by altering the length of the slide-valve rod. If a vertical engine, give the bottom port a little more lead than the top. Be careful always to turn your engine the way the eccentric you are trying would work it, or the backlash will make the measurements useless.—L. A. L.

[58027.]—**Electric Light.**—This effect always takes place with bichromate batteries. The solutions stagnate round the elements, and the current becomes very small unless the solutions be agitated.—S. BOTTONE.

[58028.]—**Wimshurst Vulcanite Plate Machine.**—TO "H. G. M."—You are trying the best method to flatten your vulcanite plates; but make them a little hotter, say up to boiling heat of water.—J. W.

[58028.]—**Wimshurst Vulcanite Plate Machine.**—Your vulcanite gets cold before you get it on the flat surface; but I don't think you get it sufficiently hot. A large disc would almost bend in your fingers at the right heat. It ought to be heated on a flat plate of iron, and a cold plate placed over it and weighted; when the whole thing is cold your disc will be flat; at the proper heat you can bend it any way, and it will remain so. It requires, however, great care, or it will be spoiled. Flat plates of glass will do as well as iron, or, in fact, anything else; the main object is to get the pressure on at the right heat. I never operated on a large piece of vulcanite, but I don't think it would bear handling at a bending heat.—OS.

[58029.]—**Greenhouse Alarm.**—The best practical arrangement with which I am acquainted, for this purpose, consists of a thin compound strip of metal, one end of which is rigidly fixed to a supporting pillar, the other being free to move in either direction between two adjustable platinum points mounted upon a metallic base; alterations of temperature causing a curvature of the strip sufficient to make a contact on either side, as the case may be. The bell may thus be caused to ring as soon as the temperature exceeds or falls below the limits previously determined by means of the adjusting screws, and in this way gives warning equally in the case of over or under-heating.—R. T. LEWIS.

[58034.]—**Dynamo.**—TO MR. BOTTONE.—You might try to put on 3lb. of No. 24, and connect in parallel with the present No. 18. You could then, if desired, use the No. 24 as a shunt circuit between the brushes; but then, of course, the ends of the two different wires must be attached to separate terminals, and connected as occasion requires.—S. BOTTONE.

[58035.]—**Condenser Tubes.**—You cannot get rid of the incrustation without injury to the tubes. Your remedy is to put in fresh ones, and to increase their number so that the temperature of the condenser may be lower than that required to form the hard deposit of lime salts.—YAMA.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last W. J. Grey has replied to 57661.

57459. Intermedial Engine, p. 42.
57461. Universities, 42.
57469. Lime, 42.
57485. Gillet's Telephone, 43.
57505. Engine Query, 43.
57512. Hydraulics, 43.
57518. Swings, 43.

57687. Village Car, p. 130.
57710. 7in. Breechloading 82cwt. Gun, 130.
57719. L. and Y. Express Engines, 130.
57722. New M. R. Engines, 130.
57731. Planing Tool, 130.
57740. Free Reeds, 131,
57745. Lampholders, 131.
57750. Tramway Points, 131.

QUERIES.

[58037.]—**Wimshurst Machine.**—Is there any way of brightening up the sparks, which pour in torrents between the poles of this most interesting electric machine, so that it may be used for the purposes of lighting instead of the dynamo or battery power? I fancy that if the electricity could be rendered more steady and the light concentrated by reflectors and lenses, we would have the cheapest of all electric lamps yet devised. I would like to know what experiments have been made in this direction, as I think for the influence machine there is a brilliant future.—E. B. FENNESSY.

[58038.]—**Faulty Telephones.**—I have a pair of telephones, with a magnet going through the centre and a coil on end of each magnet. I find that at a short distance they do very well; but when tried at a distance of about 400 yards they are a failure. I would like to know what is the cause of that, as I thought I had good wire and proper insulation? What unpatented telephones, requiring no royalty, would answer for a long distance?—CLAUDIUS T. FENNESSY.

[58039.]—**Floating 100lb. Cylinder.**—What dia. of cylinder, 10ft. long (air-tight), would it take to float 100lb. weight, the cylinder only to he immersed to the centre of dia.? Weight of cylinder about 25lb.—TWIN CANOE.

[58040.]—**Lathe.**—I have a 6in. headstock, originally designed to be driven by power. It has a 3-speed pulley for flat strap and a mandrel 1¼ diam. Would it run lighter if I substituted a wooden pulley for the present iron one? Is a cord or gut preferable to strap for ordinary work, iron-turning occasionally? Is it much better to have the crank running on friction wheels, instead of coned points?—T. H. C.

[58041.]—**Springs.**—Can any of your readers give me information about springs? All I get is that a spring is wanted to exert such a pressure, and from this I want to get the proper pitch, diam. of coil and wire, and deflection (this more especially) for helical steel springs?—CANIS.

[58042.]—**Washing Fluid.**—Could any of "Ours" give me any hints upon this subject? I mean for steeping clothes in preparatory to being washed in a machine or even with machine.—SUSIE WEBB.

[58043.]—**To Mr. James Wimshurst.**—I have read with pleasure your practical hints on working your machine? Would you kindly now tell us if it can be used for vacuum tubes instead of an induction coil and battery? Can it be used to ring bells, or could it ever compete with a dynamo for lighting up buildings? In fine, what can it be used for besides producing long sparks?—VULCANITE.

[58044.]—**Safety Valve.**—Could any of "Ours" give the dia. of a safety valve one sq. in. in area? Also one half a sq. in. area? Also the rule for finding the ⅓, ½, and ⅛ of a sq. in.?—J. F. C.

[58045.]—**Sugar of Lead.**—Will some of our friendly chemists inform me how to make sugar of lead, and state whether the electric current is used?—J. F. C.

[58046.]—**Wood Cutting on the Lathe.**—Will any of your readers tell me of the best form of tool for cutting mortises, rebates, &c., in wood, in the lathe? I have been using a flat-faced drill, with the edges on each side of the centre ground the reverse way, similar, in fact, to those used for cutting grooves in metal and facing-off nuts. This does not cut very clean, and takes a lot of driving.—G. STOCK.

[58047.]—**Warming Room.**—TO MR. P. J. DAVIES.—I wish to warm a shop from the room beyond, taking the pipe up from the boiler into the room above and down again into coil in shop below, thus avoiding connecting pipes crossing the shop. I am told it will not circulate. Should like your opinion.—HOT WATER.

[58048.]—**Windmill for Turbine.**—Will any of your kind correspondents enlighten me on the following question? I have a good dam of water, 150ft. by 150ft., and 15ft. deep, which can be so retained. If I erected a 400 gallon iron tank 20ft. above the surface, could I, by the aid of a small modern windmill, after filling the tank, continue to raise sufficient water to work a turbine by the water so raised? and, after the start, could not the turbine be made available to assist in raising the water when the wind failed? If this is practicable, what size windmill and what size turbine would be recommended?—OLD NATALIAN.

[58049.]—**Hot Dynamo.**—I have one of [illegible]gin's dynamos, with about 50 incandescent lamps. When all the lamps are turned on, the magnets get rather hot. Could anyone inform me how many degrees Fahr. the dynamo would get before there would be any danger?—J. K.

[58050.]—**Ferrous Oxalate Developer.** — In "E. M.," Oct. 30, page 185, Mr. Bottone gives us his ferrous oxalate developer. He says the substances are five—pure water, potassium oxalate, neutral ferrous sulphate, cupric sulphate, and potassium bromide; but he forgot evidently to tell us into which of the stock bottles to put, and how much of, the potassium bromide. The rest is to me quite clear, and if it answers as well as Mr. B. says it does, it is just what we amateurs want, so that those small scales and weights may be laid by.—A BEGINNER.

[58051.]—**Cement for Lead on Damp Walls.**—Would some correspondent kindly inform querist what is the best substance for cementing laminated lead against damp walls.—HOROLOGICAL.

[58052.]—**Safety Valve.**—Would any reader give me the dimensions of the following? I want a safety valve to blow off at from 100lb. to 500lb. or 600lb., the hole in valve to be ½in.; centre of valve to fulcrum 1in. What I want is the length and weight of lever and valve; also weight of ball. Is is for a test pump.—A. B. C. D.

[58053.]—**Plated Jewellery.**—Will some kind subscriber inform me how the surface of common silver-plated jewellery is produced? I mean the bright appearance. After I plate them, I cannot scratch-brush the recesses, and yet in the new jewellery they seem uniform in appearance. Are they done by the immersion process of silvering, as the coat is very thin on them? I suspect they are. Could anyone give me a process for producing a uniform brightness on goods after electro-plating—viz., brooches, earrings, and chains? The interior of links is dull, only the surface coming up after scratch brushing.—HOROLOGICAL.

[58054.]—**Curve.**—Given the valves of ordinates corresponding to a series of equidistant abscissæ of a curve, can the equation to the curve be found? If so, how?—H. E. A.

[58055.]—**Tonnage of Ships and Steamers.**—Can any of our readers kindly inform me as to the relative values of nett, gross, and underdeck tonnage in ships and steamers? Have any or all of them any real relation to the actual cargo-carrying capacity of the vessel, or are they simply used now as rates of comparison in order to form some idea of the relative sizes of the different vessels? Also, do they give any idea of the actual displacement?—ST. AUBYN.

[58056.]—**Rope Power.**—What is the formulæ for calculating the power of cotton ropes in driving machinery? Example: What will be the horse-power developed by a rope 1in. dia. working under the following conditions—viz., driving pulley, 6ft. dia., making 140 revs. per min.; driven pulley, 2ft. dia.? Could any reader of "Ours" refer to any good work on the subject?—PADIHAM.

[58057.]—**Microphone Receiver.**—Can any reader kindly tell me how to make a microphone receiver, free from patent rights, and one that will requre but small battery power? There is one described in a back number of the ENGLISH MECHANIC that I have; it consists of two permanent horse-shoe magnets, one being wound with fine wire and screwed together as close as possible without contact; but it does not describe their position. Can anyone inform me also if it can be made convenient to place to the ear, and also the size and amount of wire I ought to wind on magnet?—E. J. J.

[58058.]—**Cutting Wheel.**—Would F. Baker (p. 223) be kind enough to show the shape of a cutter which would cut properly-shaped teeth in a cog-wheel in the apparatus as described? If said cutter projected far enough to reach the bottom of an ordinary wheel cog, I am of opinion that the backlash would be a serious difficulty, and the speed mentioned, if applied to a metallic wheel, would, in my opinion, cause said wheel to become the cutter and the tool to cave in.—A., Liverpool.

[58059.]—**Electrical Units.**—Now that my query (No. 57370, p. 574, No. 1066), addressed to "Sigma," has been allowed to run through the "U. Q." column without notice, may I ask other electricians to help me (if possible, in the very explicit style of Mr. Bottone in reply to query 57949 this week) by showing me how to ascertain the number of sq. in. of zinc it is necessary to expose in each kind of battery to obtain a current of one or more ampères through one or more ohms resistance? I have "Sigma's" "Electricity," but (whether from my own stupidity or not I cannot say) I am unable to ascertain this clearly therefrom.—FINEM RESPICE.

[58060.]—**Fuller's Cells.**—How many would be necessary to light a 2 c.-p. carbon filament lamp, cells 2-pint? How long will they run it for? Do they fume? G. M. G.

[58061.]—**Bends in Stove Pipes.**—Would George Marshall, or someone who knows, explain how goose-neck elbows and other bends in the German stove-pipes are made in practice? They are made of one piece of sheet-metal, and the bend of the pipe is produced by creasing in rings. A clever tinsmith, who had some hurricane lamps for sale, showing this work at the bends, was unable to tell me the process by which the creases were produced. The work does not seem to be common in this country.—HENDEN.

[58062.]—**Back Pressure of Compound.**—What is the amount of back pressure, if any, in the high-pressure cylinder of a compound? Also, what are the factors to determine the best point of cut-off in l.p. cylinder of same? —ECONOMISER.

[58063.]—**Wire for Dynamo.**—Would Mr. Bottone, or other amateur's best friend, tell me the best quantities of wire and the best way to wind a small dynamo I wish to use for plating? The castings are some of Mr. Jones's; laminated armature 3½in. long, and the space for wire on F.M.'s is 3in.—S. B.

[58064.]—**Electrotyping.**—I have modelled several objects from beeswax, for the purpose of electrotyping them. In shape, they are like the letter C, the original objects being very old bracelets, which very nearly meet at the ends. I first gave them a coating of ordinary grate blacklead, and pushed two eyes into the wax through the lead, apart from each other, then connected with battery and slung them in copper solution. In some places the deposit was good, but bare in others. Should be glad to have a few hints as to the method of procedure.—PENWITH.

[58065.]—**Backing Millstones.**—I have a 4ft. 4in. Peak stone that is worn very thin; therefore it is hardly heavy enough. I should like to make it 4in. thicker. I am told that plaster-of-Paris and gravel is used for that purpose. Will any of our kind readers give a little information upon the subject—as to quantity of material, how to use it, &c.? Perhaps some miller or millwright will kindly give me a little advice.—J. L. C.

[58066.]—**Hot Brasses.**—I am working a pair of millstones, and the step brass of the spindle always gets very hot. I have tried many things; have tried soda, gunpowder, blacklead, sulphur, and many other things; it will not run cool. Have cut a clear way for the oil, so that is not the cause. Am using Gallipoli oil. It works well with other bearings only in one place, and that is another step brass. In the first case the brass, I believe, is too hard for the spindle toes, and the latter case the brass is too soft. I would change brasses, but the spindle toes are not the same pattern. If anyone could give me a little advice I should be greatly obliged, as it is very bad when one has these things to contend with besides his usual duty.—J. L. C.

[58067.]—**Flywheel.**—I want to drive a pair of stones by a portable engine. They are under drift. The bevel gear is already laid in. I only want a flywheel on the end of the lay-shaft. There are 45 cogs in the bevel wheel, 2½in. pitch. The wheel upon the stone spindle has 35 cogs, driven by 43 cogwheels. They also are 2½in. pitch. I want to drive the stones about 100 revolutions per minute by a portable steam-engine. I don't know the size of the portable engine flywheel for a 10 H.-P. engine. I hope some of our readers will kindly instruct me in this matter. J. L. C.

[58068.]—**Conversion of Photo O.G. into Telescope.**—I have a portrait lens of 4in. diam. Can one of the lenses be converted into an achromatic object-glass for a telescope, and, if so, where could I get a brass tube 4in. diam?—B. SC., Plymouth.

[58069.]—**Warming Claret.**—Having been ordered medically to drink claret, I shall be obliged if anyone could inform me as to the best method of warming it, so as to bring out the flavour without overdoing it.—E. MASHITER.

[58070.]—**Voltaic Battery.**—TO MR. BOTTONE, OR OTHERS.—I am about to make a battery of twelve cells, and want to know if you, or any of "Ours," have ever used common red-glazed earthenware cells, made of the same materials as pitchers, flowerpots, &c.? Will the glaze stand acids? The cells are going to be constructed as follows:—The porous pot will contain dilute H_2SO_4 and a square rod of amalgamated zinc, the outer cell a solution of $K_2Cr_2O_7 + H_2SO_4$, and packed with small pieces of carbon, as in Dale's granule battery. What would be the E.M.F. of such a cell, the elements having same surface as in Dale's? I should think the cell I have described would have a less internal resistance than Dale's, because HCl which he uses to charge would produce a greater internal resistance than H_2SO_4. It would also have a greater E.M.F. than a Fuller's cell, having a greater surface of carbon. Has anyone constructed such a cell?—CAERLEON THE ANCIENT.

[58071.]—**Link Motion.**—Having an inverted slide-valve marine screw engine, I wish to add a link-motion reversing gear to it; but having some doubts as to the curve and length of the link, I shall be glad if any kind reader would help me out of this slight difficulty. I have several back numbers, but do not comprehend the exact idea. The valve gives ½in. stroke. Am I right in thinking that the curve is got at by the stroke of the valve—i.e., if valve gives ½in. stroke the curve must be ½in. curve?—SLOT LINK.

[58072.]—**Working Pressure of Boiler.**—Having a brass vertical riveted boiler, 12in. by 6in. dia., with 5in. by 6in. fire-box all round, and all made of 1-16in. thick brass, I want to know if it will stand working pressure of 150lb. per sq. in., or more?—SLOT LINK.

[58073.]—**White Lead.**—Having a quantity of lead in oil, I want to know if it is pure or not. Could any kind reader give me the name of the acid that is used to take the impurities out of the lead?—SLOT LINK.

[58074.]—**Bicycle Repairs.**—Will some kind reader of this valuable paper give me the best method for taking cranks (with a key) off a bicycle? I have tried hammering, heating, &c., but make no impression. Also, what is the cause of the rubbers splitting and little holes appearing all around in a line with the spokes (about the same size)? I think of putting new rubbers, handle bars, and handles, also new balls. I applied to Cann and Co., Holborn Viaduct, and inclosed a stamp for catalogue, having been told I could get the best and cheapest rough and finished parts of bicycles. This was two weeks ago; I wrote again, but have not received any reply. Will someone kindly state if I was wrongly informed? Also state what is the best way to brighten the forks and backbone to take out deep rust marks, &c.?—A TWO YEAR'S READER.

[58075.]—**Galvanising.**—Occasionally I have a few small castings that require to be galvanised. Could any of "Ours" give me some practical information about the above? What is the best acid for the "pickle," and what strength and temperature should it be, and how long should the castings be in it? Is there any flux used in the zinc bath? If so, what is it composed of? How long should the castings remain in the zinc bath? Does the zinc bath require to be at a high or low temperature?—J. C.

[58076.]—**Drilling Machine and Drills.** — Will some brother reader help me to the best kind of drilling machine and drills to buy for drilling ¼ holes through ¾ brass-cased tubing? I find with the ordinary drills a great burr is left up, and a great deal of filing has to be done to level them again.—HORACE MACK.

[58077.]—**Gas Engine Query.**—About to try my hand at the making of a small gas-engine, I am in want of information as to a safe thickness of metal in a 4in. cylinder, where the mixture is to be fired under compression. Also as to the least allowable area for the igniting part, and the thickness of the water space. I presume the principle of firing under compression is not secured by any of the patentees, but only the special methods of doing it. AMATEUR.

[58078.]—**Varnish for Zinc.**—Can anyone give me particulars of a transparent or other varnish that will adhere to zinc, and at the same time resist the action of soap and hot water?—J. K.

[58079.]—**Sun Diagonal.**—In a sun diagonal, is the reflecting surface between the field lens and the eye lens, or does it reflect on to the field lens?—C. W. T.

[58080.]—**H.-P. of Locos.**—Will any correspondent give me the H.-P. of the 8ft. driving-wheel express on the G.W.R., and the Gladstone on the L.B. and S.C. Railway? —LOCOMOTIVE.

[58081.]—**Lantern Slides.**—What is the best kind of lens to use for copying into lantern transparencies the views I have taken during last summer? Some of my negatives are dense and yellow from faulty development. I do not want a cheap or an inferior lens, but some combination which will give plenty of light and definition—the very best I can obtain.—E. B. F.

[58082.]—**Cabinetto.**—The rolls of music for this instrument are very expensive; but I think I can manage to arrange and perforate the tunes myself, taking the tunes from a concertina or guitar instruction book, which give with each air an easy bass, suitable for a limit of three octaves of reeds. The great matter is the paper. Will thin brown wrapping paper answer? I can paste the sheets together so as to form a long roll.—E. B. F.

[58083.]—**Sal-Ammoniac.**—Would any reader inform me as to the best and easiest method to manufacture sublimed sal-ammoniac?—B. J. E.

[58084.]—**Electric Light.**—TO MR. BOTTONE, OR H. EAVES.—I have a granule carbon battery of four gallon cells (of course, not holding a gallon of K_2CrO_4 solution, owing to the particles of gas-coke with which it is packed). The inner cells are 3 by 8½; the zincs are 1½ by 8½. Could you tell me whether this battery would light a 5 c.-p. lamp or more? Also, if you have an appliance to raise zincs out of solution of inner cell, will that stop the action of the battery, and thereby cause the solution to retain its strength for a longer period? If you have a switch in order to turn the lamp on or off, when turned off does it cause the chemical action of battery to act quicker, and thus weaken your battery?—N. A. L.

[58085.]—**Times of Sunrise and Sunset.**—Will "F.R.A.S.," or other competent correspondent, kindly favour me with the rule for determining the times of sunrise and sunset for each day in the year for any latitude (north)? Also state if any differences occur in the times of the sun's rising and setting, on the same dates of different years, and, if so, the rule by which the amount and direction of such differences can be determined?—A. ROBERTSON.

[58086.]—**Muscæ Volitantes.**—Is there any cure? I am subject to sudden and violent attacks of the disease in one eye at intervals of two or three months, invariably beginning at the lower and inner (nasal) side. It has the appearance on every movement of the eye of a dark, muddy green solution being washed over a repelling surface. Increasing for two or three days, it gradually breaks up into filaments and spots with a thick mist, and disappears in about the same time, having rendered the eye useless for a week or more.—X.

[58087.]—**Pork Pies.**—What are the wrinkles to be observed in making the crust stand up? When my wife makes any they are all of a squat.—EDWARDS.

[58088.]—**E.M.F. of Leclanche Batteries.**—Will any kind reader explain what is meant by the terms volts and amperes? Also what is the E.M.F. of an ordinary quart Leclanché cell, and how many such cells would it take to drive a 10 c.-p. lamp?—A NEW SUBSCRIBER.

[58089.] — **Wimshurst Machine.** — Would Mr. Wimshurst kindly say what the sectors are made of, as they are not given in the construction of the machine?—W. S.

[58090.]—**Bobbin Net Lace.**—Will someone kindly describe how this may be made by hand? Would be glad to purchase the necessaries if address were advertised.—T. H.

[58091.]—**Durability of Clothing.**—What is the most durable material for a man's clothes, presuming that appearance is no object?—T. H.

[58092.]—**Jet Black Shineless Varnish.**—Would Mr. Lancaster, or some other able correspondent, come to our aid with instructions how to make a varnish, to be fine, smooth, very hard, jet black, and shineless, to paint on American cloth, quick drying, to chalk drawings on, and which will clean off with a dry cloth, and afterwards roll up without cracking? I have tried various mixtures of copal with turps and lampblack, and dropblack; also with spirit varnish, and have produced no satisfactory result. I found it cloudy, streaky, and the chalk marks difficult to rub out, and leaving shining spots here and there. School exercise books contain a blackened surface in lieu of a slate, which seems a suitable surface, and if that could be given I think it would suit us very well.—ONE IN DIFFICULTY.

[58093.]—**Can the Law Interfere?**—Would Mr. Wetherfield answer a troublesome question? Opposite my house, on the other side of the road, about 20ft. wide, including foot, is a wall, average between 6ft. and 7ft. high, flat topped, approached by slanting footpath at one end of wall. The ground inside of wall is 18in. from top; said wall is in front of dilapidated house, unfit for, and uninhabited, and the children of the street, from three to fourteen years, are daily, almost hourly, to be seen running along the top of the wall and leaping on the ground on the high side, about 18in. If they fell, which, you will see, is more than possible, on the other side it would be a fall of 6ft. or 7ft. As a resident in my own house, I am compelled to witness the danger, and although the house has been uninhabited three years, no child has been injured by falling over, except one or two—one a boy of three years, falling over and cutting his chin. I find myself continually wishing some fatal case might happen, for the Coroner to step in and alter matters. Can I compel owner to fence said wall in from trespass? The expense to fence would not be 10s. I have written and asked the owner to interfere, but have been refused, and what, perhaps, nettles one more than anything else is, the owner is one of the Communion-taking churchmen.—CHRISTIANITY.

[illegible]

[illegible] **[illegible]** [illegible]

[illegible] **[illegible]** [illegible]

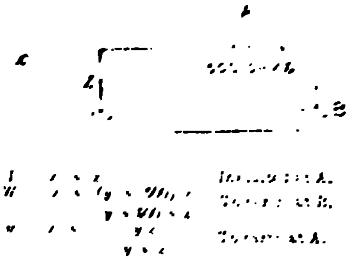
[illegible] **[illegible]** [illegible]

[illegible] **[illegible]** [illegible]

[illegible] **[illegible]** [illegible]

[illegible] **[illegible]** [illegible]

[illegible] **Electrical.** [illegible]



[illegible]

[58103.] **Screwing Machine.** Would any reader kindly give any particulars how to [illegible] a machine for screwing [illegible] and how to fix them, and [illegible] size from ⅛in. to 1in.? [illegible] I [illegible] to screw them in an ordinary foot lathe? W. G. I.

[58104.] **Colouring Brasswork.** I have done a bunch of violets and snowdrops [illegible] in repoussé work. Will some reader kindly tell me how to colour the violets blue, the snowdrops white, and the leaves green, as near as can be [illegible], and what lacquer to use afterwards? M. E. D.

[58105.] **Electro-Motor.** To Mr. [illegible]. May I trouble our kind friend for advice in the following? I want to construct a motor to give an available half horse power, and wish the A [illegible] of the cross form, described in letter 24410, No. 1020. What diameter A. [illegible], and what size and weight of wire will it require? Also what size and weight of wire for magnet? How many gal. bichro. cells will be necessary? HOPEFUL.

[58106.] **Landscape Photography.** I have three or four times, from an elevated position, taken photographic views of an extended landscape, terminated by a high hill about a mile distant from where I placed the camera. The rocks, trees, and footpaths on the hillside were clear and distinct to the naked eye; but the photographs are very unsatisfactory: they are hazy and flat, having no detail in the distance, while the foreground for nearly one half the view is very good. I used 6½in. by 4¾in. plates, and an achromatic landscape lens, solar focus 9½in., stop about ⅜in. $\left(\frac{f}{32}\right)$. Can any of our photographic readers advise me as to the probable cause of my failure? JACOBUS.

[58107.] **Arc Lighting on Incandescent Lamp Circuit.** I have an incandescent lamp installation of 80 lamps, 20 c.p., the E.M.F. being 100 volts, and the current about 40 ampères. I wish to burn an arc lamp

[illegible]

[illegible] **[illegible]** [illegible]

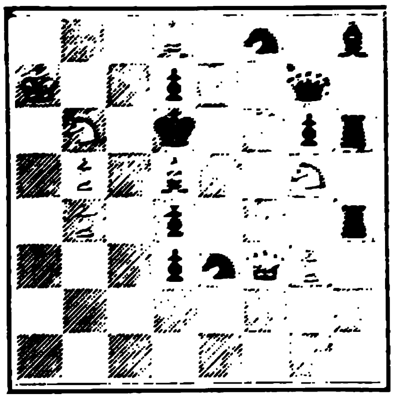
[illegible] **[illegible]** [illegible]

CHESS.

All Communications for this Department must be addressed to [illegible]

PROBLEM [illegible]

Black.



White. [illegible]

White to play and mate in three moves.

SOLUTION TO [illegible].

White.	*Black.*
1. B-K B 4	1. Anything.
2. R, B, or Kt mates.	

[illegible] variations.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 563, by H. E. T. Glover; to 564, by R. A. Bennett, [illegible], J. A. M[illegible], H. Culmer (very good indeed), and R. F. [illegible]; to 565, by H. E. T. Glover and R. F. [illegible].

J. DOBBS.—How if 1. [illegible] / P takes Kt ?

H. CULMER.—Thank you for your letter.

T. TAVERNER.—Problems received with thanks.

WE are glad to see that *Cassell's Saturday Journal* has started a Chess Column. If the succeeding problems are like the first in neatness and attractiveness it is sure to be a success. This is the position: White: K-Q B sq., R-Q R 5, Bs Q 4, K R 3, Ps-Q B 3, K B 3; Black: K-Q B 5, Ps-Q B 7, K R 5. White to play and mate in two moves.

A column of the *Liverpool Weekly Courier* is now devoted to Chess. The first problem is by the well-known composer, Mr. H. E. Kidson.

IN connection with the annual meeting of the British Association next year in Birmingham, it has been decided to hold an Exhibition of Industry and Natural History in Bingley Hall, to remain open for one month preceding October 8th. The area from which manufactures will be admitted is a radius of fifteen miles from Birmingham, and wherever practicable processes, as well as products, will be illustrated. Numbers of the leading manufacturers have already shown themselves willing to co-operate. To make the hall more attractive, streets of old Birmingham workshops will be formed.

[illegible]

[illegible]

[illegible] expensive; [illegible] not that "[illegible]" [illegible] couplers await[illegible]. (The wooden key is [illegible] holding the rail firmly [illegible] devised. Constant attention is necessary [illegible] keys tight, but the screw or nail would [illegible] the keys are wedge-shaped on purpose that [illegible] tightened up when affected by weather. [illegible] in two directions, sideways and [illegible], to prevent the rail rising in its chair when [illegible] over it. Therefore, it would be too [illegible] take out a screw every time a key [illegible] or slackening.)—C. W. T. ([illegible] be "visited" only by permission of [illegible] Royal.)—E. M. (Mr. [illegible] Holborn. W.C.)—RD. HARTLEY [illegible] top of a cart-wheel does move faster [illegible] stant, than the bottom. If it did not [illegible] follow the horse. Try the experiment [illegible] cardboard and a pencil.)—A SUBSC[illegible] "stud" is a boss or protuberance; [illegible] it would be called a "pin" or "[illegible] is movable either in connection [illegible] bearing, or with both. It is [illegible] move objects to their bearing [illegible] some kind, is the most proba[illegible] assign any definite reason [illegible] kind, or [illegible] roller and pulleys.

Instead of a vertical cutter or still better, but also [illegible] costly a "universal" cutter, in which the tool can be set to the rake of the twist, a drilling spindle is often used; but only for the purely ornamental work in ivory and hard wood as the grooves, or hollows, cut by it will be comparatively narrow. Even with an ordinary vertical cutter the tool may not be wide enough for a very coarse spiral, and may have to be shifted for a second cut parallel with the first; but, as a rule, it will not be used in such work as the Elizabethan, or coarse twist, which, if cut wholly by such a revolving tool, will need a suitable block, or head, fitted with gouges, and driven at a high speed like the cutters of planing and moulding machines. I do not remember that I ever saw such arranged for use with amateur's lathes; probably because coarse twist is not often attempted, except in a limited degree, when it is done as described above. Still, I see no reason why such simple addition to the lathe should not be made and sold as readily as the vertical cutters and drills. Overmantels, brackets, and sets of shelves ornamental very often with fretwork are articles in which short spiral pillarets look very well; and these are [illegible] overhead—a second cord [illegible] down to the mandrel pulley. Mr. Haydon proved that the apparatus sufficed for accurate screw-cutting—accurate enough at any rate, for all purposes except micrometer screws, and, hence, no doubt need be entertained of its availability for all kinds of twist. The pulley on the slide-rest screw will be a small one—say, 2in.—to gear with a [illegible] roller on the overhead, which is the usual size, and from a small pulley on the same shaft a cord will go to the largest on the mandrel *a*, which gives greater scope to a pulley mounted in the chuck, which will allow a larger size to be used. In this way it is easy to arrange that ten turns of the slide-rest screw, equal to 1in. longitudinal traverse of the tool, shall take place to less than one turn of the mandrel, giving a spiral of more than an inch pitch. Halving the small wheels will still further enlarge the pitch. The roller being unalterable, of course somewhat limits the proper proportions that would otherwise be obtainable; but we have three pulleys upon which to work the changes, and these will generally suffice. With Haydon's arrangement one turn of a spiral in six inches is easily worked.

O. J. L.

ENGINE-MAKING AT HOME.—XI.

The Eccentric and Valve.

THE fitting-up of the eccentric and valve, with their respective rods, will be our next task. Where engines are fitted up in quantity, the eccentric sheaves are turned on a templet plate having upon it a short mandrel or stud fitting the bore of the sheaves, and set to the exact amount of eccentricity required. A key-way is cut in the stud, opposite to which the key-way in the eccentric is cut, and by which it is retained in place while being turned. An unlimited number of sheaves may be turned on such a templet plate all exactly alike. This is the practice in engine-shops; but as we have only one to make, we shall not employ a plate, [illegible] the sheave on a [illegible] the key-way after we have [illegible]

The pattern of the sheave [illegible] the dimensions given in [illegible] allowances being given for [illegible] the jaws of the chuck [illegible] true the face, and turn the [illegible] half way across the [illegible] groove on the outer edge [illegible] the flange of the strap [illegible] the reverse position and [illegible] the remaining half with its [illegible] the distance between the [illegible] The second face cannot be [illegible] bore the hole and turn the [illegible] circumference of the sheave must [illegible] centre in the plate. At a distance [illegible] centre of the chuck draw a line. [illegible] diameter from the chuck centre [illegible] this line, and from the point of [illegible] strike a circle equal in [illegible] that of the sheave. Secure the [illegible] that position with the dogs, and [illegible] for the reception of the crank shaft [illegible] the second side of the sheave [illegible] being reduced thereby to [illegible]

The half-straps, cast in gun-me [illegible] these points until the diame [illegible] in the rough casting take [illegible] and transversely to the joint [illegible] nearly equal. Holes are drilled [illegible] in diameter at [illegible] centre [illegible] bolts. The halves are fastened [illegible] the entire strap chipped in the jaw [illegible] while one face is turned and the [illegible] after which the strap is re-ch [illegible] facing off of the opposite side. The [illegible] is best bored to a zinc templet [illegible] whose edge is the reverse of that [illegible] A little easing will probably be [illegible] the straps fit the sheave exact [illegible] A, which takes the end of [illegible] parallel with the joint to a dista [illegible] of [illegible] The edges of the [illegible] inside portions of the strap [illegible] and polished with emery cloth [illegible] sake.

The rod forged from a bit of [illegible] and filed to the shape and dim [illegible] and the instructions given [illegible] making of the connecting rod wi [illegible] apply to this also. Steel is prefera [illegible] with a slight rod, not so much f [illegible] of the actual strength re [illegible] its superior stiffness, and capa [illegible] bending during the actual fitting [illegible] hole for the pin at *a a*. [illegible] quite square with the axis of the [illegible] holes in that end at [illegible] from these mark off two tappin [illegible] the flat of the eccentric, which [illegible] to [illegible] deep for the reception [illegible] (Fig. 12 [illegible]).

The valve-rod is shown at Fi [illegible] usual to increase the size of the [illegible] for greater bearing surface be [illegible] oblique thrust which the eccentri [illegible] upon it. Then the bush may be [illegible] valve-rod bearing, which will pe [illegible] diameter of the rod being increase [illegible] end of the rod is screwed for a le [illegible] and nuts and lock nuts are provid [illegible] maintain the valve in position [illegible] the opposite end is attached the bl [illegible] fits into the fork of the eccen [illegible] receives the pin. It may be filed [illegible] of brass or of steel. Into it the [illegible] valve-rod is screwed, and a se [illegible] steady. The pin C, which unite [illegible] eccentric rod, is maintained in pla [illegible] of a split pin thrust through the [illegible] as simple a joint as any for a small [illegible]

The valve is filed to the dimens [illegible] Fig. 122, and screwed upon its r [illegible] tightening of the nuts upon its [illegible] distance given in the same figu [illegible] this, the whole connection betwee [illegible] and the valve is complete. But [illegible] portant portion of the work—the [illegible] valve, as it is called—yet remai [illegible] and this section of the work, wh [illegible] sents great initial difficulty [illegible] shall treat of somewhat fully.

By means of the slide-valve [illegible] ingress and egress of the steam, [illegible] of its expansion, and the cushioni [illegible] also is effected. These are reg [illegible] and the travel of th [illegible] by the throw of t [illegible]

FIG. 120.

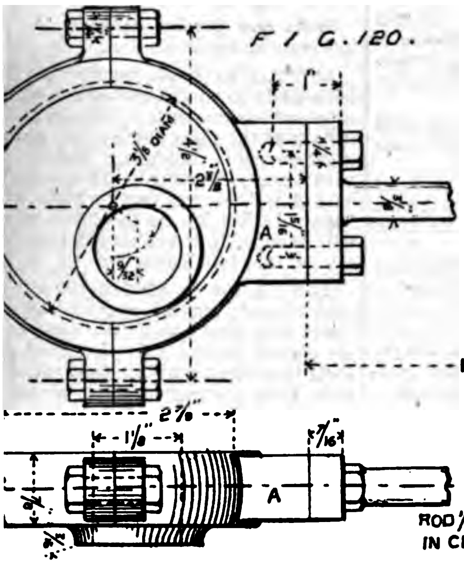


FIG. 121.

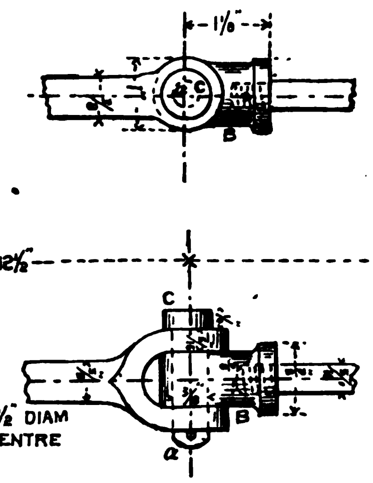


FIG. 122.

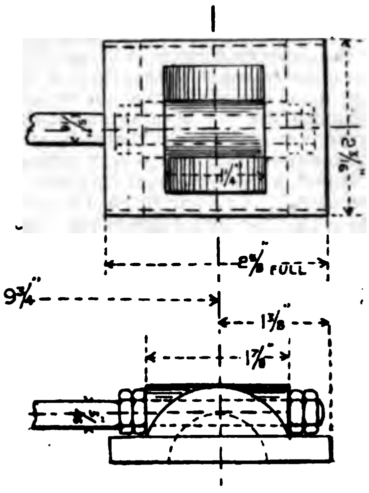


FIG. 123.

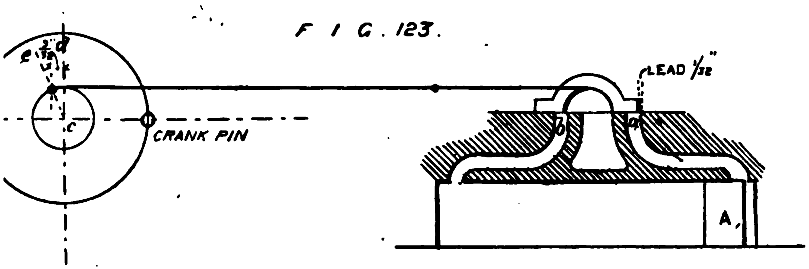


FIG. 124.

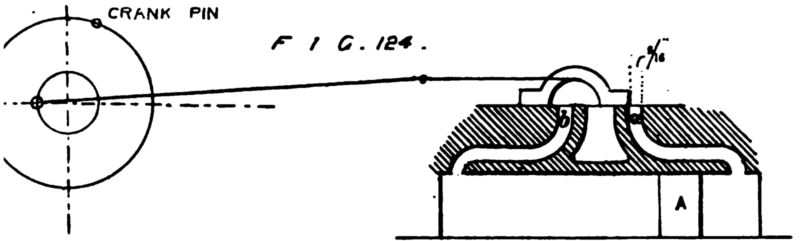


FIG. 125.

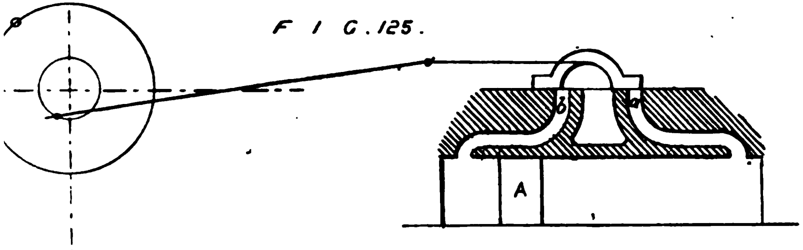


FIG. 126.

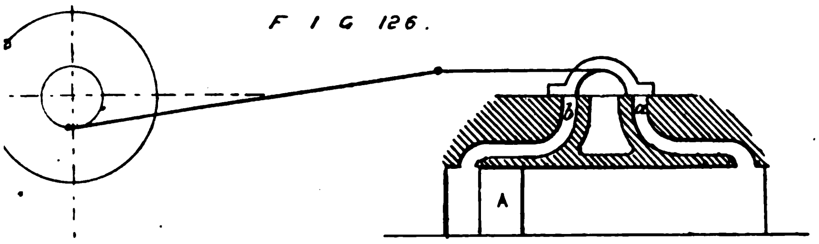


FIG. 127.

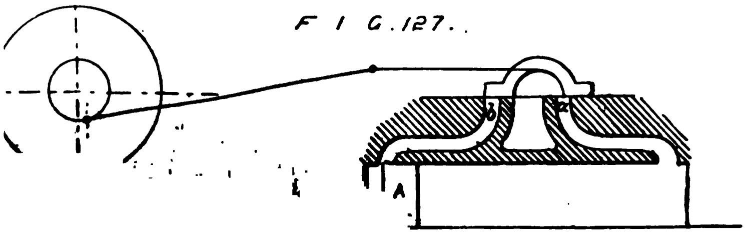


FIG. 129.

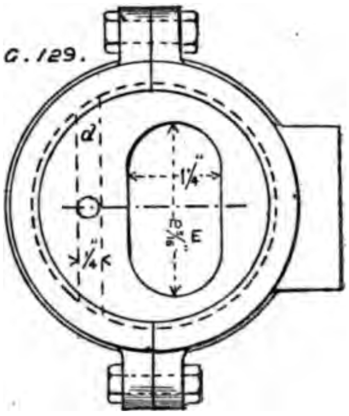
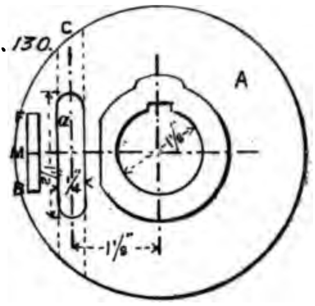


FIG. 130.



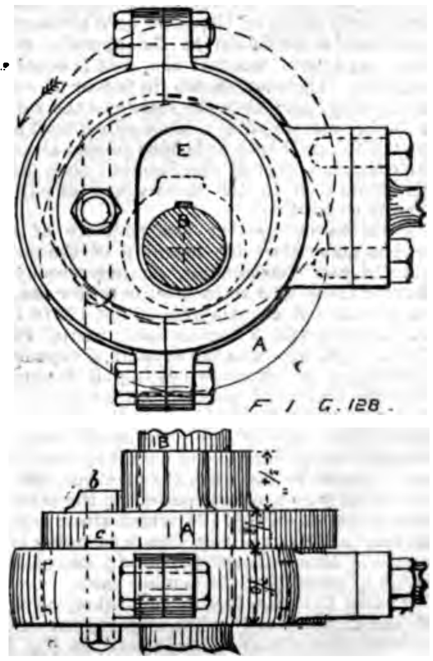


FIG. 128.

which the centre of the sheave is keyed on, relatively to the crank. If the centre of the sheave were made to correspond exactly with the centre of the crank, as in the earlier engines, the opening and closing of the ports would coincide exactly with the termination of the strokes of the piston. But by putting the centre of the eccentric forward or ahead of the crank, to a distance equal to the travel of the valve for lead and cut-off, the amount of these can be regulated, and the opening and closing of the ports do not coincide with the termination of the piston strokes, but with some fractional portions thereof, whose amount is regulated by the precise amount of setting forward given to the sheave beyond the centre line of the crank. Reversing the eccentric simply consists in bringing the full of the eccentric to one side or the other of the crank centre, or to that side of the crank in which direction we require the engine to be driven. This movement is effected in single-cylinder engines by the employment of some kind of reversing plate, and in double-cylinder engines with the arrangement termed a slot link, by which the position of the valve and valve rod is moved relatively to the steam ports.

The extent of the travel of the valve is equal to twice the greatest width open to steam, plus the two outside laps, in this case, 2 ($\frac{5}{16}$in. + $\frac{1}{4}$in.), and, of course, the throw or radius of the eccentric must be equal to one half the travel or $\frac{5}{16}$in. + $\frac{1}{4}$in. = $\frac{9}{16}$in. The angle of the eccentric (set to the linear advance of the valve) in reference to the crank will equal 90° + lap, measured on the the eccentric circle = 90° + $\frac{1}{4}''$. If we choose to put lead, it must increase the angular advance of the eccentric by that amount. I have given $\frac{1}{32}''$ lead in dimensioning the eccentric, which will make the linear advance 90° + $\frac{1}{4}''$ + $\frac{1}{32}$, as shown in the diagrams. But it will be sufficient in this instance if the port is just perceptibly open to steam only at the commencement of the return stroke of the piston. The quicker an engine is required to run, the greater the amount of lead which should be given to the steam side of the valve.

The valve is set thus: The piston A being brought to one end of the cylinder, so that the crank is on one of its dead centres (Fig. 123); the slide is set open on the steam side to the extent of its lead = $\frac{1}{32}''$, the eccentric is set on the crank shaft at the requisite obliquity corresponding with a linear advance of $\frac{9}{32}''$, and held temporarily by a key driven in the keyway cut in the shaft, but without cutting any yet in the eccentric. If, as is most probable, the rods do not come within a fraction of their exact length, the nuts on the valve-rod furnish the means of adjustment to the required extent. If we had made our valve with a T-headed recess, or a boss for a ring instead of adopting this plan of nut adjustment, the length of the eccentric rod must have been taken with trammels, and the rod either made or adjusted after the setting of the valve.

With the valve set and the eccentric sheave temporarily keyed on the shaft, turn the engine round half a revolution to the opposite dead centre, and note whether the lead is equal at each end. The chances are in favour of some discrepancy, and then the sheave or the valve, or both, will require a little adjustment and correction, until both ends open to lead alike at the commencement of the strokes; then mark the keyway off in the sheave, and cut it as exactly as possible.

I am assuming that the majority of my readers understand the meaning of the terms "lap," "lead," "cushioning," &c., here employed. But for those who do not quite follow me, an examination of the diagrams, Figs. 123 to 127, will illustrate their application. "Lap," Figs. 125 and 126, regulates the amount of expansive working of the steam by cutting off its supply at some fractional part of the stroke of the piston; "lead," Figs. 123, 127 is the amount by which the valve is open for readmission of steam at the termination of a stroke; "cushioning" relates to the quantity of steam left in the cylinder by the early cut-off on the exhaust side of the valve, Fig. 126, which steam acts as an elastic buffer to the piston in bringing it to rest, and thus relieves the strain and sudden shock of reversal of the moving parts.

Taking the diagrams in succession, we shall be able to see exactly what is going on in the *cylinder during half a revolution.* In Fig. 123 *the engine is on dead centres, the crank-pin* being nearest cylinder; the piston is, therefore, about to commence its stroke; the valve is open to lead at *a*, *b* is exhausting. In this position the centre of the eccentric sheave is set forward 90° + $\frac{9}{32}$in. in front of the crank-pin; $\frac{9}{32}$in. would be termed its *linear* advance, the angle *c d e* its *angular* advance.

In Fig. 124 the port *a* is opened to its greatest width to steam, and the port *b* is fully exhausting.

In Fig. 125 the valve has returned and cut off steam at *a*, the piston A being at $\frac{3}{4}$ stroke, after which the steam acts by its own expansion; port *b* is still exhausting.

In Fig. 126 the exhaust port *b* is just covered over, and the exhaust steam left in that end of the cylinder is being cushioned by the piston A. If there were no inside lap in the valve, it would now be in middle travel; but it has yet to move $\frac{1}{16}$in. further back to attain that position as indicated by the position of the eccentric sheave. The steam in front of the piston is still expanding.

In Fig. 127 we come to dead centres again, the crank-pin being furthest from cylinder. The piston A has made one stroke, the flywheel half a revolution, and the valve is just open at *b* for the return stroke.

Though the employment of a reversing plate did not form part of our original design (p. 533 of Vol. XL.), I have drawn one in connection with this eccentric, thinking that there are perhaps some who might wish to adopt a simple method of reversing the motion of the engine without incurring the work involved in the making of a slot link with rods. Of course, in this instance, the engine must be stopped for reversal; but in few cases would this be considered a drawback. The crank-shaft, too, will need to be extended $1\frac{1}{4}$in. if the plate is adopted.

There are several kinds of reversing plates in common use, this particular one having the advantage over some others of being more readily made. In Fig. 128 the plate and eccentric are shown bolted together in the position for motion, indicated by the direction of the arrow. In Figs. 129, 130, the two are shown separately. In the figures the same reference letters are used throughout.

The plate A is keyed fast upon the crank-shaft B. It is furnished with a slot, *a*, for the tightening bolt, the head of which is prolonged into a pointer, *b*, by which the exact position of the plate in reference to the sheave is set to the division lines F M B (Fig. 130), marked off by actual observation of the positions of the slide-valve, before the steam chest is put on. The divisions may also be inserted for different grades of expansion, regulated by different positions of cut-off. The back part of the plate is furnished with a groove, C C, in which a corresponding tongue upon the face of the sheave *d* slides, thus maintaining the sheave and the plate in their proper vertical positions. The sheave has an elliptical slot, E, cut through it, in order to allow of the necessary vertical movement, a slight clearance being given between it and the shaft. By the employment of such a plate the reversal of the engine may be effected in half a minute, it being only necessary to slacken the bolt, reset, and tighten.

ASTRONOMICAL NOTES FOR DECEMBER, 1885.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination South.	Sidereal Time.
	h. m. s. a.m.	h. m. s.	° ′ ″	h. m. s.
1	11 49 20·19 „	16 31 22	21 53 19	16 42 1·45
6	11 51 22·30 „	16 53 7	23 33 39	17 1 44·23
11	11 53 37·18 „	17 15 4	23 2 58	17. 21 27·02
16	11 56 0·78 „	17 37 11	23 20 52	17 41 9·80
21	11 58 29·05 „	17 59 22	23 27 6	18 0 52·58
26	0 0 58·13 P.M.	18 21 33	23 21 33	18 20 35·37
31	0 3 24·25 „	18 43 42	23 4 16	18 40 18·16

The method of finding the Sidereal Time at Local Mean Noon at any other Station will be found on p. 355 of Vol. XL.

Spots and faculæ continue to appear at intervals on the Sun's disc.

At 3 p.m. on December 21st the Sun is said technically to enter Capricornus, and Winter is supposed to commence. He is in reality at this instant at the right angle of an approximately right-angled triangle, which he forms with λ and μ Sagittarii. This is the theoretical date of the shortest day; which will actually happen in London on the 22nd, when the Sun will be only 7h. 44m. above the horizon, and, of course, 16h. 16m. below it.

At 5 a.m, on the 31st, the Sun is in perigee, which is only another way of saying that the Earth is in that part of her orbit in which we are nearest to him. At the time specified we shall be separated by an interval of 90,808,434 miles from the mighty Ruler of our Planetary System.

The Moon

Is New at 1h. 16·7m. in the afternoon of December 6th, and enters her First Quarter at 6h. 21·8m. p.m. on the 14th. She will be Full at 8h. 58·6m. at night on the 21st, and enter her Last Quarter 21·8m. after Noon on the 28th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	24·6	7 48·5 a.m.
6	29·6	11 50·9 „
11	4·9	3 48·0 p.m.
16	9·9	7 30·3 „
21	14·9	12 6·4 „
26	19·9	4 3·7 a.m.
31	24·9	8 11·0 „

The Moon will be in conjunction with Mercury at 6 a.m. on the 8th; with Venus at 11 p.m. on the 10th; with Saturn at 5 a.m. on the 22nd; with Mars at 9 a.m. on the 27th; and with Jupiter at the same hour on the 28th.

Mercury

Is an Evening Star during the earlier part of December, but comes into inferior Conjunction with the Sun at 4 a.m. on the 19th, after which he obviously must pass to the west of the Sun, and become a Morning Star. He is very badly placed indeed for the observer, on account of his great South Declination. His diameter increases from 6·6″ on the 1st, to 9·8″ by the 17th, at which it continues for a day or two, and then, slowly beginning to diminish again, is only 8″ by the 31st.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	18 3·5	25 39·1	1 21·3 p.m.
6	18 20·2	24 54·6	1 18·2 „
11	18 22·0	23 42·4	1 0·4 „
16	18 4·5	22 11·4	0 23·2 „
21	17 36·1	20 42·6	11 35·3 a.m.
26	17 16·7	19 58·0	10 56·3 „
31	17 14·5	20 12·9	10 34·5 „

The curious looped path indicated by the above Ephemeris begins in a blank region in Sagittarius, and extends towards λ in that constellation; just to the North of which Star the planet will be found on the 6th. Three days afterwards Mercury returns on his course, and finally travels into the Southern part of Ophiuchus.

Venus.

Is an Evening Star during the entire
and though extremely badly placed
observer at the beginning of it, yet
slightly better position towards the
She attains her greatest
Sun (47° 16′) at 7 a.m
exhibits a beautiful
Her angular dia
December 1st, inc
of the year.

Jupiter's Satellites.

Satellite.	Pheno-menon.	H.	M.	S.	Day of Month.	Satellite.	Pheno-menon.	H.	M.	S.	Day of Month.	Satellite.	Pheno-menon.	H.	M.	S.
II	*Sh I*	7	42	A.M.	14	I	Ec D	3	24	25 A.M.	23	I	Oc R	3	14	A.M.
II	*Ec D*	1	53	35 „	14	I	Oc R	6	51	„	23	*I*	*Tr E*	12	22	P.M.
II	*Oc R*	7	0	„	15	I	Tr I	1	43	„	26	II	Sh I	4	40	A.M.
III	Sh E	3	37	„	15	III	Oc R	2	29	„	26	*II*	*Tr I*	7	11	„
III	Tr I	5	9	„	15	I	Sh E	2	47	„	26	*II*	*Sh E*	7	31	„
II	Tr E	2	8	„	15	I	Tr E	3	59	„	26	*IV*	*Tr I*	12	9	P.M.
I	*Ec D*	7	3	2 „	16.	*I*	*Oc R*	1	19	„	27	IV	Tr E	1	20	A.M.
I	Sh I	4	9	„	17	II	Ec D	7	2	18 „	28	II	Oc R	4	10	„
I	Tr I	5	19	„	18	IV	Ec D	4	36	46 „	28	I	Ec D	7	10	33 „
I	Sh E	6	26	„	18	*IV*	*Ec R*	7	23	38 „	29	III	Ec D	2	31	54 „
I	*Tr E*	7	35	„	19	II	Sh I	2	7	„	29	I	Sh I	4	16	„
I	*Ec D*	1	31	17 „	19	II	Tr I	4	36	„	29	I	Tr I	5	31	„
I	Oc R	4	56	„	19	II	Sh E	4	57	„	29	III	Ec R	5	31	49 „
I	Tr E	2	4	„	19	*II*	*Tr E*	7	24	„	29	I	Sh E	6	34	„
II	Ec D	4	27	52 „	20	*I*	*Sh I*	7	55	„	29	*III*	*Oc D*	7	34	„
IV	Tr I	5	26	„	21	II	Oc R	1	35	„	29	*I*	*Tr E*	7	47	„
IV	*Tr E*	7	30	„	21	I	Ec D	5	17	31 „	30	I	Ec D	1	38	49 „
III	Sh I	4	20	„	22	III	Ec R	1	34	42 „	30	I	Oc R	5	7	„
III	*Sh E*	7	33	„	22	I	Sh I	2	23	„	30	*I*	*Tr I*	11	59	P.M.
II	Tr I	1	59	„	22	III	Oc D	3	35	„	31	I	Sh E	1	2	A.M.
II	Sh E	2	24	„	22	I	Tr I	3	38	„	31	I	Tr E	2	15	„
II	Tr E	4	47	„	22	I	Sh E	4	40	„						
I	Sh I	6	2	„	22	I	Tr E	5	54	„						
I	*Tr I*	7	14	„	22	III	Oc R	6	30	„						

Eclipse ; Oc Occultation ; Tr Transit of Satellite ; Sh Transit of Shadow ; D Disappear-
; R Reappearance ; I Ingress ; E Egress. The printing of a phenomenon in *italics*
ates that its visibility is rendered doubtful, either by the brightness of the twilight, or by
er's proximity to the horizon.

ultation of Uranus, and Occultations of (and near approaches to) Fixed Stars by the Moon.

Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
		h. m.		°	°	h. m.		°	°
URANUS		5 0 a.m.	Bright	81	53	6 9 a.m.	Dark	231	213
κ Virginis	4½	4 24 „	Bright	129	92	4 56 „	Dark	190	155
18 Aquarii	6	8 31 p.m.	Dark	130	166	‡9 30 p.m.	Bright	267	306
B.A.C. 7697	6½	5 56 „	Dark	74	88	6 56 „	Bright	332	355
μ Piscium	5	1 47 a.m.	Dark	120	159	‡2 40 a.m.	Bright	271	308
B.A.C. 741	6½	3 9 „	Dark	28	66	‡3 23 „	Bright	357	34
B.A.C. 987	6½	11 2 p.m.	Dark	138	162	12 2 p.m.	Bright	251	284
γ Tauri	4	†4 11 a.m.	S.	5	44				
B.A.C. 1526	6	†5 6 p.m.	N. by W.	191	151				
111 Tauri	5½	5 6 a.m.	*Dark	72	113	5 56 a.m.	Bright	287	325
117 Tauri	6	6 35 „	*Dark	40	77	‡7 6 „	Bright	319	353
B.A.C. 1930	6½	5 46 p.m.	*Dark	78	38	6 37 p.m.	Bright	294	253
ξ Leonis	6	3 55 a.m.	Bright	69	80	5 5 a.m.	Dark	252	276
48 Leonis	6	6 50 „	Bright	93	123	7 48 „	Dark	223	258
τ Leonis	5	5 48 „	Bright	100	110	6 47 „	Dark	211	232
θ Virginis	4½	4 5 „	Bright	85	60	5 15 „	Dark	226	211

† Near approaches. ‡ Star below the horizon. * But seemingly bright.

Venus.

Right Ascension.		Declination South.		Souths.	
h.	m.	°	′	h.	m.
19	57·4	23	28·8	3	14·8 p.m.
20	19·4	22	11·9	3	17·1 „
20	40·3	20	43·4	3	18·3 „
21	0·1	19	5·1	3	18·3 „
21	18·4	17	19·1	3	17·0 „
21	35·3	15	27·6	3	14·2 „
21	50·5	13	32·7	3	9·7 „

arting thus from Sagittarius, Venus travels across Capricornus, and by the 3rd is on the boundary between the last-named ellation and Aquarius. She will not ach any conspicuous star during the entire

Mars,

iis Meridiar —

increases to 10·4″ by the Eve of the New Year, so that he continues to be an uninteresting and insignificant object in the telescope. He is in "quadrature" with the Sun at midnight on December 3rd.

Day of Month.	Right Ascension.		Declination North.		Souths.	
	h.	m.	°	′	h.	m.
1	10	52·7	9	31·6	6	11·6 a.m.
6	11	0·8	8	48·4	6	0·1 „
11	11	8·5	8	7·7	5	48·1 „
16	11	15·7	7	30·0	5	35·6 „
21	11	22·3	6	55·6	5	22·5 „
26	11	28·3	6	25·0	5	8·9 „
31	11	33·7	5	58·7	4	54·6 „

This path lies wholly in Leo. Mars will be about 1° N. of χ Leonis on the 5th, but will approach no other star of any size.

Jupiter,

In so far as his Southing is concerned, is a ing Star ; but as he rises before midnight ds the end of December, we resume our eris of him. He is in so-called "quadrature" with the Sun at 2 p.m. on the 26th ; and although, of course, his enormous distance from the Earth precludes his exhibiting any actual phases, his preceding limb will be seen to be very appreciably darker than that next the Sun. His Angular equatorial diameter increases from 32·1″ on December 1st to 34·9″ by the last day of the year.

Day of Month.	Right Ascension.		Declination.		Souths.	
	h.	m.	°	′	h.	m.
1	12	10·4	0	10·0 N.	7	29·1 a.m.
6	12	12·8	0	4·7 S.	7	11·9 „
11	12	15·1	0	18·0 „	6	54·5 „
16	12	17·1	0	29·9 „	6	36·8 „
21	12	18·9	0	40·2 „	6	19·0 „
26	12	20·5	0	48·9 „	6	0·9 „
31	12	21·8	0	55·9 „	5	42·5 „

The short arc described by Jupiter will be seen to lie wholly in Virgo. On the early morning of the 8th the planet will only be some 8′ south of η Virginis.

Saturn

Is now visible practically all night long, coming into opposition to the Sun at 11 a.m. on December 26th ; and is about as well placed for the observer as he possibly can be. The North Declination of the planet is very great, and his rings for practical purposes are at their widest opening. In fact, the student may be cautioned that so favourable a condition of things for examining the physical structure of Saturn with the telescope will not recur for something like 30 years ; and is hence urged to lose no opportunity of scrutinising and sketching so marvellous an object. The equatorial diameter of the planet increases quite insensibly from 18·4″ at the beginning of the month to 18·9″ by the year's end.

Day of Month.	Right Ascension.		Declination North.		Souths.	
	h.	m.	°	′	h.	m.
1	6	29·8	22	23·2	1	49·5 a.m
6	6	28·3	22	24·6	1	28·3 „
11	6	26·7	22	26·0	1	7·0 „
16	6	24·6	22	27·7	12	41·4 p.m.
21	6	22·9	22	29·1	12	20·0 „
26	6	21·1	22	30·6	11	58·6 „
31	6	19·3	22	32·0	11	37·1 „

The short retrograde arc indicated in the above ephemeris is described within the isosceles triangle formed by ε, μ, and ν Geminorum.

Uranus,

In quadrature with the sun at 4 a.m. on December 29th, is, for the observer's purpose, invisible.

Neptune

May be well seen during the working hours of the night, as his North Declination gives him considerable altitude ; but of course he requires a powerful telescope to be distinguised from a small fixed star.

Day of Month.	Right Ascension.		Declination North.		Souths.	
	h.	m.	°	′	h.	m.
1	3	27·3	16	59·2	10	43·5 p.m.
6	3	26·8	16	57·4	10	23·3 „
11	3	26·2	16	55·7	10	3·1 „
16	3	25·8	16	54·1	9	43·0 „
21	3	25·3	16	52·6	9	22·9 „
26	3	24·9	16	51·3	9	2·8 „
31	3	24·5	16	50·2	8	42·8 „

So that Neptune is still situated in a perfectly blank region in Taurus.

Shooting Stars

May be watched for on the nights from the 11th to the 13th, and again on the 24th.

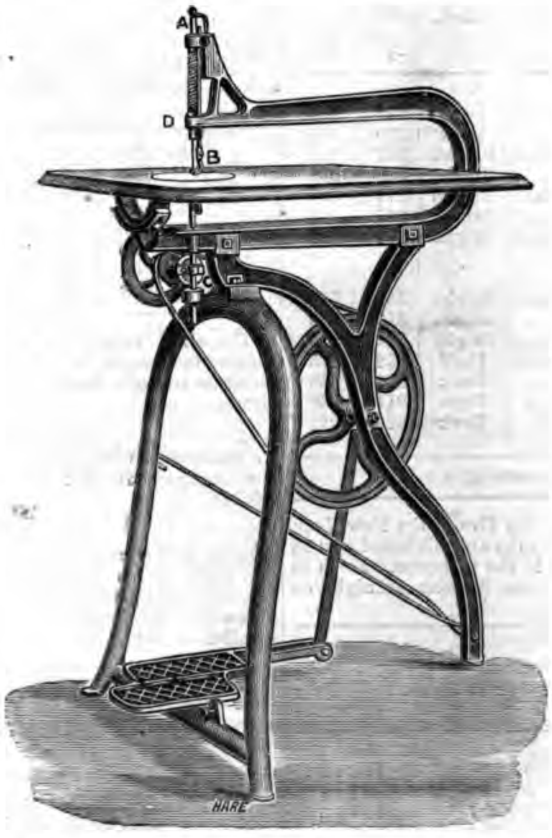
Greenwich Mean Time of Southing of Eighteen of the Principal Fixed Stars on the Night of December 1st, 1885.

Star.	Souths. h.	m.	s.	
α Aquarii	5	17	1·38	p.m.
ζ Pegasi	5	52	46·73	„
Fomalhaut	6	8	18·18	„
Markab...	6	16	1·50	„
γ Cephei	6	51	35·00	„
δ Sculptoris	6	59	48·36	„
α Andromedæ	7	19	16·47	„
α Cassiopeiæ	7	50	45·20	„
β Ceti	7	54	31·57	„
Polaris...	8	34	30·69	„
α Arietis	9	17	12·64	„
α Ceti	10	12	37·83	„
α Persei	10	32	27·57	„
γ¹ Eridani	11	8	52·12	„
Aldebaran	11	45	26·35	„
Capella...	12	24	13·73	„
Rigel	12	25	0·59	„
Leporis	12	43	36·17	„

The Method of finding the Greenwich Mean Time of Southing of either of the Stars in the above list for any other Night in December, as also that of determining the Local Instant of its Transit at any other Station, will be found on p. 356 of Vol. XL. It must, however, be noted that the first of these rules is not rigidly accurate when applied to Polaris, or any other close circumpolar Star (nor even, in fact, to a star like γ Cephei), although it will probably be found quite sufficiently so in practice.

NEW FRET SAW.

THE engraving below illustrates a new registered fret saw brought out by the Britannia Company, Colchester, which has been specially designed to meet a demand from advanced fret cutters and cabinet makers for a strong saw capable of doing large work. As will be seen, the table is oblong, and extends the whole length under the arm, while it can be tilted to any required angle for cutting inlays, &c. This saw, which is 20in. from the back of the arm, has a true vertical stroke, effected by the arrangement shown at C, and the spring and rod at A and D, while B is a presser foot which can be instantly adjusted to any usual thickness of wood, and which prevents the upward jerk of the wood and the consequent liability to breakage of saws. At B, too, will be seen a loose round piece, which can be removed when fixing a saw, thus giving a clear view of the lower bar. The machine is fitted with a horizontal drill, and the shaft is arranged to carry emery wheels, buffs, and polishing brushes. An efficient blower completes this useful fret-cutting machine.



RAILWAY COUPLINGS.

THE action of the Amalgamated Society of Railway Servants, in setting apart £500 of their rather scanty funds in order that a practical test may be made of some of the modern devices for safety coupling of railway waggons, is, in a sense, a direct challenge to the companies, and as the subject has recently attracted much attention in the United States, it is not impossible that at last something definite will be done. It is well known that in view of the difficulty of introducing any uniform coupling arrangement, or, indeed, of inducing any railway company to alter the existing rolling stock, some superintendents have supplied the shunters with a hooked pole, by means of which the shackle can be lifted on to the hook without going between the buffers; but it is felt that an accessory such as that is only a temporary device for avoiding accidents as much as possible, and the thing to be aimed at is an automatic coupler, which can be placed on all kinds of rolling stock at a comparatively low price. In America a variety of automatic couplers have been in actual use, some of them for several years, and at the trials made under the direction of the executive committee of the Master Car Builders' Association held at Buffalo, N.Y., in September last, a dozen were selected out of forty-two for further trial in actual service. So far as we know, no automatic coupler has yet been tried in actual work in this country; but there were many devices at the Inventions Exhibition, and we have chosen three typical examples for illustration, in order to give some idea of the nature of the device required. In Figs. 1 and 2 we show the well-known Janney coupler in two positions. This coupler, which has been in use for many years on some lines in the United States, is of the knuckle-coupling type, which acts in a vertical plane, the jaw being at the end of a bar which is free to slide in the framing against a coiled spring, thus acting as a drawbar and a buffer. It will be seen in Fig. 1 that the short arms of the cranked hooks engage with one another, while the longer arm is held fast when the coupling is complete or locked by a pin which prevents the cranked hook from turning. As the two parts are brought together, an incline on the longer arm of the hook raises the locking-pin, which falls when the parts reach the position shown in Fig. 2. When it is desired to uncouple cars, the locking-pin is withdrawn by means of a lever connected to the pin by a short chain, so that there is no occasion to go between the vehicles at all. The illustrations show the coupler in plan; but as it is one of the vertical plane type, it will be understood that it readily accommodates itself to varying heights of buffer beams. There is, however, no provision for loose coupling, which is deemed necessary here for goods trains, in order that engines may be able to start their loads. Of the twelve couplers selected at the Buffalo convention, six were of the Janney type, more or less, the prototype being of course included. They all act in the vertical plane, and differ only in details. Fig. 3 represents in side and plan view the coupling patented by Mr. G. F. Belling, of Little Ilford, Essex. Instead of a drawhook the patentee uses a flat piece of iron,

FIG. 1.

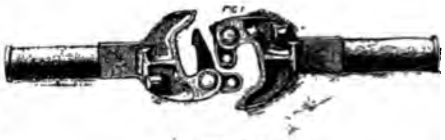


FIG. 2.

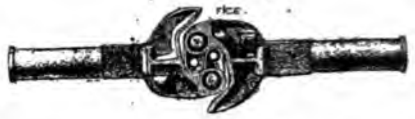


FIG. 3.

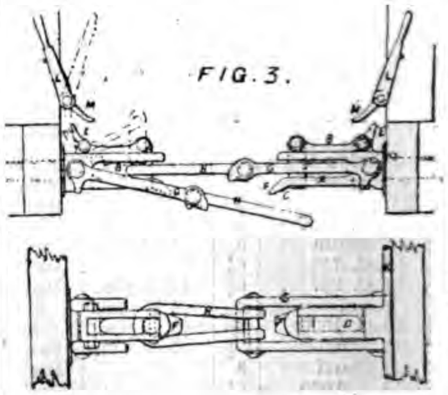
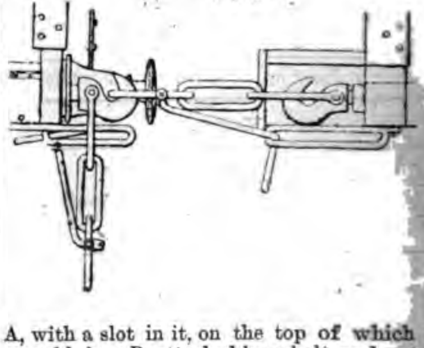


FIG. 4.



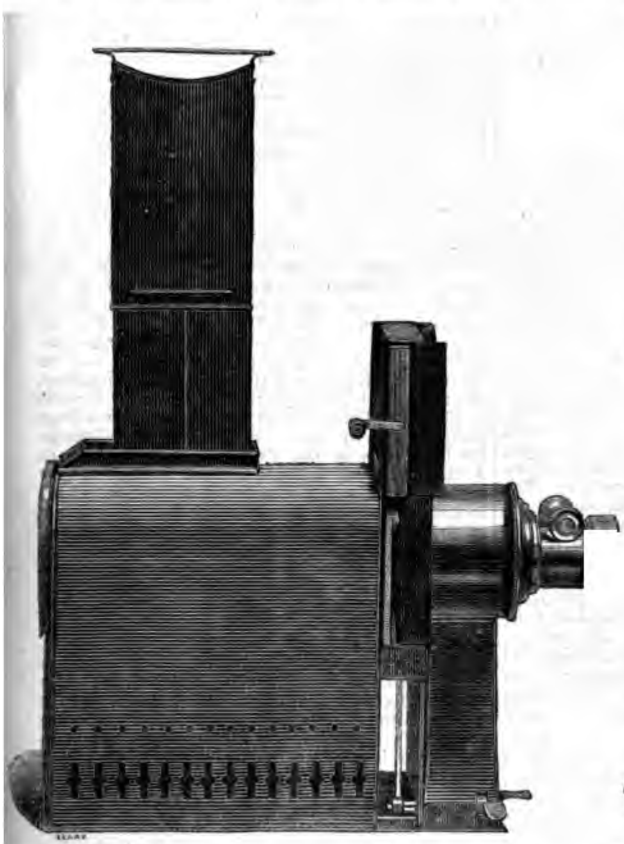
A, with a slot in it, on the top of which is a movable bar, B, attached by a bolt and nut, and carrying a swinging-pin, C, which passes into the slot, D. The lower part of A is slightly curved, as shown at F, so that the free end of the double-shackle, H, may slide into the slot and drive the pin C before it until it passes clear and the pin drops behind the shackle, completing the coupling. It will be seen that there is considerable play in the coupli itself, and the parts accommodate themse within tolerably wide limits to the va height of the waggons. Uncoupling is plished from the side l connected to M, which] the bar B, thus withdra coupler is of the loos of which were select Buffalo Convention.

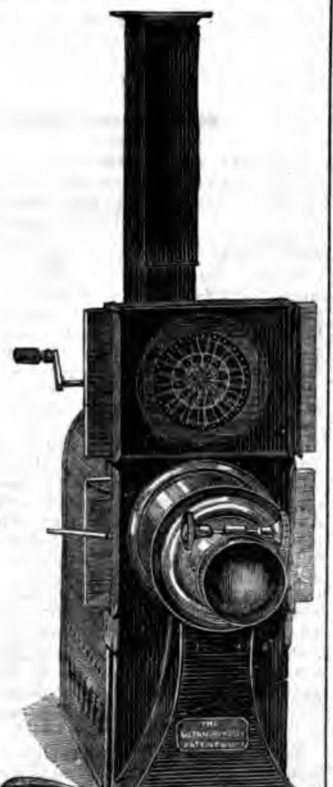
automatic coupler actuated from the side. As will be seen, the shackle is connected by a bar or link to a rod which is operated from the sides of the waggon by a handle, so that the shackle can be readily guided on to the hook. The device illustrated is one of many of a similar kind, and was patented by Mr. Davies, of Amherst-street, Fallowfield. This type offers little inducement to railway companies, as although loss of life would be prevented to a certain extent, no time would be saved in coupling or uncoupling except that which may be lost now in getting under the buffers. Not one of the twelve selected for further trial in America is of this (the non-automatic) type; all are automatic, and only one, that of Ames, on the fixed-link plan. The tests made were whether the device would couple with the standard link, whether it would couple with its own kind at a slow speed, and also when the two waggons were brought sharply together, and finally, whether it could be set not to couple. The first series of trials were made on a straight, level bit of road; the second on a curve, having a radius of 282ft., and with the centre of the draw-bar of one waggon 3in. above the corresponding point in the other. Out of the forty-two different couplers tried, many failed completely in the second series of tests; but the fact that the committee were unable to decide definitely until the selected twelve have been further tested in actual work shows that the question is one not easily settled.

THE "METAMORPHOSER" LANTERN.

MESSRS. JOHN WRENCH AND SON have just introduced a new lantern, which, they claim, is a great improvement on all other single lanterns.

The great advantage is, that by means of a double changing stage, working vertically, any framed slides (such as rackwork, lever action, changing comic, &c.) can be shown with one antern one after another without any interval, ms doing away with the unsightly appear- cf the white disc of light seen on the changing the slides in the stage le lantern. Another ad- lantern any mechani- a l





placing the mechanical slide in the bottom stage and raising it when required into position, and then lowering the stages again to their former position, without having, during the change, shown any white light on the screen, which is impossible to do with an ordinary single lantern. The double sliding stage is raised and lowered by a lever, which enables the operator to either raise it slowly, so as to make the slides exhibited appear like a panorama, or to raise it so quickly that the change from one slide to another is almost imperceptible.

This lantern is fitted with a 4in. compound condenser, mounted in brass cell (2 plano-convex lenses), and a ¼-plate portrait lens front, with special large size lenses to the back combination (thus giving greater light) and double pinions to the rack adjustment. It has also a new 4-wick lamp, with wicks 2in. wide (placed to form two wedges, thus W, this preventing the flicker of the wicks, seen on the screen, when they are placed parallel to one another), and a tall jointed Russian iron chimney, with a large oil-can and filler.

The oil-can, when not in use, fits into the chimney, and the chimney then slides into the lantern body underneath the lamp, thus making the box in which the lantern is packed as small as possible (size, 15 by 11½ by 6).

A WARNING TO DRY-PLATE MAKERS.*

THERE is a matter of the utmost importance to photographers, which we think it well to bring forward at this particular time. It has regard to the amount of emulsion which is spread on plates, and perhaps our remarks may bear more directly on the work of the plate-maker than on that of the actual photographer.

It is well known that a film of a certain thickness is necessary, if it be desired to obtain the best results. This is necessary for two reasons: in the first place, it is necessary that there should be sufficient silver in the film to form the high-lights of the image after reduction. Indeed, it is necessary that there should be some margin in this matter, otherwise there is liable to be no distinction in density between the few points of very sparkling brilliancy, which go more to make a picture than almost anything else, and the lights, which are a little less brilliant than these. Both will be represented in the print as one tint *approaching* to white, or, if the negative be intensified, both will be shown quite white. In either case the effect is very bad; in the first case there is loss of brilliancy, in the second case there results hardness. It may perhaps be said that the best result possible is not produced on a plate unless the film is so thick that there is no appearance at all of the developed image on the back.

In the second place, it is necessary to have a certain amount of opacity in the film to prevent halation, which is produced chiefly from reflection from the back of the glass. It is all very well for plate-makers to point out to photographers that this difficulty can be overcome by backing the plates. Photographers will *not* back plates for ordinary work.

A good way of testing if the thickness of a film is sufficient to give the required opacity is the following:—The film is wetted, and the plate is placed between the observer and a bright gas or lamp flame. If the film is thick enough, the shape of the flame will not be seen through any part of it; in other words, it (the film) will be translucent, but not transparent. Of course, the actual plate experimented on will be spoiled, but the destruction of one plate is a small matter if it will enable the photographer to determine whether he will be wise in purchasing a batch of plates or not; and if he desires to try several, he may use any safe artificial light in which no diffusing medium is used; in which, that is to say, the flame of the light is visible. But with the safest light possible, the examination must be very rapidly performed if the plates are sensitive. They must be held near the light, and at the best the test is not so searching as with an uncovered light. Of course, the plates used may have received an exposure, and the test may be performed immediately before development, so that there is no waste. Plates which show a flame as described should be rejected, much more those which show the shape of the flame through the film whilst it is dry.

We have so far pointed out the evils which result from the use of plates too thinly coated, and the readiest way of judging of a film whether or not it is thick enough; and now we have to make a somewhat serious charge against plate-makers in general. We have no hesitation in saying that the *average* opacity of the films of plates in the market has greatly fallen off during the last few years. One cause of this is doubtless to be found in the fact that the average *sensitiveness* of plates has, during the same few years, considerably increased, and that, therefore, the opacity has decreased, apart from any reduction in the amount of silver used. Every one who has experimented with emulsion knows that, as a rule, increase of sensitiveness means decrease of opacity and covering power.

But we fear that this is not the only cause; that besides this there has been an actual tendency to save silver at the expense of the quality of the films produced. This doubtless is due to the keen competion between the manufacturers, and is an excellent example of the evil results arising from the competitive system of production, or, as some economists prefer to put it, the system of production for profit instead of production for use. The temptation to cut down the amount of silver, and then to be able to undersell a competitor in the market, is doubtless great, especially as the effect in the matter of deterioration in the quality of the resulting negatives may not be noticeable in all classes of work, and may not be noticeable at all except to an educated eye.

There are undoubtedly makers of plates who have not given way to the temptation to reduce the amount of silver, who have, indeed, as the average sensitiveness of their plates increased, increased the quantity of emulsion spread on them. We were in conversation with one of these some little time ago, and he remarked to us: "My greatest difficulty now really is to spread a sufficiency of emulsion on the plates. All that will remain on them after the most careful coaxing is not at all too much."

This matter of the thickness of films is one of the greatest importance both to producers and to consumers at all times; but to the producer of films on glass, perhaps it has never been of so great importance as at the present moment, when there seems to be a great probability that glass will in a great measure be superseded by paper. One of the greatest faults showing itself in the case of emulsion on glass, when the film is too thin, does not occur in the case of films on paper. We refer, of course, to halation. We have no hesitation in stating that the introduction of paper films is greatly facilitated by the fact that, taking an average, the present films on glass issued by commercial plate-makers are far too thin. Actual halation, as it is generally understood, does not in all cases arise from thinness of films, but merely a degradation of dark portions where they are near to bright lights, as, for example, in the case of foliage when adjacent to a bright sky. We noticed in connection with the late exhibition the large number of pictures which showed this defect. It is also to be noticed sometimes in the case of portraits, the eyes specially being rendered less brilliant than they should be.

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* From the *Photographic News*.

It would, of course, be entirely out of place to name particular makers here; but we may state that in more than one case a test has shown that not more than half the amount of bromide of silver that was, four years ago, is now used. Our last word is one to plate-makers, warning them that unless they bethink themselves in this matter, they are doing all in their power to aid the enterprising firms who are pushing the sale of paper films as a thing better for negative-making than glass.

PHOTOGRAPHING ON SILK.

AMONGST processes successfully adopted for printing photographs on silk may be noted the following: Dissolve by soaking for about six hours, and afterwards gently heating 10gr. of fine white gelatine in 20oz. of water, and when solution is complete add 45gr. of chloride of ammonium; filter and label No. 1. Make No. 2 solution of nitrate of silver 300gr., citric acid 3gr., water 10oz., filtering as usual. To sensitise the silk, cover it first with No. 1 solution, and after that has dried, with No. 2. A sufficient quantity of No. 1 to completely coat the silk having been poured on, it is spread over the entire surface by means of a canton flannel swab, and is allowed to remain on the silk about two minutes, after which the surplus is removed and the frame set aside to dry in a place free from dust. The No. 2 solution is then applied in the same manner for about two minutes, except that the operation must be performed in a dark or dimly-lighted room. Before printing, the silk is drawn tight over a stretcher, care being taken to remove all wrinkles, and to secure a perfectly flat surface. The negative is then placed in the printing frame, and upon it the silk stretcher. The printing, toning, and fixing are accomplished in the ordinary way, except that print is a little darker than on silvered paper, and toned to a somewhat colder colour. In the *Archiv*, another method for printing upon silken fabrics is given:

From 10grm. to 12grm. of chloride of ammonium, and 6grm. Iceland moss, are dissolved and macerated in one litre of boiling water till the water has cooled down. The infusion, after being filtered, is ready to receive the silk, which remains there for 15 minutes, and is then hung up to dry. The silk is made sensitive by placing it for 15 minutes in a solution of nitrate of silver, 5grm. to 6grm.; nitric acid, 10 minims; water, 100c.c.m. When dry it is laid upon a stiff cardboard, the edges turned over and fastened to the board with gum paper. The directions are, print much darker than ordinarily, wash in several waters, and tone in water, 2½ litres; acetate of soda, 30grm.; chloride of gold, 1grm.; powdered chalk, 1grm.

This solution should be used only 24 hours after its preparation. Tone bluer than the finished picture is desired to be, rinse well in water, fix in hypo, 1 to 5, and wash thoroughly.

HOT-AIR BATHS AT HOME.

THE lamentable death of Dr. Carpenter, by accident in connection with the use of a hot-air bath at home, has not unnaturally given rise to a great deal of uneasines in the minds of patients and their friends in cases where these really valuable appliances have been recommended. It is perfectly natural that apprehension should be aroused, and it is well that an incentive to carefulness should be supplied; but it must not be forgotten that Dr. Carpenter's death was entirely due to an altogether irregular procedure. The safety lamp of his bath being out of order, he extemporised a lamp with common spirit in a gallipot. Nothing could have been more dangerous. In short, the "accident" has no sort of rational relation to the use or misuse of the bath proper. It will, however, be worth while to embrace the opportunity offered for a few words of counsel as to these hot-air baths, which, as a matter of fact, are seldom satisfactorily administered. If we may venture to be dogmatic as well as didactic, it must be said that we have always entertained a strong objection to that form of the bath which involves the patient being in an erect or sitting posture. The hot-air bath is not like a vapour bath. It is not used for the purpose of applying medicaments to the skin, but to produce perspiration, and it is always possible that some amount of faintness or giddiness may be experienced by the bather even when the blanket or tent-shaped envelope is so effectively applied as to prevent the fumes rising to the mouth and being inspired. It is always far better, and we think ought to be a rule, that the patient should be in the recumbent position. With a properly-constructed cradle-head the bed-clothes can be raised and the lamp placed safely in the bed itself, the clothes being well tucked in round the neck and under the chin, so that nothing may reach the mouth. In this way the patient may enjoy the full benefit of a fairly high temperature without the least fear of faintness. There are, nevertheless, certain precautions which ought to be observed, and which are too commonly overlooked. 1. A thermometer with a long stem ought to be so placed that the bulb may be inside the clothes and the indicator-column visible outside. Such a thermometer might with advantage be supplied with the bath. It is always desirable to know the temperature of the atmosphere to which the patient is subjected. 2. The moment perspiration is induced there arises the question—How far ought it to be carried? If the purpose of the bath be to eliminate fluid or any product of tissue-waste from the body, there may be a need for the maintenance of the cutaneous perspiration for some time: but otherwise it is not, generally speaking, well to let the patient remain in the heat for more than ten minutes; otherwise, the result can only be to saturate the bedclothes with moisture, which will begin to cool as soon as the lamp is removed, and after the lapse of twenty minutes or half an hour must place the patient in the perilous position of lying, perhaps sleeping, in a damp bed! We have seen cases in which more harm than good has been done by the neglect of obvious precautions in this respect. A hot-air bath for ordinary purposes is better given in the morning than at night; or, if that be impossible, the patient should be removed to a dry bed with hot blankets. The body-heat can never be safely trusted to keep the clothes, which have been saturated with moisture by a bath, warm after the lamp is withdrawn. It is quite a different matter when the perspiration has been raised by the heat of the body itself. As a rule, the patient should be removed and wiped dry in about twenty minutes after the withdrawal of the lamp—that is, in half an hour from the commencement of the bath. If the perspiration be acid, it is desirable to sponge the surface with hot water, in which about a dessertspoonful of carbonate of soda has been dissolved—say, in a quart of water. 3. If the case be one of rheumatism or gout, it must be recognised that by determining to the skin we are likely to get *increased* stiffness and surface irritation after each bath until the excrementitious material has been thoroughly eliminated. Overlooking this fact, patients, and sometimes practitioners, fail to persevere long enough with the baths, because, as it seems, each bath makes matters worse. These are but a few of the general points worth noticing; but they may suffice to suggest others.—*Lancet*.

Rainfall at Greenwich.—The following figures relating to the mean monthly rainfall at Greenwich Observatory have been compiled by Mr. G. A. Biddell, M.I.C.E., from the returns of 39 years ending with 1879:—The mean monthly fall is 2·06in. = 202 tons, or, say, 45,000 gallons per acre, just over one gallon per square foot. The mean yearly fall is 24¾in., about 2,500 tons per acre, rather more than 10cwt. per square yard, or nearly 13 gallons per square foot. The dryest year was 1864, 16·38in. The wettest year was 1852, 34·01in. The seven dryest years—each below 20in.—were 1847, 1850, 1854, 1858, 1864, 1870, and 1874. The seven wettest years—each above 30in.—were 1841, 1848, 1852, 1860, 1866, 1872, and 1879. The six winter and spring months—viz., December, January, February, March, April, and May—give a fall equal to 10½in., each quarter about 5¼in. The six summer and autumn months—viz., June, July, August, September, October, and November equal 14¼in., each quarter nearly half this quantity. The following are the mean monthly averages given in the order of their rainfalls:—March, 1·42; February, 1·54; April, 1·66; December, 1·76; June, 2·05; January, 2·05; May, 2·07; November, 2·23; September, 2·25; July, 2·40; August, 2·49; October, 2·82. In these, one day is taken from January and one from March, and added to February, thus making them each equal to 30 days. If March is taken as 31 days the fall is 1·47in., and if February is taken as 28 days the fall is 1·44in.

THE longest draw span bridge in the world is being constructed by the Passaic Rolling Mill and Bridge Works, of Patterson, N.J., for the Minnesota and North-Western Railroad Company's bridge across the Mississippi River, at St. Paul. The total length of the bridge will be 1,430ft., the draw being 430ft. in the clear, and will weigh over 500 tons, the material being iron and steel. The machinery for lifting, latching, and turning can be operated by hand or steam power. The turntable revolves on fifty wheels 18in. in diameter, while the drum has a circumference of 76ft.

AN advanced centenarian has died at Auberivesen-Noyans, in South-Eastern France. Widow Giraud claimed to be 125 years old, and, though bent double from age and shrivelled as a mummy, she was sensible to the last. She existed on public charity and the sale of her photographs, and her sole food consisted of soup and brandy.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE opening meeting of the session was held on Wednesday evening, the 18th inst., when the following papers were read:—(1) "The Helm Wind of August 19th, 1885," by William Marriott, F.R.Met.Soc. This wind is peculiar to the Cross Fell range, Cumberland, and is quite local, but very destructive. The chief features of the phenomenon are the following:—On certain occasions, when the wind is from some easterly point, the Helm suddenly forms. At first a heavy bank of cloud rests along the Cross Fell range, at times reaching some distance down the western slopes, and at others hovering about the summit; then at a distance of one or two miles from the foot of the Fell there appears a roll of cloud suspended in mid-air, and parallel with the Helm cloud; this is the Helm bar. A cold wind rushes down the sides of the Fell, and blows violently till it reaches a spot nearly underneath the Helm bar, where it suddenly ceases. The space between the Helm cloud and the bar is usually quite clear—blue sky being visible. At times, however, small portions of thin vaporous clouds are seen travelling from the Helm cloud to the bar. The bar does not appear to extend further west than the river Eden. The author visited the district in August last, and was fortunate enough to witness a slight Helm. He gives a detailed account of what he experienced, and also his observations on the temperature of the air at the summit and base of Cross Fell, the direction and force of the wind, the movement of the clouds, &c. (2) "The Typhoon Origin of the Weather over the British Isles during the Second Half of October, 1882," by Henry Harries. The author shows by means of daily charts that a typhoon which originated near the Philippine Islands on September 27th, passed over Japan and the Aleutian Archipelago, entering the United States on October 10th; crossing the Rocky Mountain Range, it proceeded through the Northern States and Canada to Labrador and Davis Strait. In the Atlantic it was joined on the 18th by another disturbance which had come up from the Atlantic tropics, the junction of the two being followed by a cessation of progressive movement from the 19th to the 25th. During this period the severe gale which passed along our southern counties on the morning of the 24th was formed; its sudden arrival upsetting the Meteorological Office forecasts of the previous night. Observations are quoted showing that it would have been impossible for the department to have been aware of its existence before about 3 a.m. of the 24th. Following in the wake of this storm the parent cyclone reached the French coast on the 27th, its advent being marked, as in Japan and America, by violent gales and extensive floods over the whole of Western and Central Europe and Algeria. The village of Grindelwald was destroyed, and in the Austrian Tyrol the damage caused by floods reached at least two millions sterling. Passing through France and the Netherlands, the disturbance showed signs of exhaustion, and on November 1st, in the Baltic, it quietly dispersed, after accomplishing a journey of over 16,000 miles in 36 days. This is the first storm which has been followed day by day from the Pacific to Europe. (3) "Notes as to the Principle and Working of Jordan's Photographic Sunshine Recorder," by J. B. Jordan and F. Gaster, F.R.Met.Soc. This instrument consists of a cylindrical dark chamber, on the inside of which is placed a prepared slip of photographic paper. The direct ray of sunlight being admitted into this chamber by small apertures in the side is received on the sensitised paper, and travelling over it by reason of the earth's rotation, leaves a distinct trace of chemical action whenever the light is of sufficient intensity to show a definite shadow on a sun-dial. The cylinder is mounted on a stand with adjustments for latitude, &c. The record is fixed by simply immersing it in water for a few minutes. As this instrument records the actinic or chemical rays it usually shows more sunshine than is obtained by the ordinary "burning" sunshine recorder.

THE population of Paris is decidedly decreasing. This autumn there are nearly 115,000 fewer inhabitants of the French capital than four years ago, and this diminution bears heavily on the cab and omnibus companies. Apparently the chief absentees are the foreign residents, and the poorer working-class, who can get food and house-room cheaper outside the city.

M. A. AUDOYNAUD, referring to the adulteration of olive oil intended for consumption b[illegible] addition of sesame cotton, and other oils ex- [illegible] from seeds, says that bichromate [illegible] nitro-sulphuric acid are useful [illegible] ing these sophistications.

SCIENTIFIC NEWS.

THE Dun Echt Circular No. 99, calls attention to the desirability of watching the path of the meteors which were seen to radiate from near Gamma Andromedæ on Nov. 27, 1872. It is not impossible that something may be seen which will serve to determine the fate of Biela's comet. To-day (Friday), and for a few following days, careful watch should be kept, if the weather is favourable. The Circular points out that the comet's periodic time, and presumably that of the meteors, being about 6·6 years, nearly two periods will have elapsed since the meteoric shower of 1872. If, therefore, the meteors are very widely distributed along the comet's orbit, there is a chance that they may again appear in considerable numbers this year. In 1892, and still more in 1905, there is a probability of a return of the display of 1867.

Prof. E. S. Holden has been elected President of the University of California, and Director of the Lick Observatory. He has been the practical director of the work in connection with that observatory since 1881, and he will resign his appointment as director of the Washburn Observatory on Jan. 1 next.

The California University will be located at Palo-Alto, thirty miles from San Francisco, and will be endowed by Senator Stanford with property and money to the amount of £4,000,000 sterling.

The Cantor Lecture at the Society of Arts on Monday next will deal with modern microscopes, Mr. Mayall, jun., describing their peculiarities of construction, and making special observations on the various forms.

According to *The Times*, " A decided departure from the practice hitherto followed in the construction of electric engines for working tramways has been introduced in an electrical locomotive which has been built for the North Metropolitan Tramways Company. Instead of the electric motor being a fixture and having motion transmitted from it through belt gearing to the wheels of the car, the motor itself revolves, the motion being transmitted through bevel gearing." The facts are, that the motor is built to the designs of Mr. Elieson, that one part of it revolves, as is the case with other motors, and that all the North Metropolitan Company have to do with it, at present, is giving permission to the Electric Locomotive and Power Company to use the lines between Stratford and Aldgate for private trials after ordinary traffic has ceased. The locomotive carries 50 E.P.S. cells, which are said to be equal to 280 ampères.

At the opening meeting of the Session of the Dublin Philosophical Club, a paper on the marine fauna of S. W. Ireland, was read by Prof. Haddon. Mr. J. H. Stewart, B.A., read a paper entitled, "Earth to Moon," the object of which was to show how, by the application of the theory of potential, many dynamical problems may be simplified. Mr. G. Stoney described a method of showing the neutral axis in iron bars. One surface of the bar is coated with a brittle varnish, and when that is dry the bar is bent; the varnish then flies from all parts except a line coincident with the neutral axis.

Mr. William A. Eddy, of the American Signal Service Bureau, calls attention to the fact that the study of the phenomena of tornadoes has advanced so far that predictions of the appearance of these terribly destructive agencies can be made with a considerable degree of accuracy. Of thirty-eight predictions that tornadoes would occur in April and June of last year eighteen were verified; of nineteen predictions in June and July of this year, fifteen were generally verified; and where regular tornadoes failed to arrive, violent wind and hail storms partially fulfilled the prophecy.

At the meeting of the Royal Meteorological Society last week, Mr. H. Harries read a paper, in which he traced a typhoon from Manila to the British Isles during the second half of October, 1882. The author says, "this typhoon was the principal contributor in making Octo- [illegible] by far the worst within living [illegible] ding to his calculation, the [illegible] er 14,000 nautical [illegible]

Major-General Hutchinson, reporting on the accident at Warwick-road Junction, when a District train came into collision with a Great Western train, owing to the failure of a signal rod, recommends that the arms of signals should be so balanced that when even a connecting-rod gives way the signal should spring to danger, "in accordance with the long-established requirements of the Board of Trade." What is the exact value of the "requirements" of the Board of Trade it is difficult to say; but there cannot be a doubt that all signals should fly to danger when any portion of their fittings is out of order.

Dr. Dupré has recently published some account of his investigations into a new method of water analysis, which promises to supply a much-needed means of discovering the presence of micro-organisms. It will be remembered that the late Dr. Angus Smith tried to settle the point by measuring the evolved hydrogen, while Dr. Koch tries to make the living organisms visible by feeding them with gelatine. Dr. Dupré ascertains the presence of organisms by measuring the amount of oxygen absorbed. The water from the Trafalgar-square well, which, according to the chemical test is practically pure, was shown to lose about 30 per cent. of dissolved oxygen in ten days: that is, that amount had been consumed by the invisible organisms. A water containing organisms must be looked upon with suspicion until we are enabled to determine whether those organisms are malefic or harmless.

Mr. A. B. Sawyer, an inspector of mines, recently read a paper before the North Staffordshire Mining Institute, in which he estimated that the temperature at the depth of a mile from the surface will be about 122° Fahr., and that long before that temperature is reached it will be necessary to use compressed air for cooling and ventilating the workings. The compressed air will then, we presume, be first utilised in driving machines for breaking down the coal.

The Havre Town Council have voted the sum of £40 to M. Pasteur as a contribution towards the expenses of his philanthropic investigations. Meantime someone has unearthed the fact that so far back as 1849, the usefulness of inoculation with rabies-poison, as an antidote and preventive against the effects of bites by mad dogs, was discussed in Jahr's *Klinischen Anweisungen*, in the articles on "Poisoning" and "Dog-Rabies." Constantine Hering, a physician then living in Philadelphia, is there mentioned as having actually made use of this remedy.

At Great Glen, near Leicester, last week, Mr. Stretton delivered a lecture on "Practical Railway Working," illustrated by diagrams and models. One of the models is 9ft. long, having a pair of lines with points, signal posts, and interlocking apparatus, with a locomotive and train fitted with a continuous brake. One of the waggons has an improved coupling, showing how vehicles can be coupled and uncoupled without going between the buffers.

Owners of coupling appliances who are desirous of bringing their inventions under the notice of the Amalgamated Society of Railway Servants with a view to a practical trial, are requested to communicate with the General Secretary, 306, City-road, E.C., without delay.

An archæopteryx has been found in a quarry near Solenhofen, and has been sold to the Berlin Museum for £1,000. The skeleton is quite perfect, and is on a slab 18in. long by 15in. broad.

What small-pox can do in an unvaccinated community is seen by the returns from Montreal. A telegram last week reports a total mortality of 2,641—2,404 being French Canadians, and of those 1,600 were children under five years of age.

IN the German and German-speaking universities, by far the largest medical faculty is that of Vienna, which has 18 professors, 34 extraordinary professors, and 82 privat-docents, making 134 teachers, the number of students being 2,307. Next comes Munich, with 13 professors, 7 extraordinary professors, and 22 privat-docents, making 42 teachers, the number of students being 1,129. After this comes Berlin, with 1,072 students, and no less than 100 teachers. The smallest of all appears to be Rostock, with 11 teachers and 92 students.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

NOVA ANDROMEDÆ.

[25031.]—NOVA Andromedæ seems quite gone in a 6in.—no trace to be seen. Mr. Ward is quite right. Figure in Guillemin is misplaced and non-telescopic. Upon closer examination does not compare well with Smyth except as to one star group.

J. Rand Capron.

Guildown Observatory, Nov. 17.

COLOUR OF THE NEW STAR IN ANDROMEDA.

[25032.]—AS I was the first to direct attention in these pages (letter 24822, p. 99) to the variation in colour of the Nova, I feel it incumbent upon me to make a few remarks upon Mr. Woodside's letter (24992, p. 221) in which he states that the new star has always had a greenish tinge. I can only say that Mr. Brooks (letter 24850, p. 121) and he appear to be the only two observers who ascribe a greenish colour to the Nova. No observer on this side the Atlantic appears to have noticed it of that colour, though several—Dr. Copeland, Mr. Denning, Dr. Huggins, and Lord Rosse, for instance—agree as to its having been of an orange or yellowish colour when it first made its appearance.

To account for those observers seeing it of that colour, Mr. Woodside assumes that they must have observed the star too near the horizon; of course, it is possible that that may have been the cause in some instances; but whether it is probable or not, I must leave for those observers I have mentioned to say for themselves. Speaking for myself, I may say that I have always observed the star when at a good altitude, and near the meridian, and I can most positively affirm that the star's colour was decidedly *yellow* (I cannot say red) on Sept. 3rd, and that it has since changed to a *bluish* tinge; for confirmation of which I am pleased to be able to refer those interested to the letters of our friend Mr. J. Rand Capron (24797, p. 79), Mr. Tarrant (24906, p. 158), and Mr. I. W. Ward (24879, p. 138), from which it will be seen that the greenish colour spoken of by the American observers above referred to is probably due to their instruments or a physiological effect. **B. J. Hopkins.**

Forest Gate, E., Nov. 17.

CIVILISATION IN URANUS.

[25033.]—WITH all deference to the "F.R.A.S." (p. 238), I must submit that though the form of a double stellar orbit and its inclination to our line of sight be ever so accurately known, this is not determining which of the two planes so inclined to right and left is the plane of the actual orbit; in short, though the two points are known at which the revolving star is nearest to and furthest from us, we cannot tell which of these is which. For the satellites of Uranus, this can be, and doubtless has been, found by means of our own annual motion, which, however, applied to the case of Neptune, cannot be a tenth so effective.

I have never seen it remarked that the position we are forced to ascribe to the axis of Uranus makes him, even out there, as likely to be jolly habitable as any planet known. All inhabitants must migrate once in forty years from one to the other of their two homes on the poles. They have warning when the sun sinks enough to begin to touch the horizon, but need not muffle up and start till the lengthening, though short, nights begin to be chilly. Crossing the vast, icy wilds, where sun dipping and rising are constant they have not only the nightly sight, like us, of the stars, but the quite novel one of moons, never seen at home. They can so time their journey that the equinox, coming just when they cross the frigid line, is the only time they need have a single night as long as day. Then, pushing on but a thousand or two of miles further, they regain constant sun, and in 20,000 more their other polar settlement, already the sunniest and soon most fertile region.

After 40 years of daylight, the sun's dipping will again warn them to prepare for migration. Even the 360th of our strength of sunshine, constant, if there are no London fogs, cannot be gloomy.

If there happen, as is very likely, to be no land, but only sea (say of alcohol, or of naphtha), of course all are swimmers; but this need not hinder their getting, in fishbone or something else, material to build far better planned cities than ours; and better ships, steamers, and dynamo-engines. Though our earth, however, is the very biggest body we can find likely to have any solid mineral crust, there may elsewhere be vegetable lands and continents; or, indeed, almost any oddity, conceivable or not.

Nov. 20th. **E. L. G.**

A 2in. APERTURE.

[25034.]—I MUST premise that in what follows I have no claim to any authority. I speak simply of my own opinions and experiences. As I do not possess a 2in. achromatic, my ideas are mostly derived from the result of a 2in. eccentric stop upon a larger aperture. I know this is usually regarded as an unfair procedure.

We are told that 2in. out of the centre of an o.g. is better than any 2in. o.g. can be; but, to me, this is simply a proof that the 2in. falls short of attainable perfection. With a mirror and an eccentric stop clear of flat and supports, a clearer image will be obtained, of course, than with any aperture where the flat is in cone of rays. Diffraction phenomena must take place at edge of flat mount, and at the edges of supports, and the greatest attainable perfection in a reflector will only be arrived at when mirrors are so made that the flat is at one side of the incident cylinder of light, and completely clear of it. Superb definition is thus obtained, the image of a star being clear of all surrounding rays, and so clear—it is difficult to believe in any possible improvement.

I regard the use of a 2in. aperture, except for special purposes—where one has larger aperture—as simply waste of time. Much can be seen with a 2in. that cannot be seen without it; but it is hardly fit to call an astronomical telescope at all, and ends, to quote Mr. Gemmill in using it, "in prolonged endeavours to see what is beyond reach," and to "spending time and energy to no purpose."

A good deal may be done with the sun with 2in., the spots, faculæ, and spectroscopic observations being easy; but it will not show the stippling of the disc. A large aperture is generally useless on the sun, since the boiling of the atmosphere prevents high powers being used, except occasionally, and light is always superabundant.

All the features of the moon, except minute ones, can be made out with 2in.; but such an aperture will not show the minute detail, nor enable its owner to make such beautifully detailed drawings as those of Mr. Gwyn Elger; nor can it afford satisfactory evidence of changes on the moon's surface.

Of Venus, it will show the phases. I have seen nothing else; but, on the testimony of numerous observers, it will exhibit a variety of spots upon her disc, and the serrations of the terminator caused by the mountains; and also, if an achromatic, probably show a satellite. All these will probably disappear on recourse to a larger aperture, especially if a reflector.

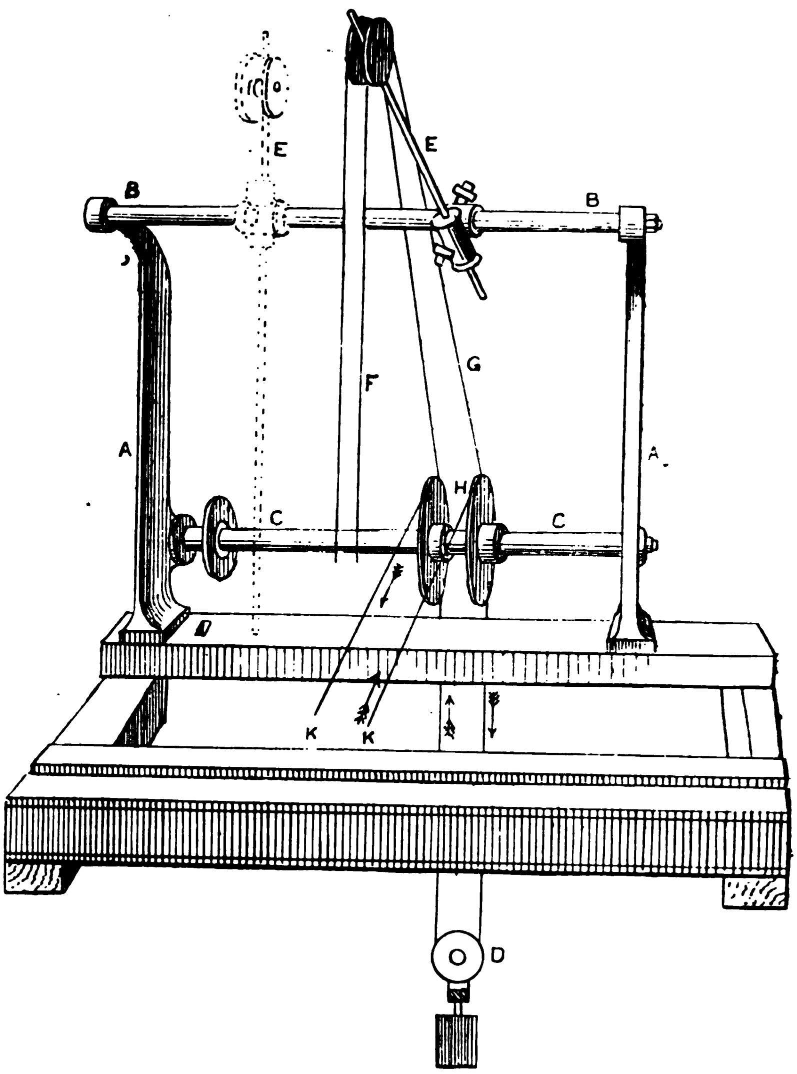
With Mars it will do nothing, except a small red, not well-defined disc.

It will show the satellites of Jupiter, but not raise discs on them; the belts, but no detail further. The shadow transits, and possibly transits of the satellites when dark transits take place. How far it is advisable to waste time endeavouring to catch these, I leave others to decide.

It will show certainly two satellites to Saturn—uncertainly, according to the imagination of the observer. With the same assistance, Cassini's division may be seen all round, and Encke's in the ansæ, with possibly two or three more. All this detail, except the principal division in the ring, becoming less and less visible as the aperture is increased. The crape ring may be seen at times.

The *comes* to Polaris and the 43″ *comes* to Vega can be seen with 2in. aperture; ε^1 and ε^2 Lyræ can be—one divided, and the other nearly so. I have not seen the debilissima with 2in.; but with long looking and much pretending it might, perhaps, be accomplished. The *comes* to Aldebaran can be seen. γ Leonis easily divided, so is ε Boötis; and a variety of stars to be found in Webb. But 2in. aperture will not discover any pairs under 1″ apart, nor 2″ either; it will not show very faint *comites*, it will not discover any new ones whatever, and it will annoy the owner very much in his vain endeavours to see and to glimpse objects which require a larger aperture, and he will have to do so much averted-vision, that not unlikely he will get a permanent squint.

Mr. Gemmill was wrong in his statement that I asked space to comment on this question, and then did not. I asked to comment on his letter, which I did. I think every other observer will agree with my statement which excited his wonder if I ever tried 2in. aperture.



I am much obliged to Mr. Franks (letter 24937) for the assurance of his readiness to give me assistance after my "covert insinuations," "unkind and ungentlemanly" behaviour, "cold-blooded and cynical manner, suggestive of gall and wormwood," and "carping hypercriticism," which "wounds without convincing" him. I am glad to learn, after these Parliamentary expressions, that Mr. Franks has "taken no offence"; but I cannot say I admire the "good-tempered friendly spirit" in which he has inaugurated "the higher tone of courteous discussion" he so much desires. This claim for courtesy is a two-edged weapon; but without venturing further into personalities, I feel called on to deny that I was at all wanting in courtesy to Mr. Franks except that I was uncourteous enough to differ from him, and to prove I was right. This is "gall and wormwood." I shall not write another word on this matter; but I ask for the insertion of this, after Mr. Franks's covert insinuation.

Edwin Holmes.

LATHE OVERHEADS.

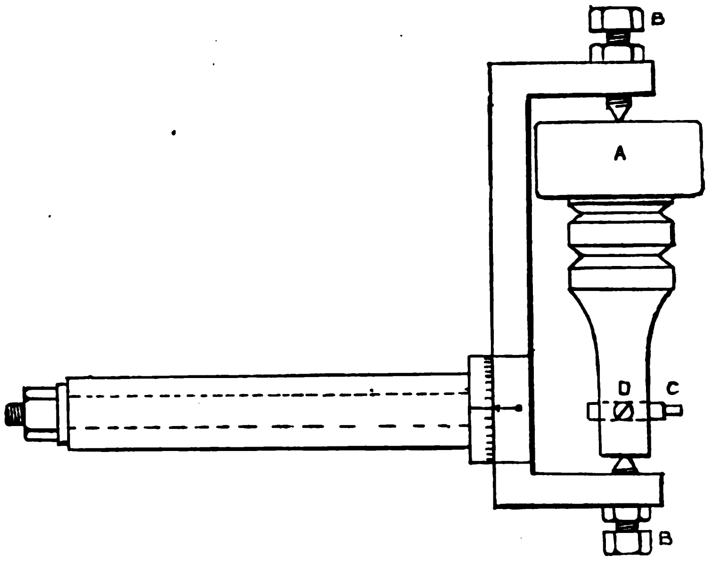
[25035.]—WE have had a few chapters on overhead gearing. As I have had some little experience with various forms of this necessary adjunct to the lathe, may I be allowed to describe my own? I do not claim to advance anything new exactly, but the one here illustrated is unlike any I have seen. It is a combination of the best points that have presented themselves in the many forms that have come before me. Your space shall not be wasted, so the description shall be as short as possible, leaving the sketch to tell its own tale.

On a plank 6in. by 2in., fastened on to the back of the lathe-bench, as shown, are bolted two cast-iron uprights 20in. high, marked A A, which are braced together at the top by a turned steel bar ¾in. diam., B B. This bar has a groove ⅛in. square cut its whole length. Between these standards a turned steel spindle 24in. in length runs in steel centres marked C C. This spindle or shaft has a groove cut into it like the bar above it. At the left hand it carries a 4in. hard wood pulley keyed fast opposite to, and driven by, the lathe flywheel. On this same spindle run also two pulleys 6in. diam., H, the left-hand one of wood bushed with brass, not keyed, but a sliding fit; I will call it the idle pulley. The one on the right is cast . keyed on, but allowed to slide laterally with e I will call this the driver. The top of t pulleys is about level with the lathe centres, wl by the way, are not shown, in order not to c load the sketch. E is an adjustable jib, wher in use shown by the dotted portion. As a m of fact, this jib is only used with the ornam drill and eccentric cutter when their axes ar parallel with the lathe-bed. In every other the driving cord is brought straight across lathe-bench, as at K K. The pulley at D is diam., and is used for the purpose of keepin endless band taut. A very light weight su The cord, of course, drives the idle pulley in reverse direction to the driver. A word as to driving cords. I have them of spliced whip soaked in neatsfoot oil, and rubbed with fi bow resin, and beautifully they run. Two len are requisite, as will be perceived: the one fo short lead, the other when the jib is being use

I have used this form of overhead now time, and I believe it to be the most efficient there is. The lathe-bench is perfectly steady it is in action, even at its greatest speed, the w of the moving weight being so low down. I recommend it to those interested as being a excellent arrangement. Any question readers may ask as to its details I will willi answer. I forgot to say that the groove in top bar is to receive the end of the tightening sc Please note, Mr. Editor, that the real thin very much better than the sketch. I am a efficient turner than draughtsman. **Trebo**

LATHE OVERHEADS AND CUTT WHEEL TEETH.

[25036.]—AS we should all regret that "F. A should cease to send his contributions on "I Matters" because he appears as a solitary spondent, I write a few lines to keep him Having worked with a variety of overh the preference to the arrangeme "F. A. M." in Figs. 1 to 4, page 1 for October 23rd. This is ad- lathe, which I constantly use grooving, &c. For this purp more than the one gut band l



foot wheel. In my arrangement the shifting guide pulleys above on the swing bar are set within stirrups, so that the gut cannot fly off. The lower guide pulleys are set on a shifting standard, which can be conveniently clamped in any required position on the lathe-bed below. Both the upper and lower guide pulleys swivel, so as to be set in a proper direction to suit the run of the gut band.

In Mr. Walz's lathes special attention has been given to milling arrangements and wheel cutting in metal to suit the requirements of mechanicians, and, as will be seen by Fig. 7 given by "F. A. M.," the method of driving the cutter spindles allows a strong gut to be used under great tension with an entire turn round the driving pulley, thus enabling a heavy cut to be taken.

If only a few wheels require to be cut having a special form of tooth, it is a troublesome and tedious job to make a circular wheel cutter for the occasion. A fly cutter, consisting of a single cutting edge, is very readily formed, and, if properly used, will cut an immense number of teeth without needing any alterations; but if the force required for the cut is derived from the direct pull of the gut band, the elasticity of this gives a jerking action, which will allow only very light cuts to be taken. I have, therefore, made my cutter spindle very heavy, so as to act as a flywheel by storing up the force in an entire revolution, to be utilised in the short period of the cut.

My arrangement is shown by the accompanying figure. A is the body of the cutter spindle, consisting of a block of steel weighing 18oz. Hardened steel plugs are driven in the ends for the hollow centres for receiving the conical points of the hard centres of the screws, B B. C is the cutter, set in a hole drilled transversely through the spindle, *a*, and held fast by the side screw, D. This part of the cutter spindle is ¼in. diameter for the purpose of obtaining a substantial cut, as taken from a short radius. There are two-sized V-grooves for the guts to run in, shown just below the head of the spindle. This heavy spindle enables me to take a clean cut without any chattering. The frame that holds the cutter spindle is of the usual description, with the hollow stem and divided rim for setting at any angle for oblique cuts, and which also serves to cut grooves wider than the cutter by inclining the spindle more or less.

F. H. Wenham.

LATHE MATTERS.

[25037.]—The letter of "A., Liverpool," in reply to "H. C. B.," contains also some strictures upon a recent paper of mine, which I will not attempt to controvert, as there is evidently an advantage quoad accuracy in squaring side 4 from side 1, instead of from 3. But, at the same time, if the square itself is inaccurate, the result will be the same whichever method is followed—i.e., I mean the result will also be inaccurate. Still, the error will not be multiplied. But with regard to the general accuracy of the tool, I have just tested my ordinary plated square, made by Buck, and find it quite satisfactory, even if not absolutely—i.e., mathematically—true; and the result of squaring a piece by its aid, even following the sides in the order 1, [illegible] 4, would be, and is, quite accurate enough [illegible] purposes of carpentry. A very [illegible] lay it upon a surface plate, [illegible] truly planed edges, and [illegible] the flat of the plate [illegible] steel square, which I bought for accurate metal work, and it is equally satisfactory. I think, therefore, I can square up a bit of wood quite accurately enough for all ordinary purposes of carpentry in either of the two ways in question. Very probably I should need to correct all the sides if the job was a particular one, because, unlike a professional carpenter, I use the turning tool oftener than the plane, and I might not obtain as good a result as the professional would do in the safer way of setting off face 4 from face 1. Although, therefore, I quite agree that "A., Liverpool" is right as to the proper method, I think that a tool made to test the accuracy of work ought itself to be accurate, and if it is not the workman should correct it. The fact of the case is this, that if the tool is untrue you have to make a compromise in any case, and you do not eliminate the error by taking 1, 2, 1, 4, although you do somewhat lessen it. What I plead for, therefore, is accuracy in all tools by which accuracy has of necessity to be tested, so that a workman may, e.g., lay his square either side up, and strike the same line by its edge. Even a trained carpenter, after framing up a door or similar work, finds it necessary to rectify errors by a few final strokes of his plane, and, in his case, such errors are probably due to faulty tools. But after such final strokes have been given, he has probably introduced fresh inaccuracies by partly unsquaring, if I may coin a word, the styles or the rails which he had squared-up so carefully at the onset. Nevertheless, he has done his work in the best way—the way which experience has proved to be the best—and any such slight inaccuracies are of no practical importance, as they neither interfere with the strength nor with the general appearance of the work. I never did, or would, pit myself against a professional, and if only the latter would more frequently come to the fore with pen and ink, there is no reader of the English Mechanic who would more eagerly devour the information thus rendered than

O. J. L.

[25038.]—I notice in your issue of Nov. 20th several inquiries which may be very briefly answered, and for convenience I group them all under the above heading.

First, I notice that H. Rey (25018) has designed a fly-wheel for his lathe which he believes will be inexpensive; I don't think he will find it so, however. Also he labours under the mistaken impression that mere difference in total weight of fly-wheel is what must be rendered adjustable. Now, it is not the *total* weight but the position of the added weight which gives increased momentum to a fly-wheel; in other words, the weight and diameter of the wheel determine its inertia. It is no use putting the added weights in the centre of wheel. Probably H. Rey's best plan would be to procure the lightest possible speed-wheel, of diameters so proportioned as to embrace the whole range of work he is likely to undertake; then, if added momentum were desirable at any time, it would be best secured by a plain flywheel on his crank-shaft *outside* the right-hand standard if the shaft will allow of it, and as I understand he has not yet made his lathe stand.

The wheel mentioned by "A. Liverpool" (57734) is a very useful size, and leaves nothing to be desired. A difference of opinion will probably always exist respecting the advisability of balancing fly-wheels; I can only say that I infinitely prefer a [illegible]rately-balanced one to one that has no coun[illegible] to the treadle. Is not "A., Liverpool" [illegible]ugh" on squares in general? I hope for of the family he is referring only to carpenters' squares. I don't think I quite know what he means by a "connecting-rod" for his crank-shaft in lieu of chains. Does he mean a sort of hook or pitman lined up with hard wood; a hard and fast connection between the crank and treadle is not advisable, certainly.

I wonder whether I can help to "darken counsel" in the matter of trains of wheels for screw cutting; it is just about the simplest thing in the world to do, but somewhat difficult to explain lucidly, perhaps.

The leading screw has two threads to the inch—add 0 to it = 20.

The screw to be cut is (say) eight to the inch—add 0 to it = 80.

There are the two wheels required then; 20 on the mandrel, and 80 on screw. You can put any size wheel you like in between.

But suppose you want to cut 16 to inch, and you have not got 160 wheel, then you must make your 20 wheel gear into (say) a 60 wheel, and this 60 is keyed on the same sleeve as a 30 wheel; now let the 80 wheel on the screw gear into the 30 wheel; this has the effect of halving the number of revolutions of the leading screw and, consequently, *doubling* the number of threads cut.

In reply to "T. H. C." (58040), I would recommend a V-grooved pulley with (say) four speeds, and a corresponding flywheel, with a largest diameter of 26in., and a couple of extra speeds for slow metal work, about 14in. and 18in. respectively. He will thus be enabled to do a large range of work. I would not recommend a wood pulley to be used with a gut band; they soon wear very much out of truth; it is rather a different matter with flat speeds for belts—such wood pulleys are more "lively," I think. It is not necessary to have either friction wheels or coned points for the crank-shaft to run on; it is scarcely possible to improve upon the very simple method of turning the ends of the shaft down to run in cast-iron bearings; in the case of iron standards they can be bored to suit the shaft; you can case-harden the ends of the shaft with advantage. By the bye, do this with *red* and not yellow prussiate of potash.

To mortise, &c., in the lathe, requires a different tool to that which G. Stock (58046) has been using. I could show him one, or send him a wood model, if he will advertise his address. I would send a drawing, only I don't suppose it would be of such general interest as to warrant the engraving of it.

W. S. Brown.

INDUCTION-COIL ROTATION—ELECTRICAL TOURNIQUET.

[25039.]—Under these titles M. de Fonvielle's "Electro-magnetic Gyroscope" has lately been brought into notice by several of your correspondents. As a help to the explanation of its curious phenomena, I beg to give your readers a brief account of certain experiments I made with it when it was first published about four years ago. My instrument consisted of a disc of soft iron (stout sheet "tin") about 4in. diameter, balanced on its centre within a flat coil of covered wire. When a rapid succession of currents of electricity, alternately in opposite directions, was passed through the wire, and the disc made to rotate in either direction, the rotation could be maintained indefinitely as long as the alternate currents continued to pass. (This experiment was most successful when the alternate currents were equal in duration.) When one pole of a magnet was placed close to one end of the coil, the rotation of the disc could be started by the passage either of an interrupted current in one direction, or of a succession of alternate currents, provided those in one direction were longer than the currents in the opposite direction. If the alternate currents were equal, they could not originate the rotation, but could maintain it when otherwise begun. With the arrangements capable of starting the rotation, a reversal of the direction of the currents always caused a reversal of the direction of rotation. If the coil was placed with its length in the magnetic meridian, a magnet became unnecessary, its place being then supplied by the earth's magnetism.

FIG. 1.

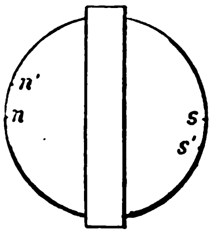
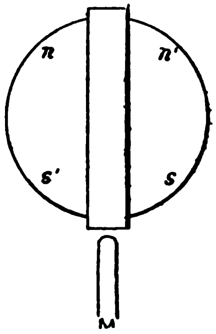


FIG. 2.



My first experiments were made with a small induction coil as the source of the currents. The currents from the secondary wire failed entirely to affect the gyroscope. When the gyroscope coil was included in the primary circuit by attaching its ends one on each side of the break, the apparatus worked admirably while the secondary circuit was kept open; but when this circuit was closed by means of a short wire connecting its terminals, all rotation of the disc ceased. This showed that the effective currents were not those derived directly from the battery (although these I afterwards found to be sufficient when used without passing through the primary wire of the induction coil), but must have been one or other, or perhaps both, of the extra alternate currents induced in the primary wire by the changes of magnetism of the core. When the direction of the battery-current was reversed, that of the rotation was also reversed. This reversal raised the suspicion that the effect was due to only one of the two sets of extra currents, possibly those resulting from the interruption of the battery-current by the opening of the break, as these are presumably the stronger—they are those, at any rate, for which the gyroscope coil was the only available circuit. As, however, it had been asserted that *alternating* currents were indispensable to work the gyroscope, it occurred to me to test experimentally this and some other doubtful matters. Accordingly I devised means whereby the rotating disc was subjected to the following conditions (a magnet being placed at one end of the coil):—

(A) A rapid succession of currents in one direction was passed through the coil with (1) the duration of the currents greatly exceeding that of the intervals of no current, and (2) with the intervals much longer than the currents. In these two experiments the disc was rotated—in the first feebly, in the second actively. In both reversing the direction of the current changed also that of the rotation.

(B) Alternating currents in opposite directions (1) with the currents exactly equal in duration, and (2) with those in one direction longer than those in the other direction. In the first case the equal currents failed to start the disc into motion, but vigorously kept up a rotation in either direction which had been begun by an extraneous cause, as by a touch of the finger. (This differed from rotation maintained without using a magnet in being much more lively.) As might be expected, reversing the direction of the currents while the disc was rotating had no effect. In the second case the disc rotated, and the greater the difference between the two sets of currents (my apparatus enabled me to vary this difference and make it extreme), the more energetically did the disc move. When the long currents were cut out, the disc rotated still faster in the same direction; when the short currents were omitted the disc stopped, and then moved *slowly* in the opposite direction under the influence of the long currents. This greater effectiveness of the shortest currents seems at first singular, but might be expected when we consider that very short currents separated by relatively long intervals is the condition farthest removed from that which exists when an uninterrupted current in one direction is passed through the coil—in which case there is an actual resistance to the rotation of the disc. A succession of long currents, separated by the shortest possible intervals, is a close approach to this latter condition. Perhaps the following may be accepted as a reasonable explanation of the causes of these rotations under the conditions above described: Take first the case of rotations effected without the aid of a magnet; let Fig. 1 represent the disc and coil, the disc being supposed stationary. When a current is passed through the coil, the disc is, of course, magnetised in a direction at right angles to the coil; let *n s* be its magnetic poles. On the current being reversed there ensues a repulsion between the coil and the disc as long as the polarity due to the preceding current lasts. This repulsion, being exerted with equal force in opposite directions, cannot move the disc, which, however, is in a position of unstable equilibrium, out of which it is ready to move on the slightest impulse in either direction. Such an impulse being given carries the poles out of that position (as to *n′*, *s′*), so that the repulsive force can take effect in continuing the rotation. Of course, the original polarity quickly fades, and an opposite polarity is induced by the reversed current; but the new poles are formed in rear of the first ones, and being carried forward by the motion of the disc, they are in their turn driven in the direction of rotation at the second reversal of the current, and so the movement is kept up.

When a magnet is introduced the operation becomes more complicated. In Fig. 2 let *n s* indicate the polarity of the disc due to the joint action of the magnet M, and a current in the coil. While this current continues there can be no movement of the disc, because the poles occupy the position of rest which would be assumed by a compass needle, *were that* substituted for the disc. If now the current ceases, the pole *s* is at once attracted by the magnet, and the disc moves accordingly. A second current in the same direction as the first will develop another pair of poles behind the former ones, and these new poles will be attracted by the magnet at the next interruption of the current.

If currents in the opposite directions are used, the magnetic poles will be formed on the other side of the magnet, and of course the direction of the attraction and consequent rotation will be reversed. It should be here particularly noted that there can be no movement of the disc *until the cessation of the current which has helped to form its poles.* If this is kept in mind, there will be little difficulty in understanding the action of aternate currents. When these are used, each of the two sets forms a separate pair of poles in the disc. If *n s* (Fig. 2) shows the position of the poles (with regard to the magnet M) formed by the currents which pass in one direction, *n′ s′* will represent the poles due to the current passing in the opposite direction. The magnet attracts *s* and *s′* alternately. But the effect of the magnet is *measured by the time during which it acts.* If the duration of the currents is equal, of course these times are equal, and the attractions in opposite directions being consequently equal, the disc does not move, although if the alternations of current are made slowly, a vibration of the disc may be produced, but there can be no continuous rotation in one direction. When, however, the disc is set rotating in either direction by a touch of the finger, the balance arising from the equality of the attractions is overcome by the one *s* pole being brought nearer while other is carried away from the magnet; then, of course, the attraction for the former prevails, and the disc continues to rotate. When alternately long and short currents are employed, the poles produced by the short currents, *being longest under the influence of the magnet*, are the most effectively acted upon, and consequently determine the direction of the rotation. While the short-current pole is thus being attracted by the magnet, the other one being under the influence of the current which produced it, is not attracted, but it tends to hold the disc stationary, and hence acts as a drag upon the motion. Therefore it is that, as before stated, when the long currents are cut out (their place being supplied by corresponding intervals of no current) the disc starts into more rapid rotation.

All the above experiments were equally successful when for the coil was substituted a couple of short electromagnets, through the wires of which the currents were passed, these being placed at points of the disc at right angles to that at which the permanent magnet stood, and with the north pole of one and the south pole of the other presented to the edge of the disc. I may mention that the terms "long" and "short," as applied above to currents and intervals, are to be understood as relative merely, the fact being that in my experiments the alternations, whether in interrupting or reversing currents, took place from the nature of the apparatus employed much more rapidly than those produced by the automatic interrupter of an induction coil.

Walter Hardie.

Joppa, Midlothian, Nov. 16th.

MICROSCOPICAL BINOCULARS.

[25040.]—I HAVE carefully tried the experiment suggested by Mr. Nelson with regard to the stereoscopic effect produced in the vertical and horizontal positions of the main suctorial pipes in the blowfly's tongue, and I come to the conclusion that the effect is heightened in the case of the horizontal position above that observed in the vertical, simply because the former position is one which admits of greater difference of perspective in the two pictures than the latter, not because of any failure in the binocular to do its work completely. I mean that a long solenoid held vertically before the face will less easily be discerned as a hollow coil than if it were held horizontally.

I find that any part of the membrane in the fly's proboscis lying in the least above or below the tube is instantly detected as so placed by the binocular in whatever position the object be placed. My prism is, I think, specially good and well placed. I can resolve through it with perfect definition difficult diatoms—P. Fasciola, for instance—with ¼in.

F. B. Allison.

HYDRAULIC RAMS.

[25041.]—IF proof were wanting in support of my assertion that Montgolfier's ram has been strangely neglected by writers on hydraulics, we might find it, I think, in the variety of theories lately started to explain such an apparently simple matter as the recoil of the motive column and the fall of the valve. First, we have the theory that the valve is made to counterbalance the statical pressure and fall by its unassisted weight; then that the momentum of the water somehow causes a partial vacuum; then it is suggested that the atmosphere above the outer valve is compressed, and by its re-expansion forces down the valve; then that the elasticity of the metal has something to do with it. We have the explanation usually given in books that the recoil is due solely to the re-expansion of the air in the secondary chamber; and, finally, Mr. Davies tells us as an established fact that it is the elasticity of the water which causes the recoil. This last is at least an intelligible theory, but is it quite established that water would have this power? I have heard, though I cannot speak from experience, that when a vessel bursts under hydraulic pressure the pieces do not fly off as they would under air or steam, and hence the value of hydraulic pressure in testing boilers, &c. It is strange, too, —I do not in the least mean that this disproves the theory—but it is strange that this explanation of the recoil has not been offered before either by Mr. Davies or anyone else so far as I know. In the case of a *closed* pipe the agent, it would seem, must be elasticity—whether of the metal or water I will not pretend to say, though I incline to the metal; but with a working ram having a vent through its inner valve, and most frequently a secondary air-chamber as well, the case, as I said before, is widely different; here neither the elasticity of the metal nor of the water can be called into play to anything like the same extent, if at all, and until I see it disproved I must continue to prefer the explanation which I gave, from Morin, p. 123, first column—viz., that it is the descent of the inner valve under the pressure of the column in the delivery pipe, or, which is the same thing, of the compressed air in the ball which gives the motive column a motion backward and upward. This motion is continued by inertia for an instant after the inner valve is closed, and hence a partial vacuum is formed under the outer valve. This is what I suppose Mr. Davies means by "backing" of the water. The inner valve cannot fall without some water returning with it. In short, it is precisely what "A, Liverpool," expresses (25029) in other words. I am sorry, indeed, if I did not make myself understood on p. 123, for my first object in writing was to publish this theory, which, obvious as it seems, I have met with nowhere but in Morin. At the same time I wished to show that the secondary air-chamber is not, as is usually stated in books, the one cause of the recoil; but that, on the contrary, rams will work more stably and "efficiently" without it, however useful it may often be in other ways. Now, to reply briefly to Mr. Davies. I do not at all ignore what you say about heavy valves: it is a point I am most anxious to have explained, and my query, to which you were good enough to reply last week, was put with the special object of drawing from you an admission of the immense weight which would be required to balance even so low a fall as 5ft. You say rightly 661b. Now have you ever seen a ram-valve of half that weight? Are such in existence, and, if so, could you say where? for I would go a long way to see one. I asked this question two years ago, but without getting a direct answer. There is nothing contradictory in my second paragraph (25008). I fully intended all I said. It refers only to the elasticity of the *metal or water* in the body of the ram. This is called into play in experiment (2) to a greater extent than in experiment (1); yet with a better recoil in (1). This proves, I say, that there must be some cause for the recoil beyond that of the elasticity either of metal or water. My argument was not meant to show what that cause was (I have tried to do that elsewhere), but merely to prove that it was something more than elasticity of metal or water. My objections to springs are—(1) That they consume power needlessly, I believe; (2) That they spoil the beautiful simplicity of the machine; (3) That they give trouble by rusting and breaking. I am unable to answer your question respecting your experiments 47 and 16. I should imagine that in 47 the length of the drive-pipe was not enough for so low a fall, and that in consequence of this the recoil interfered with the proper flow of the water. There is no note to this experiment, but the note to 4 rather leads me to this conjecture. You cannot, I think, give a constant ratio between length and height drive-pipe. A low fall would require a pro tionately longer pipe than a high one.

W. A.

[25042.]—*Re* my letter (25030) of last I find it necessary to make a correction 244, third column, line 25 from bottom, w dently is a printer's error, as I find in my manuscript it was distinctly written bore throughout," but the printer has "4in. bore throughout," which wo tremendous difference in the effect showing experiments.

P.

HYDRAULIC RAMS EX

[25043.]—I WAS very much lucid explanation given by M p. 244 of the "E.M." He has th the action, and in such a clear leaves not a shadow of doubt

›pens; but I for one must say that I have
en the explanation in print before, and I
ask Mr. P. J. Davies to be good enough to
ere I can see such, for I have an idea that
the first to explain the real action of the
valve. Of course, it is like all other things,
mple when once explained. I now cannot
tand why I could not see that its opening
is due to the elasticity of the water when
ıded meeting with a solid (though free to
›ackwards) resistance. I may say that I am
ıteur, but a practical ram-fitter, and hence
ıson for my watching the letters so closely.
periments conducted by Mr. Davies are very
ting, and of great value, but I am at a total
understand them if a 4in. ram was used, and
there must be some great mistake about the
he lift of the valve explains this; in fact,
ld rather say that it could not exceed a 1½in.
ıd trunk. I should like Mr. Davies to give
ther column of figures with his experiments
in. fall to 4ft., with lengths of trunk running
ft. to 60ft., with the exact size and lift of
ste valve, number of strokes, and the height
ch the jet would rise. Such a table of ex-
ınts would be very valuable, as there is
g of the kind for the guidance of the ram-
Under these circumstances, I beg of Mr.
to give us a complete set, if not asking too
I think the jet business a good idea.

A Ram-Fitter.

LEGAL REPLIES.

44.]—ANCIENT LIGHTS (57759).—Querist
nfused the Statute of Limitations with the
iption Act. The Act he refers to makes twelve
instead of twenty, the period within which
actions relating to land must be commenced,
action will be barred. This Act was passed
4, and came into operation on 1st January,
But it has nothing to do with the Prescrip-
ct, which makes an uninterrupted user of a
f light for twenty years necessary to obtain
thereto by prescription; and that period has
en reduced.

VANT—MONEY HELD BY MASTER AS
ITY (57818).—In this case the servant
stand in the same position as any other
r with regard to the money paid to his
as security in the event of his master's
ıptcy. It would, therefore, not be returned
, either wholly or in part, as it would not
n under the clause as to articles or inden-
of apprenticeship; nor would it be a debt
d to payment in priority, as would the
's claim for wages or salary to a certain
t. He would in short simply prove for the
so intrusted to his employer as an ordinary
r in bankruptcy.

EAMS—RIGHT OF NATURAL FLOW—DI-
ON—(57822).—Every landowner has a natural
the stream which naturally flows over his
He has a right to the uninterrupted flow of
ral stream having a defined channel. This
incident of property in the land through
it passes. Every owner of land in which the
flows can use it for his own purposes so that
not in any way lessen the stream or pollute
ter. If A. finds that B. is really about to divert
ream, he should give him notice that he will
his right to do so, and will ask the Court
injunction to prevent him. Should B. per-
.'s only remedy is by action in the Chan-
Division for such an injunction or for
es.

HT OF WAY—CANAL TOWING-PATH.—
)—I cannot undertake to answer so difficult
tion as this without knowing more of the
. For a *private* right of way, 40 years' user
ın indefeasible right. But this seems to be
l as a *public* right of way, to which the
iption Act does not apply. Of course, such
of way can be acquired; but it may be that
ing-path has only been used by some sort of
ion, and not as of right. Anyhow, the claim
t as a highway because it is a short cut
ot, I think, be supported upon length of
nc. It is not like so many rights of way
ı example of a private way leading to some
r place; it is a towing-path, and belongs
ıal. **Fred. Wetherfield,** Solicitor.
ham-buildings, Guildhall.

THE BLOWPIPE, &c.

—IT is only necessary to remark with
B. C. R.'s" allegations (letter 25023,
M.") that out of some hundreds of
England, Germany, France, and
ly using Al plates, B.B., not one has
fr it is in *process of analysis*, as
lone. Of course, if you
a powerful bl-
have no do
d from a
only.

bring the pyrocone obtained from an oil lamp with a small mouth blowpipe to bear upon them.

Mr. Letcher, of Truro, has never "supplied me with Al plates" (I get all mine direct from the manufacturers, Messrs. Johnson and Matthey, of Hatton-garden), but I put sublimates of volatile metals on half a dozen of them he sent up to town for the Inventions Exhibition, and I am quite sure that with the *fair* treatment of ordinary blowpipe analysis no holes could be turned in them; but I have no doubt he will write himself, and defend his articles from depreciation.

"B. C. R." is quite mistaken about "the fusing point of aluminium being between those of zinc and silver." *Beyond a certain bulk*, its fusing point is far higher than either of those metals, in proportion, in fact, to its higher scale of conductivity.

I repeat that it is impossible to produce the proper effects of oxidation and reduction of sublimates on Al plate by means of a pyrocone formed by forcing the blast and its air-vortex *inside* a gas-flame, although I have no doubt the temperature obtained by such a pyrocone is very high indeed.

W. A. R.

PYROLOGY.

[25046.]—I FULLY concur in the opinion expressed by Col. Ross (letter 25025, last week's "E. M.") to Mr. Furlonge. I have never been able to produce a suitable pyrocone for boric acid bead reactions from any oil or grease lamp I have yet used; they are, moreover, very smoky and dirty. After I had finished my gas blowpipe to satisfaction, I set about experimenting, with a view to produce a blowpipe that would burn a liquid hydrocarbon in the same manner as gas. I have the pleasure to inform those interested in this subject that I have succeeded, even beyond my most sanguine expectations, in producing a blowpipe for burning a liquid hydrocarbon. The flame burns with an intense blue cone, just like gas in appearance and intensity. It is perfectly under control, very steady, and clean. I can regulate the size and intensity of flame by taps on hydrocarbon and air tubes, just the same as in my gas blowpipe. There is no trimming of wicks and no smoke. The hydocarbonous vapour burns at the nozzle of tube like gas. The air is also heated before being burnt, so that it may be called a hot blast. I shall have more to say about this blowpipe shortly, and should there be a demand I will advertise my address.

B. C. R.

POLARISATION IN BATTERIES.

[25047.]—IT is not the case that copper dissolves in sulphuric acid spontaneously, as supposed by "A. E. B." (25600, p. 223). He has misunderstood the statement of Prof. Thompson as to the E.M.F. of copper dissolving in acid, which refers to the work contributed by the copper to the circuit. To dissolve, it would have to displace hydrogen, which requires a greater energy than copper can supply. Copper, in fact, only dissolves in acid by aid of heat, which furnishes the extra energy, and then it gives off sulphurous acid instead of hydrogen. This reaction is—

$$\left.\begin{array}{l}H_2SO_4\\H_2SO_4\end{array}\right\} + Cu = \left\{\begin{array}{l}CuSO_4\\H_2SO_3\end{array}\right. + H_2O.$$

We know, on the other hand, that hydrogen does displace copper, at all events when presented to the solution with its energy in the suitable form, or in the "nascent" state, as it is called, which really means before the active energy has been used in making it gaseous.

Copper dissolving, contributes E.M.F., as in the ordinary depositing process: this is often stated to be a mere resistance involving no E.M.F.; but that is not the case. The dissolving and deposited metal do not exactly balance each other, owing to their different state of molecular arrangement; but the difference is only trifling, so that any cell is able to deposit against almost any resistance.

Sigma.

LECLANCHE FOR LAMPS.

[25048.]—UNDER the above heading, a letter appeared in No. 1,074 of "Ours" stating that a small incandescent lamp could be lighted by five quart Leclanché cells, and that such an arrangement could be seen in operation at Mr. Swan's stand at the International Inventions Exhibition.

This statement is erroneous and misleading. It is impossible to light any lamp at present manufactured by any number of quart porous cell Leclanchés in series, be it 5 or 50.

The correspondent also asks, Why should not a Leclanché light a lamp as well as a Bunsen, being 1·50 and 1·89 volt respectively. The reason is that the resistance of the Leclanché is so high that a quart cell only gives half an ampère, whereas a Bunsen of the same size will give over three ampères. Now, as the lamp in question
g to Swan) takes 75 ampères, cells
sed that are capable of supplying
of current at least. For this purpose the battery spoken of is composed of five large surface agglomerate cells with zinc cylinders surrounding the negative, of low resistance, and therefore enabled to supply a current of the requisite strength. The cost of these cells is considerable—8s. each, I think. I have been induced to write the above in the interest of those who are constantly inquiring as to the practicability of using Leclanché cells for lighting purposes, and to warn them that it is imperative to know the current strength of all cells required for this kind of work, and not to jump at conclusions, although the E.M.F. of a cell may be relatively high.

C. D. R.

ENGINE - DRIVING.

[25049.]—I SHOULD be glad if some of our practical engine-drivers would give us their opinions about their way of working and the result.

In an article in the *Engineer* it is stated that whether the driver works expansively or not, there is not much difference, and that "not a scrap of evidence" can be got on either side. It must, Sir, be a misprint, or else the evidence must be kept in the background by the drivers.

If *expansive* working is no good, why trouble about "link" or "Joy" gears? But I should like to get some facts as to what coal is burnt with the engine with and without expansive working.

As to compound engines, I think it strange that none of our readers do not take up this matter; it must be one that ought to interest English mechanics. Then, again, there is a question—an important question I will call it—of English versus American engines. It is claimed in America that their engines can do more than ours can. Now what is the cause of this? or, I might say, is it a fact at all? If not, would it not be as well for it to be contradicted? **Locomotive.**

LOCOMOTIVES, &c.

[25050.]—MR. C. E. STRETTON is always prompt in laying before the public through your columns a copy of the Board of Trade continuous brake returns. And in connection with the Clayton vacuum in use on the Midland Railway, he always notes that the steam brake which is worked with it is non-automatic. A short while ago I saw a Midland express engine—I think it was No. 1530—with a printed notice on the left side of the cab, ordering that the ejector should be kept blowing continually, whether the engine were coupled to a train or not, in order to keep off the "automa ic" steam brake. Will Mr. C. E. S. be good enough to explain the action of this exception to his r ule?

The subject "Compound Locomotives" does not appear thrashed out even yet. *Engineering* still devotes a good deal of space weekly to the question, so one more suggestion will perhaps be admitted.

Would not one of the most profitable systems of compounding be the adoption of steam-tenders, for goods traffic, at all events. It is well known that Mr. Sturrock's steam-tenders were never treated fairly; but that a great deal of extra power was developed is indisputable, and had it not been for the unfortunate dispute between masters and workmen which followed their adoption, no doubt the system would have shown up more economical than it did, and would have found supporters in many of the most prominent engineers of the day.

Rugby School. **W. B. Thompson.**

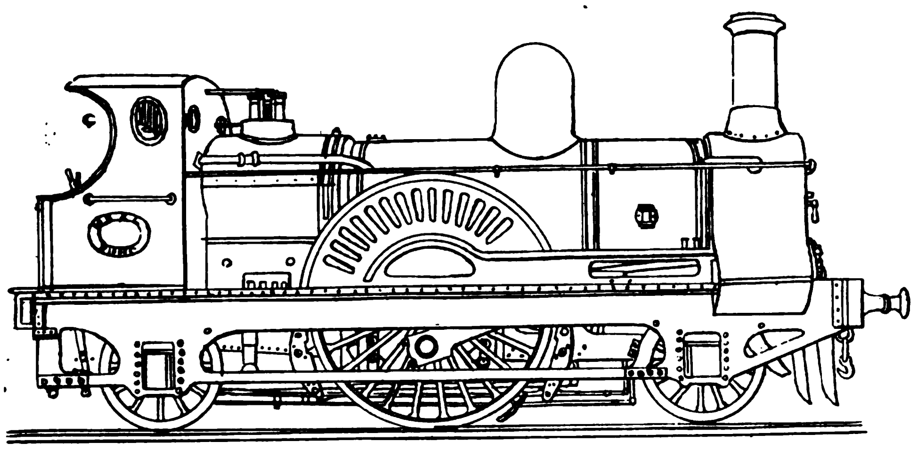
COMPOUND LOCOMOTIVES.

[25051.]—THE relative superiority of compound and simple locomotives is not, it seems to me, much of a question for argument. Unless there is a sufficient diminution in the coal bill to pay for the extra cost of the engine and the extra repairs, compounding for locomotives is out of the question—in spite of the gold medal of the Inventions' jury. A 7ft. driving-wheel makes in round numbers 250 revolutions to complete a mile, and that means 500 strokes of the piston. If these have to be made in 60 seconds, it will occur to many that it is rather a complication than an improvement to compel the steam to pass through two cylinders. Even in the case of slow speeds it seems doubtful whether compounding can be advantageous in locomotives, for condensing is out of the question. Until someone discovers a method of dispensing with the reciprocatory motion of the piston, no great change in locomotive construction is to be expected.

Nun. Dor.

MANCHESTER, SHEFFIELD, AND LINCOLN RAILWAY ENGINES.

[25052.]—AS the new Manchester, Sheffield, and L. Ry engines have not received much notice from your correspondents, I have inclosed a drawing of one of the express outside cylinder engines, with some of the principal dimensions. Boiler: diameter outside, 3ft. 11in.; length of barrel, 11ft. [illegible]in. Fire-



box shell: Length, 5ft. 6in.; height (front), 6ft. 7⅜in.; height (back), 7ft. 1⅝in.; width between frames, 4ft. 0½in. Tubes: Number, 195; diameter, 1¾in. Heating surface: Firebox, 87 sq. ft.; tubes, 1,057 sq. ft.; total, 1,144 sq. ft. Cylinders: Diameter, 17½in.; stroke, 26in.; connecting rods centres, 5ft. 7⅞in.; eccentric rods centres, 5ft. 7⅜in.; Wheels: Leading, 3ft. 8in.; trailing, 3ft. 8in.; driving, 7ft. 6in. Wheel base: Leading centres, 7ft. 9in.; trailing, 8ft.; total, 15ft. 9in. Weights: Leading, 11 tons. 3 cwt.; driving, 17 tons 11 cwt.; trailing, 11 tons 18 cwt.; total, 40 tons 12 cwt. Tender: Wheels (diameter), 3ft. 9in.; capacity, 3,000 gallons; weight empty, 16 tons 13 cwt. These engines are running the through trains of the Great Northern and M. S. and L. Ry to Manchester from Grantham in first-rate style.

Alfred R. Turner.

THE MIDLAND 19IN. CYLINDER ENGINE.

[25053.]—I NOTICE the following "errata" in my letter which appeared on August 21st (Vol. XLI. p. 541):—The station passing time should have been stated as given to the merest fraction of a "*minute*," not "second"; "branches of 1 in 176" (top of col. 2) should be "*banks*"; and "Bradford" (in line 3, same column) should be "*Bedford*"; and also the word "slow," as applied to the Scotch expresses, should be "*slower*," the comparison being with the fastest Leeds expresses. I shall be much obliged by your allowing me to correct these errors.

I may add to my specimen of Midland loco. work the following:—St. Pancras to Bedford (newspaper express) in 56min., No. 1490; Bedford to Kentish Town (night Scotch express) in 57min., No. 168 and 14 coaches; Bedford to Leicester in 57min., No. 1498; Kettering to Nottingham in 56½min., No. 1587; Leicester to Kentish Town in 1h. 53min., Nos. 1481 and 818, with 17 coaches; Leicester to Bedford in 56½min., with 1499 and 12 coaches; Liverpool to Stockport in 43min., with No. 1315. I have the details of all these and of many others equally remarkable.

Wellington, N.Z. **C. Rous-Marten.**

THEORY OF THE WIMSHURST "INFLUENCE MACHINE."

[25054.]—IT would be, perhaps, not out of place to conclude the sketch which has been already given of the practical details of the machine with the outlines of a theory which has been worked out and kindly sent me by A. J. Walter, LL.B. It is a theory expressed in terms which are current in the science at the present time, and may serve to explain to some degree the action of the machine, though, with our present limited knowledge of the nature of static induction I cannot, and, I believe, the writer does not, pledge his faith to this or any other theory.

The following remarks may be rendered clearer by the aid of a diagram, and in it, it will be most convenient to view the two plates as two cylinders, across which a section has been made. The outer ring will then represent the back plate revolving from right to left, and the inner ring the front plate revolving from left to right. LL and KK are the two prime conductors, DB is the neutralising rod on the back plate, and ST the neutralising rod on the front plate; A is one of the sectors on the front plate, and C one of the sectors on the back plate.

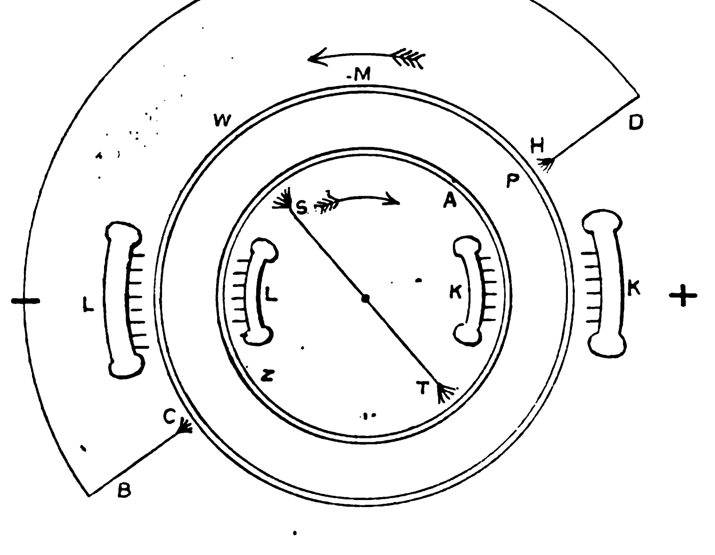
To explain the production of electricity by induction, it is necessary that some part of the machine shonld be in a state of electrical excitement. Authorities differ as to how this disturbed condition is brought about: some hold that it is due to the suction of the plates with the air, some to the friction of the wire brushes with the metal sectors, and others to a mere difference in the electrical potential of different parts of the machine.

In whatever manner it may be produced, let us imagine that at the point A on the front plate we have a small + charge.

This + charge at A will hold a – charge bound at O, whilst a + charge will be repelled to P, disturbing its neutral condition, and keeping a + charge bound there. This + charge will in like manner disturb the neutral condition at H, holding a – charge bound there, and repelling a + charge along the neutralising rod D B, from the end of which it will be discharged upon the back plate at C.

The nature of the changes which have been assumed to take place at the points A, O, P, H, and the important part played by the mutual inductions in the space between the plates receive some support from the fact that at the points where the neutralising brushes are opposite the glass, there are always masses of sparks between the plates. Assuming that the condition of the rest of the machine is neutral, what will be the change in the distribution of the charges when the plates are turned?

The sector A will be carried past K, and come opposite T, where the positively charged sector C will at the same time arrive. At this point there will be a series of changes in electrical condition similar to those which took place at A, the result being that a – charge will be held bound on the sectors of the front plate, whilst the repelled + will be discharged through the brushes at S on to the front plate, whence it will be carried round and collected at K.



Precisely similar inductive and neutralising actions will take place opposite the brushes B and S in the manner already described.

From a small initial charge at A the electricity has been distributed over all parts of the machine; and it only remains to examine in various parts of the plates the nature of the charges induced—that is, whether the electricity is in a free or bound condition.

To do this, we will examine the plates whilst in movement at the point M. From the preceding account, we know that the sectors on the front plate, after leaving S, have a + charge, whilst those on the back plate, after leaving D, have a – charge. The induced charges on the inner surfaces of the two plates will, in the manner above described, have adjusted themselves by discl between the plates, and on the inner surface front plate will be a – charge, and on the surface of the back plate a + charge.

The charges at this point M, therefore, o plates are bound, and no electricity can be co here nor anywhere between the points S The condition of the plates between T an precisely similar, and the above explanatio suffice, the terms + and – being substit each instance for – and + respectively.

What, however, is the condition of the between A and K? The sectors on the bac coming from the brush at B are positively c —so also are the sectors on the front plate from S, and as soon as they pass over one the bound + charges of each will be co into free + charges, for the + charge on t side of each of the plates will induce a + on the inside of each of the opposite plat like repelling like, the charges on the outs the plates will be repelled, and may be co at the prime conductors.

What the actual electrical condition of th surfaces of the two plates is it is hard to sa as, on entering this space, each of the inn faces bears a – charge, it is not improbab these – charges and the induced + charge tralise one another, and that the space betw plates is nearly neutral. The + charges outer surfaces will hence have nothing to p them from being collected by any suitable conductor.

A similar explanation will serve to descri condition of the plates between S and B, tuting as before the terms + and – for – respectively.

As the inner surfaces of the plates have n foil upon them, we may view them as mer surfaces of dielectrics in a state of electric t Such surfaces, unlike metallic surfaces, do stantly alter their electric condition, bu slowly part with their charges. This fac serve to explain the apparent increase i charges which takes place on the front plat A to T, and from Z to S, and on the back plat X to H, and from W to C, for though each sectors as they leave A and X have their charge, and as they leave Z and W have – charge, it is not until they reach and C respectively, that the series of in neutralising actions between the plat completed, and the previously bound come entirely free charges.

The reason why the prime conduc placed close to the neutralising br although theoretically the tension of may be higher there than midway brushes, where the conductors are u yet the very tension of the charg electricity to leap from sector to escape by the neutralising brushes, tically to lose its high tension.

The action which in the preli the theory was attributed to brushes in discharging electricity of the plates seems needed to ex tion of the charges over the wh when the plates are being rev would rather appear to be to s and – charges to run together another.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[57360.] — **Chronometer Balance.** — I am pretty sure "First-Class Honours" is wrong in his answer to this query, and I hope, for the sake of the examiners, that his answer did not help to gain him his title. Though at the Equator the c.g is further off, and the centrifugal tendency is greater, yet temperatures being even, a chronometer removed to there from the poles would not be affected by such removal otherwise than by the reduction of the friction on the pivots, end stones, &c., the which would cause it *to gain* on time. The balance of a chronometer is a wheel, not a pendulum, and is specially so made to avoid the action of gravity, and to confine its action to that of its mass. On shipboard instruments are gimballed horizontally, so that springs, levers, hands, &c., are all also free from gravitational interference with their motions otherwise than through friction.—WEN.

[57618.]—**Loss of Taste.**—If "J. A. P.'s" power of tasting is impaired he ought to give up tobacco. Smoking has a tendency to injure taste, and smell, and memory. Drinking raw spirits also injures the two former.—J. C. P.

[57618.]—**Loss of Taste.**—If "J. A. P." can taste the substances that I mentioned his complaint cannot be very serious. I should recommend him to pay a visit to his dentist to see whether there are any irritating stumps which might cause this condition reflexly. A weak current, applied of course with wet sponges attached to the electrodes, every day, might possibly be of some benefit. The current should he made to run from the back to the tip of the tongue.—MEDICUS.

[57643.] — **Mechanical Singing Birds.** — Circumstances have prevented me from replying before to "C. R. H.," but, if not too late, I beg to say that I was fortunate enough to obtain from "Cosmopolitan," during the time he was writing the letters on the singing bird, full particulars of the construction of the whistle, and if "C. R. H." will advertise his address I shall be happy to forward him (for it is too long for insertion in the query column) a copy of the drawing and instructions I received.—J. O. RESTALL.

[57680.]—**Distillation of Essences from Plants.**—If this querist will write to me direct, I will give the reply, which is too long for the columns of this journal, unless the query be put in a more definite form.—S., Patcham Drug Co., 13, Princes-crescent, Brighton.

[57719.]—**L. and Y. Express Engines.**—The following are the principal dimensions of these engines: — Cylinders, 17½in. by 26in.; wheels, bogie, 3ft. 6in.; wheels, coupled, 6ft. 6in. Heating surface—of tubes, 935 sq. ft.; of firebox, 93·25 sq. ft.; total, 1,028·25 sq. ft. Area of grate, 19·25 sq. ft. These engines have ordinary link motion. I hope soon to be able to send dimensions of the G. N. 7ft. 6in. singles.—G. D. SEATON.

[57756.]—**To Mr. Wimshurst.**—Having completed my alterations on influence machine, I now let you know the result. I have not retained the netal bosses, as I found that I could make a pair f wooden ones with very little more work. I have tered the balls to ⅞in. and ⅛in., and have rernished the plates; but I can only get a 3¼in. rk from the machine with jars attached; without jars I can only get a spark ¾in. long. If I arate the terminals more, I get nothing but a sh discharge, which my machine is very apt to somehow. I have carefully gone over the to see if there were any rough places on them, ould find none. I am going also to reduce the ng of the jars a little. I always get a positive arge from the small ball—is this right?— C.

57.]—**To W. H. Eaves, Coventry.**—I see nter has made an error in my query, printing instead of ·9 amp. The lamps are regular 16 c.p. lamps, each requiring a current of amp. In lieu of full figures, could you rule for finding proper size wire and weight for the dynamo. I am told that Edison ule ($\sqrt{\text{ampères required} \times \cdot018}$ = dia. of ils.) to find the wire for armatures of his Does the rule appear to be correct, and at does the constant ·018 represent? red for offer of 50-volt machine; but I f 100-volt lamps that I would like to rSYLVANIA ENGLISHMAN.

Joints.—The

The

brass tube, a space of about ¼in. to ½in. is left between the two ends. This portion is placed in the iron mould, which is hinged and opens in halves. The mould being pinched together, the molten solder is poured in at the "gate," and escapes at the outlet when the joint is filled. It is a method which anyone can carry out, and the brass tube certainly prevents any solder getting into the pipe; but a skilled plumber would wipe several joints while the "unskilled labourer" was making one with this appliance, which, after all, requires some skill, and some little expenditure for plant and brass tubes.—S. R.

[57760.]—**Fire Gilding.**—Clean the article thoroughly, and apply an amalgam of grain gold and mercury 1 to 8. Heat, and when mercury is driven off, polish. As I gave fuller particulars so recently as No. 1,027, p. 285 (just a year ago), I cannot venture to occupy more space.—NUN. DOR.

[57761.]—**Fire Gilding with Alloyed Gold.**—The answer to this question must be No, I think. Certainly it must as to fire gilding, as the querist will see; but "any other process" is too wide for me.—NUN. DOR.

[57762.] —**Hand-Made Paper.**—It is not possible to produce the qualities obtained in hand-made papers by means of machinery; at least, no one has succeeded in doing it.—S. R.

[57763.]—**Steam Launch.**—Certainly, one of the navy boats mentioned would do.—ESSAR.

[57764.] —**Nickel-Plating.**—If this querist will refer to pp. 96, 117, 139, Vol. XXXIX., he will find a full account of the art of nickel-plating, and possibly discover a remedy for the faults of his arrangement.—NUN. DOR.

[57774.]—**Coupler to Harmonium.**—Before "J. H. A." can "attach" an octave coupler he must provide space for it. He can probably do that by lowering the action in the case; that is, put the cheeks lower and put new attachments for the key-frame. If he will look through back volumes he will find several notions for octave couplers; but as he intends to buy, it is simply a question of whether he can find room between the pallets and keys. I should have thought that a two-row harmonium was noisy enough without an octave coupler.—FLIEGEN.

[57779.]—**Gower-Bell Telephone.**—How many "cells" do you use? Two ought to be enough, and they ought to be connected in series; but as you have the cells, why not try which arrangement gives best results?—S. P. T.

[57785.]—**Ship Designing.**—By calculating the weight of metal, or by ascertaining the displacement; but what is the querist's object?—J. M. D.

[57794.]—**American-Organ Blower.**—Rather a peculiar query. A gas-engine would be cheapest.—G. L. B.

[57800.]—**Spermaceti Emulsion.**—Spermaceti is insoluble in water. The querist might as well ask somebody to bring the moon a little closer, so that he could observe the surface.—T. J.

[57802.]—**Ostrich-Feather Dyeing.**—There are many recipes in back volumes. To dye black, soak in a solution of washing soda, wash in warm water, and soak in a solution of nitrate of iron; wash again, and place in a decoction of equal parts of logwood and quercitron.—E. G. M.

[57811.]—**Boiler.**—Quite unsuited for such work; you want a multitubular boiler.—S. N.

[57813.]—**Gramme Dynamo.**—Mr. W. H. Eaves is evidently wrong in placing the north pole in the position he has in his cut, p. 207, and this is irrespective of the error in the position of the block. Should Mr. Eaves desire to refresh his memory with regard to the names of poles produced in a helix by any given current, he need only bear in mind that if he be swimming along with the current and facing the core, "the north pole will be always to his left hand." (See p. 264 Guthrie's "Electricity.")—H. W. NEEDHAM.

[57813.]—**Gramme Dynamos.**—TO MR. W. H. EAVES.—I am much obliged for the sketch, but my machine is wound in the right direction. Since I sent in my query I have taken three layers of wire off each coil of my F.M.'s, leaving now about 12lb., or six layers thick. It will now excite its own fields, but I get very little E.M.F., and it will not light one 8 c.-p. lamp when connected up in series. The best result obtained is by shunting the current—i.e., by closing the current and drawing away direct from the brushes. Then I obtain a very fair arc light, burning ¼in. carbons, but I have not sufficient E.M.F. to light any incandescent lamps. I would again like your advice what to do to enable me to light lamps equal to about 120 c.p. The workmanship and insulation is and the armature runs within $\frac{1}{16}$ of the pole- eed about 2,000. Armature 6in. diameter wide, with ½in. thick iron wire ring. of cast iron, and are not quite as soft as might be. Would annealing them help me?—PICKWICK.

[57814.]—**Mathematical.**—It is the converse of interpolation. An example of its use would occupy much space, and be of little benefit even to the querist, to say nothing of other readers.—A. C.

[57817.]—**Patenting Steel Wires.**—Heat the wires in iron tubes packed with leather and hoof shavings, and cool in oil. Anneal, and repeat process.—S. O.

[57912.]—**Potential of Induction Spark.**—A spark of ¼in. in air means an E.M.F. vastly greater than 2,000 volts. In 1877 some experiments were made by Miller and De La Rue with a chloride of silver battery of 11,000 cells. The total electromotive force was 11,330 volts, and the striking distance was only ·3378 *centimètre.*—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[57915.]—**Hot-air Engine.**—TO MR. J. SUTCLIFFE.—In your reply to Mr. Hepworth, the sketch appears to have a flat plate in the displacer—is that right? Also would it be troubling you too much to give the relative bores and strokes of both working cylinder and heater, as I wish to construct a small one?—PATRICK.

[57952.] — **Electro-Motor.** — TO "SIGMA."—"H. B." is correct in his supposition as to the duration of nitric acid; 1lb. can give up a certain quantity of energy, and it can be expended in more or less time as desired. But the "ampère-hour" term does not give quite a correct result, because current is related to resistance, and we might have different currents giving the same ampère-hours, yet meaning very different expenditure of energy. But the effect of diluting the acid would be to lose energy and E.M.F. Strong acid gives 1·8 volt, while the weak may only give 1·2. These considerations are much too complicated to be explained in these replies.—SIGMA.

[57956.]—**Arc Lamps.**—I am much obliged to Mr. Bottone for his reply in this matter, referring me to arc lamp in No. 1,009 "E. M." This, I may say, I saw last July. I also read the statement that it "embodies all the modern improvements in regulating mechanism." After all, what he refers to is only a toy lamp. What I want is one that will do for workshop, to be run from a small dynamo giving 60 volts 10 ampères. Will someone refer me to where I can see or get drawings of a simple arc lamp for workshop? As I said before, I do not see why I should be called upon to pay £8 or £10 for a lamp that, in all fairness to maker and user, ought only to be £1 10s.—LEAR.

[57981.]—**Power of Pocket-Lens.**—All the correspondents who have answered this question exactly agree, from which one might judge the question to be a very simple one, and scarcely worth asking. The reason I troubled you with the query was, a short time ago I had a platyscopic pocket-lens—15 diameter power—from Mr. Browning. To test the power I ruled a few equal spaces about the fortieth of an inch apart, and looking at them with both eyes—one through the lens, the other naked—I found that one magnified space covered only something less than five of the spaces seen with the other eye; I quite expected it would have covered fifteen. I cannot suppose there is any misrepresentation as to the power on the part of the maker, and I would be glad if "F.R.A.S.," or some other correspondent, would point out where I am likely to be at fault. Years ago "F.R.A.S." recommended the above system of testing the power of a telescope. It may not be applicable to the microscope. I may just add I took pains to have the lens in proper focus.—X.

[57991.]—**Electro-Capillarity.**—TO "SIGMA."—I do not remember in what papers the querist will find any full account of Lippmann's researches; but I think they will be found both in the ENGLISH MECHANIC and in the *Chemical News* of 1874. On reference to the first edition of my "Electricity," I find that there is a paper on the subject in the *Philosophical Magazine* of April, 1874, describing the first electrometer and also the generation of electro-motive force.—SIGMA.

[57994.]—**Gas-Engine.**—I don't think it is the exhaust pipe; but examine it, and if made up with carbon, your engine is choked: it is more likely to be your exhaust-valve not acting, and losing compression, or you have not the roller on exhaust-lever adjusted to $\frac{1}{16}$ clearance between it and cam; take out your exhaust-valve and grind it with flour of emery and water. As they are iron valves, write to Messrs. Crossley Brothers for a book of instruction. I have a 3½ H.-P. Otto, and a few weeks since was driving one of Messrs. Robinson's deal frames cutting four deep in 13in. deals, with circular cross cutting 4in. and 3in. ash, and a drilling-machine at one time, and looked as if it would have done more.—SAMUEL SHAW, Belfast.

[57996.]—**Metal Spinning.**—An illustrated article on spinning was published on p. 513, Vol. XXXIV., of the ENGLISH MECHANIC. As it seemed to be just what I wanted, I procured the tools and had a good try at it; but I am bound to say without success, and I came at last to the conclusion that there was some knack in doing it that it was impossible to acquire without seeing it done. Since then I have made several unsuccessful endeavours to get a sight of the process. If any reader of "Ours" can really spin, I hope he will give us some further information on the subject.—FAL.

[58010.]—**Tar Solvent.**—Why do you dip your iron while so hot? Of course it destroys the tar itself; it should only be hot enough to dry the tar quickly. You can use naphtha to dissolve the tar and make a coarse varnish.—SIGMA.

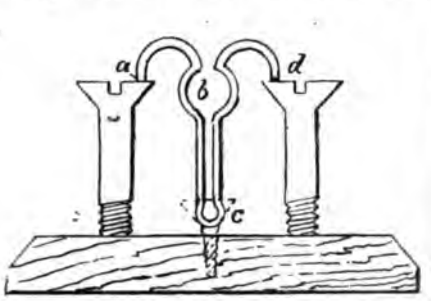
[58012.]—**Shannon Fishing Cott, or Punt.**—Our Shannon cotts are roughly made, with two or three planks a-side nailed together, the bottom formed by cross-pieces similarly fastened and pitched. They have peering stem and stern, and are very serviceable boats. The larger size—"grudlas" we call them—sail very fast off the wind.—SHANNON.

[58014.] — **Astronomical Objects.** — If it would serve "Dear Dirty Dublin," he may consult Webb's "Celestial Objects," on application at my address—91, Seville-place. I am sorry, however, I cannot assist him in the other parts of his query; but, no doubt, better-informed correspondents will.—W. H. M.

[58015.]—**Boat.**—"White Sand and Grey Sand" will find, in the centre-board gig, figured in Dixon Kemp's "Yacht and Boat Sailing," exactly the boat he wants; the 14ft. size will be the most suitable. For sailing in open water it will be advisable to increase the freeboard by adding a false gunwale with boxes cut in it for the oars. I should be happy to give him my experience at length if he cares to correspond with me, and will advertise his address.—SHANNON.

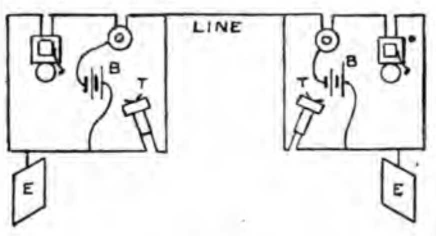
[58029.]—**Electric Greenhouse Alarm.**—A. frost alarm may easily be constructed by pivoting a thermometer in a horizontal position, so that if the spirit flows to a higher or lower degree than that which is required to be maintained in the house, the thermometer falls on one side or the other, and by this means an alarm-bell may be rung.—BUNSEN.

[58029.]—**Electric Greenhouse Alarm.**—(1) Take two brass screws about 1½in. long, one small, size immaterial; a mercurial thermometer tube, large bore; a few inches of half-round brass wire, and a piece of wood for stand; bend the wire to the shape *a c d* in the figure with the flat side towards *b*, and make *b* a little smaller than the tube of the thermometer so that the spring of the wire may hold it fast. File the ends *a* and *d* to knife-edges in the plane of the wire, so that these edges may be just above a horizontal line drawn through the centre of *b*; make a small scratch in each of the long screw-heads, and screw these screws into the piece of wood for stand, so that when the knife-edges of the wire rest in these scratches, the bight *c* may just clear the wood; pass the thermometer-tube through *b* till the system balances on the knife-edges when the temperature is about 40° Fahr. It is evident as the Hg contracts by cooling the bight *c* will move either to or from us according to whether the tube or bulb of the thermometer is towards us; screw the small screw (shown dotted in the figure) into the wood stand so that the bend *c* may just touch it when the temperature is 32°; attach one bell-wire to the small screw, the other to either of the large ones. If the instrument is too delicate, file the knife-edges *a* and *d*; if not delicate enough, file *c*.—L. A. L.



[58037.]—**The Wimshurst Influence Machine.**—TO E. B. FENNESSY.—The spark discharges may be brightened by passing them through some of the gases. It would be interesting, and probably useful, to make a complete set of experiments in this direction. Many leading men think as you do—viz., that the expenditure of power, in relation to the light produced, is less with the "*statical machine*" than with the "dynamo." I am not able to say what experiments have been made in this direction.—J. W.

[58031.]—**Two Telephones.**—Annexed is a sketch of the mode of connecting up line, battery, bell, earth, and a pair of telephones.—S. BOTTONE.



[58031.]—**Two Telephones.**—I inclose a sketch of the connections for a telephone station, the same, I think, as that employed by the United Telephone Company. In Fig. 1 B is the bell, K is a Morse key, E is the earth connection, S the automatic switch, R receiver, and T transmitter; *i* is the coil, *p p* ends of primary, *s s* secondary. The contact is included in the primary, and a switch, *k*, cuts out the battery. This is also done generally by the automatic switch, but for clearness it is not so in the figure. The connections are the same at each end. If positive is to line at one end, it must be at the other also. Sometimes the receiver is connected as in Fig. 2. I hope this is made clear.—BUNSEN.

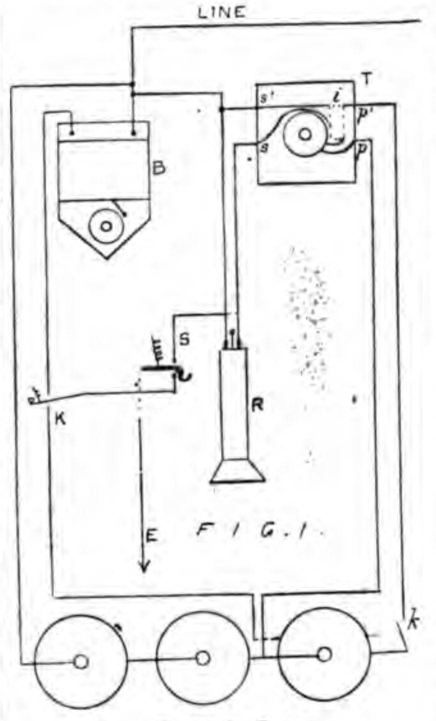
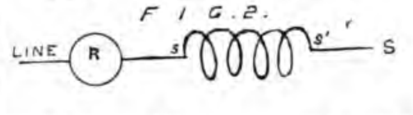


FIG. 1.

FIG. 2.



[58039.]—**Floating 100lb. Cylinder.** — The weight of fluid displaced will be 125lb. = 2 cube ft. if the fluid is distilled water. Then the whole contents of cylinder will be 4 cube ft., or the cross sectional area will be ·4 sq. ft., and the diameter will be $8\frac{9}{16}$in. Read some elementary book on hydrostatics and mensuration.—J. S. C.

[58040.]—**Lathe.**—Wood or iron pulley would make no difference. I have used gut band but never strap for foot-lathe. I do not see that there would be any difference; and as you have a flat pulley in headstock, drive with a strap. Friction wheels for crank-shaft are no better, if as good, as centres; but plain bearings of cast iron are what you will want for a long shaft, unless it is very strong, to run on centres.—WESTWOOD.

[58043.]—**The Wimshurst Influence Machine.**—"Vulcanite" will find this machine very beautifully lights up vacuum tubes; it is much cleaner for the purpose than the induction coil and the battery; but it does not heat the platinum wire: for that exhibition a powerful coil is required. The machine is not useful for ringing bells: hitherto its use has been chiefly for educational pu
J. W.

[58044.]—**Safety-Valve.**—The diam
circle 1 sq. in. in area is 1·13in. Areas o
figures are as the squares of their line
sions, and the linear dimensions are as t
roots of the areas. So that the dia
¼ sq. in. is $\frac{1{\cdot}13}{2}$, of ½ sq. in. $\frac{1{\cdot}13}{\sqrt{2}}$, and of
$\frac{\sqrt{3} \times 1{\cdot}13}{2}$. Read "Euclid" and som
tary book on mensuration.—J. S. C.

[58044.]—**Safety-Valve.**—To find th
a circle in square inches when the di
given you must square the diameter, and
by the constant number ·7854, thus:—

$$D^2 \times {\cdot}7854 = A.$$

Now, it is evident that to find the diam
circle when the area in square inches is
must simply reverse the above rule by di
area by the constant number ·7854, and e
square root of the answer, thus:—

$$\sqrt{\frac{A}{{\cdot}7854}} = D$$

A = area in square inches
D = diameter in inches

You will find by working out the above r
safety valve of 1 sq. in. area is 1·128in.
and one of ½ sq. in. is ·797 of an inch dia
have only carried the working of these two
to three places of decimals; but I think
be sufficiently correct for all practical pu
cannot understand what "J. F. C." requi
question, "Also the rule for finding the
of a sq. in.?" No rule is required, for ¼ o
must be ·25, or a quarter of a square i
must be ·5, or half a square inch, and so
If he wants the rule for finding the dia
circles for ¼, ½, and ¾ of a square inch in
one I have given, of course, applies to all
circles, and ½ a sq. in. I have worked o
SAXTON.

[58045.]—**Sugar of Lead.**—I pre
querist, when he asks how to make sug
means acetate of lead, and is not poking
an idea that sugar can be made out o
means of the electric current. The so-ca
of lead is made by dissolving litharge
acid, evaporating to a density of abou
then running the liquor into crystallisi
NUN. DOR.

[58045.]—**Sugar of Lead** is made by
litharge in acetic acid. The equation is–

$$\underset{223}{PbO} + 2\underset{120}{\left\{\begin{matrix}Me\\COHO\end{matrix}\right.} = \underset{325}{\left\{\begin{matrix}Me\\Co\\Co\\Me\end{matrix}\right.}\!\!\!\!\left.\begin{matrix}\\ \\ \\ \\ \end{matrix}\right\}PbO'' + \underset{18}{H_2}$$

—WM. JOHN GREY, F.C.S., Analytical
Newcastle-on-Tyne.

[58049.]—**Hot Dynamo.**—If the dy
properly insulated with good shellac var
heat might rise to 212° Fahr. without an
to the machine; but the current will be le
to the increased resistance.—S. BOTTONE

[58050.]—**Ferrous Oxalate Develo**
"A Beginner" will kindly turn to the l
graph of page 185 of the "E.M.," Oct.
will see that the potassium bromide is not
either of the stock bottles; but is kept in
of saturated solution, to be used only w
exposure is suspected.—S. BOTTONE.

[58052.]—**Safety Valve.**—The upwa
sure of the valve × its distance from the
must equal the weight of the lever by
of its centre of gravity from the fulc
weight of ball by its distance from the
100lb. acting upwards 1in. from fulcrum is
by 10lb. acting downwards 10in. from
and 500lb. acting upwards is balanced
acting downwards 10in. from fulcrum, or
20in. from fulcrum, neglecting the weig
lever. Having settled on the length of
weight and the position of its centre o
can be found, and the weight of ball m
duced so as to give the result mentioned i
sentence. The weight of the small val
neglected. Read some elementary boo
chanics.—J. S. C.

[58054.]—**Curve.**—Some time ago
question similar to this, and received
formation privately from a correspo
writes under the intials "W. H. B."
not answer this query I will endeavour
WM. JOHN GREY, F.C.S., Analytica
Newcastle-on-Tyne.

[58056.]—**Rope Power.—A**
velop," but only transmits **h.**
cular case the h.p. depend
the driving-wheel to rev
by the friction of the rop

-**Rope Power.**—The power of a
depends upon two things—the actual
ope, and the speed at which it runs. In
re us there is no information as to the
ent, so that an answer cannot be given.
elocity of rope in feet per *minute* and
, then

$$\text{H.P.} = \frac{v\,p}{33{,}000}.$$

IN GREY, F.C.S., Analytical Chemist,
n-Tyne.

-**Microphone Receiver.**—What does
t mean by a "microphone" receiver
permanent horse-shoe magnets? It
that, the initials being the same, this
referred to in the answer on p. 230,
of middle column.—S. P. T.

-**Electrical Units.**—The only way to
information you require is by experi-
then only approximate results can be
Take a bichromate for instance. The
f the cell is constantly changing because
ening of the exciting fluid surrounding
Not only so, but the distance between
s must be taken into consideration, as
hem far apart resistance is introduced,
equent lowering of current. The sur-
ative exposed, the conductivity of the
purity of the zinc, all must be taken
t and actual measurements taken of the
n periods.—C. D. R.

-**Electrical Units.**—I overlooked the
estion of "Finem Respice." It is not
is stupidity (as he suggests) which
m from finding in my book "how many
f zinc it is necessary to expose in each
tery to obtain a current of one or more
one or more ohms resistance." He will
t information in any book I have ever
e simple reason that it cannot be given
xactness. Some things cannot be put
l-dried statements to suit all cases. An
ement exists, for instance, in every cell
ous jar in it; then many cells vary
, both in E.M.F. and internal resistance,
riation of the external resistance. The
which control the results must be
t so happens, however, that "Finem
an find in my "Electricity," which he
arest approach to what he wants that
n give, and which I do not remember
in any other book. On p. 118 of the
, or p. 168 of the second, he will find a
e "Work and Constancy of Cells,"
wn experiments on the point. If he
currents there by 5·7 he will have the
nerated by plates 2in. by 1in. square
smallest possible external resistance.—

-**Electrical Units.**—Although it is
ossible to calculate the electro-motive
ny battery provided we know the
f which it is constructed, since the
ive force will always be that of the
ment minus the electro-motive force of
e element, yet in practice to calcu-
nber of ampères given by any battery is
lt, owing to the fact that it will vary
e of the plates, the distance they are
emperature, &c. The following table
ectro-motive force in volts, the resist-
s, of a few of the commoner forms of
-

VOLTS AMD AMPERES GIVEN BY
BATTERIES.

f	Size of Negative.	Volts.	Ohms.	Ampères
...	...	1·45	1·45	1·00
.....	6in. by 6in.	·47	·47	1·00
.....	6in. by 6in.	1·079	1·75	·55
.....	3in. by 3in.	1·900	·07	27·00
f ..	" "	·8	·4	·2
.....	6in. by 6in.	1·48	1·8	·9

NE.

-**Electrical Units.**—The principal
e volt, ohm, ampère, and farad. We
ke account of the first three. Ohm's
$\frac{\text{E}}{\text{R}}$. That is—

$$\text{mpères} = \frac{\text{electromotive force in volts}}{\text{resistance in ohms}}.$$

ans total resistance—that is, the resist-
the wires and lamps, &c., added to the
he battery. Call ρ the in-
tery, and R the

ρ = 4 ohms, and an electric bell of 12 ohms (the twelve ohms taking into account the resistance of the wires leading from the bell to the battery, &c.), then the current in ampères $= \frac{1\cdot4}{4 + 12} = \cdot087$. The E.M.F. does not increase as you increase the size of your plates. The E.M.F. is due to the difference of potential between the two elements—i.e., plates of the battery. Here is a list of a few of them in their order:—Zinc, iron, lead, copper, silver, platinum, carbon. Now, as zinc is at the top of the list, and carbon at the bottom, it is plain that there is a greater difference of potential between zinc and carbon than there is between zinc and copper; that is (other things being the same), that a battery made up of zinc and carbon will have a higher E.M.F. than a battery made up of zinc and copper. From this one sees that increasing the size of the plates does not increase the E.M.F. What increasing the size of the plates does is to diminish the ρ of the battery, by that means increasing the current; for instance (not taking into account the external resistance) $\text{C} = \frac{\text{E}}{\rho}$; therefore, if we double the size of the plates, and by that means halve ρ, ρ becomes $\frac{\rho}{2}$ $\therefore \text{C} = \frac{\text{E}}{\frac{\rho}{2}} = \frac{2\,\text{E}}{\rho}$, we have, therefore, doubled the current. ρ also varies with the distance that the plates or elements are from each other. For instance, if you halve the distance between the two plates you halve ρ, or if you double the distance from each other you double ρ; therefore, from this, it stands to reason that the nearer the plates are to each other (without touching), the better; ρ is also influenced by the exciting liquid. For example, water has a high electrical resistance. Now, H_2SO_4 has much less electrical influence; therefore, the stronger the solution of H_2O and H_2SO_4 in a bichromate cell, the less ρ will be. The ρ of batteries varies considerably, say, from 5 ohms of a bichromate to a Minotto of, perhaps, 50 to 1,000 ohms. If we take six cells, and join the zinc of the one to the zinc of the next, &c., and the carbon of the one to the carbon of the next, &c., it will be the same as having one piece of zinc six times the size of each separate one. The same with the carbon; but the E.M.F. will only be equal to that of one cell. This arrangement is called grouping them in arc. Let m = number of cells in arc; then, if ρ = internal resistance of one cell, $\frac{\rho}{m}$ = internal resistance of m cells in arc; therefore, Ohm's law becomes

$$\text{C} = \frac{\text{E}}{\frac{\rho}{m} + \text{R}}$$

Now, if, instead of joining them in arc, we join them in series, that is, the zinc of one to the carbon of the next, &c., in this case we get six times the E.M.F of one; but at the same time we get six ρ. Let S = number of cells in series, then Ohm's law becomes

$$\text{C} = \frac{\text{S}\,\text{E}}{\text{S}\,\rho + \text{R}}.$$

Example.—Suppose we have five cells E.M.F. = 1·6, ρ = 20 ohms, and an external resistance R = 36 ohms; then, all in arc—

$$\text{C} = \frac{1\cdot6}{\frac{20}{5} + 36} = \frac{1\cdot6}{40} = \cdot04$$

In series—

$$\text{C} = \frac{5 \times 1\cdot6}{5 \times 20 + 36} = \frac{8}{3{,}600} = \cdot00\dot{2}$$

Therefore, in this example, to get the largest current we must couple up our cells in arc. This does not show us if we are getting the greatest possible current. As a matter of fact, by using the simplest form, $= \text{C}\,\frac{\text{E}}{\rho + \text{R}}$, we can see that one cell would give more current than the five in series. Now, if we take these two formulæ we see that with S in series, and m in arc—

$$\text{C} = \frac{\text{S}\,\text{E}}{\frac{\text{S}\rho}{m} + \text{R}}$$

By extracting m, we get—

$$m = \frac{\text{S}\,\text{C}\,\rho}{\text{S}\,\text{E} - \text{C}\,\text{R}},$$

which is the number of cells needed to give a current C through a resistance R, with S cells in series, and by extracting S we get—

$$\text{S} = \frac{m\,\text{C}\,\text{R}}{m\,\text{E} - \text{C}\,\rho},$$

h is the number of cells in series required to
current C through a resistance R, there
ells in arc. The total number of cells
Of course the answer does not always work out exactly. For instance, suppose we get as an answer 4·8 in arc and 5 in series, n = 24 cells. Now, as 4·8 is nearer 5 than 4, we would take 5 in arc and 5 in series = 25 cells. If we had taken 4 in arc and 5 in series = 20 cells, that is not so near the correct amount, 24, as the other way, and therefore the other is the best. I hope these explanations will make the matter clear to you.—C. L.

[58060.]—**Fuller Cells.**—Four or five cells would do. They will run for one or two hours. No; they do not fume.—C. L.

[58060.]—**Fuller Cells.**—Depends upon the resistance of the lamp; three cells at least would be required, of large size. They would run it a few hours only. No fumes are given off.—C. D. R.

[58060.]—**Fuller Cells.**—Three cells, at least, will be necessary to light a 2 c.p. lamp. They do not fume, and give a constant and powerful current for several weeks, working about 4 hours a day.—BOBADIL.

[58061.]—**Bends in Stove Pipes.**—Has "Henden" seen the correspondence on the above subject, which appeared in the "E. M." some little time back. If not, he will, on referring to "A Curious Stove Pipe," on page 520, Vol. XLI., August 14 of this year; also page 540, same volume, August 21.—T. R. SAXTON.

[58063.]—**Wire for Dynamo.**—Kindly turn to reply 58001 in last week's "E. M."—S. BOTTONE.

[58070.]—**Voltaic Battery.**—TO MR. BOTTONE.—Flower-pots with the holes plugged will do very well for porous cells; but the ordinary red glazed jars will not stand bichromate of potash. Western's salt jars will. The electromotive force of such a battery, whether as large as a house or as small as a thimble, will be the same—viz., about 1·99 volt.—S. BOTTONE.

[58070.]—**Voltaic Battery.**—Yes, you can make the outer cells of any glazed earthenware, jam pots if you like. The E.M.F. of the granule is 1·60 volt. The amount of carbon surface does not alter the E.M.F. of any cell, but lowers its resistance, and therefore gives a larger amount of current for use. See replies concerning this cell recently.—C. D. R.

[58070.]—**Voltaic Battery.**—Do not use the common earthenware you speak of. It might serve (badly) for porous pots, but would be worthless for outer jars. Use the best brown stoneware, and proper porous jars. You are mistaken as to the E.M.F. and resistance. Hydrochloric acid gives a higher E.M.F., and I think a lower resistance than sulphuric acid, and the size of carbon only affects the E.M.F. as regards rate of polarisation.—SIGMA.

[58070.]—**Granule Battery.**—The common pottery glaze will not stand the action of bichromate solution, but scales off. The charging you suggest is the best for this sort of battery. Do not use any chlorides. The E.M.F. will be 1·6 volt, but this is not affected by the surface of carbon exposed, as you seem to imagine. That will only affect the internal resistance—in this case reducing it. The maximum current from this battery in series is 2 ampères for the size you mention.—W. A. W.

[58074.]—**Bicycle Repair.**—You ought to have got the cranks off by heating, and a drift from behind, if there be not a set screw in anywhere. Cause of rubbers splitting will be because the spokes are not tensioned up. As for putting new rubbers, handle bar, handles, ball bearings, &c., my advice is, from practical experience as a rider since the boneshaker days, to get a new one; sell the one you have, if you can, for what you can get—by what you say it is not worth more than scrap (say 30s.). The repairers you have applied to have thought it not worth while troubling you. Write the Coventry Machinist Co., Coventry; Hillman, Herbert, and Cooper, Coventry; or Rudge and Co., Coventry, for price list; these are three of the leading makers, they supply real good articles, and as cheap as anyone. If it will not run to a new one, peruse the advertising columns of *Cyclist* every week, and get a second-hand one of either above make, with ball bearings on all working parts, for about £10. If this be too much, my advice is not to have one at all, for if you can't afford ball bearings, the money will come out of your body.—W. WASS.

[58075.]—**Galvanising.**—Molesworth says: Pickle the article six or eight hours in water containing about 1 per cent. of sulphuric acid, held in wooden vessels. The acid requires to be renewed from time to time, according to the quantity of iron pickled. After pickling, scour and wash well in clean water. Keep the article under clean water (in which a little fresh burnt lime has been stirred) until ready for the next process. Immerse in chloride of zinc for one or two minutes, until a skin of fine bubbles is formed on the surface. Chloride of zinc may be formed by saturating hydrochloric acid with metallic zinc until effervescence ceases, then decanting, and adding a little salammoniac. Dry the article on a heated iron plate, then immerse it in a bath of molten (not glowing) zinc until it acquires the temperature of the zinc bath. The surface of the molten zinc should be protected by salammoniac, or some other substance. In some cases there is a partition at the surface of the bath, one portion of the surface being protected with salammoniac, the other with a layer of charcoal. Beat the article while hot to remove the excess of zinc. From another work the following is given: The iron is cleaned by dilute acid and friction; is heated and plunged into a bath of melted zinc, covered with salammoniac, and is stirred about until the surface becomes alloyed with zinc. Small articles are treated in the same way, and, as they are found to be soldered together by the metal when dipped therefrom by the skimmer, they are placed in a crucible with charcoal powder, heated and shaken. Chains taken out of the zinc are shaken to separate the links. Wire is reeled through the zinc. Mallett recommends an amalgam of zinc, 2,292; mercury, 202; and about 1 of sodium or potassium. This melts at 680° F. The cleansed iron is dipped in this, and removed as soon as it reaches the temperature of the alloy. Morewood and Rogers' plan is: The plates are tinned by placing them in a solution of muriate of tin in a bath, the plates alternating with granulated zinc, and thus forming a weak battery, by which tin is deposited on the iron. The plates are then passed through a bath of melted zinc.—T. R. SAXTON.

[58076.]—**Drilling Machine.**—The fault lies with "H. M." The machine can make no difference, except for speed, which must be quick for small holes; drill must be sharp, to do away with fraze as near as possible, for it is impossible not to make a fraze. He might drill the holes too small, and widen with fluted bit to size. It is the keenness of the edge of tool that is required; the more blunt the tool the larger the burr. If they were counter sunk slightly it would remove part of burr. —WESTWOOD.

[58080.]—**H.P. of Locos.**—If some correspondent will state the actual work done by the engines referred to in his query it will be easy to calculate h.p. Data needed are: 1, Weight of engine and tender; 2, weight of train; 3, speed along a level, or up a gradient of given steepness.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[58083.]—**Salammoniac.**—This salt was originally made from camels' dung, and was the starting point for the production of the other compounds of ammonium. It is now obtained from the ammoniacal liquor of gas works by heating with lime, and conducting the evolved gas into hydrochloric acid and evaporating. It may also be prepared by heating a mixture of ammonium sulphate and common salt, whereupon double decomposition occurs, and ammonium chloride sublimes.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[58084.]—**Electric Light.**—TO MR. BOTTONE OR H. EAVES.—For a short time this battery would light a low resistance, five-candle-power lamp. Removing the zincs from the solution keeps the battery longer in working order. If a switch is used, action goes on in the battery just the same. —S. BOTTONE.

[58084.]—**Electric Lighting.**—Four gallon cells would not be sufficient to light a 5 c.p. lamp; the E.M.F. of each cell is 1·6 × 4 = 6·4 volts. A 5 c.p. lamp requires about 10 volts. Make two more cells, and then you may be able to light two lamps in parallel. It would be an improvement if you made the zincs half an inch wider. There is no advantage in raising the zincs of this kind of battery; rather otherwise, as it causes the solutions to mix. Always have some mercury in the porous cell. When the light is turned off by a switch, the circuit is broken and the battery at rest. Charge: outer cell, sat. solution bichromate and one-tenth sulphuric acid; inner cell, dilute sulphuric acid, same proportion. Add a little fresh acid to enliven it when required.—W. A. W.

[58086.]—**Muscæ Volitantes.**—The distressing complaint that "X." is suffering from is practically incurable. From his graphic description I should say that they are muco-lachrymal muscæ. These apparitions are caused by mucus, tears, fat globules or bubbles moving over the surface of the cornea. It has been said that the experience of some patients has been the muscæ did not intrude themselves on their notice when the general health is good. So I should advise that the querist should live carefully, take plenty of exercise, and feed well.—MEDICUS.

[58087.]—**Pork Pies.**—Firstly, best biscuit flour should be used for the paste, and about 5oz. of lard to a pound of flour. Secondly, it is always best to make pies in the afternoon or evening of *the day. Place them in a very cold, dry place, and bake slowly (yet in a tolerably hot oven)* the next morning. Thirdly, practice in packing the meat in properly, and making the paste is essential.—THE OLD LADY.

[58088.]—**E.M.F. of Leclanche Batteries.**—The E.M.F. is about 1·50 volt, no matter what its size. It is not suitable for driving current through lamps. The volt is the unit of E.M.F., and the ampère the unit of current. You had better procure a work on electricity—Mr. Sprague's for instance.—C. D. R.

[58088.]—**E.M.F. of Leclanche Battery.**—For first part of query see my answer to 58059. The E.M.F. of a Leclanché cell is 1·48 volt. Why light a lamp with Leclanché cells? I suppose you know that a Leclanché only gives a current for about ten minutes at a time. You might need ten, twenty, or even more cells.—C. L.

[58088.]—**E.M.F. of Leclanche Batteries.**—Kindly turn to reply 57949 for explanation of volts and ampères. The E.M.F. of a Leclanché cell is about 1·48 volt. The resistance of the best form is about 1 ohm. The current is, therefore, about 1 ampère for a few minutes. It would require, at least, 25 such cells to drive one 10c.p. lamp.—S. BOTTONE.

[58088.]—**E.M.F. of Leclanche Batteries.**—The E.M.F. of a Leclanché cell is approximately 1·726, that of a standard Daniell being 1·079. The volt is the unit of E.M.F., and is ·9268 of a Daniell cell. The ampère is the unit of current or quantity. The querist should obtain Sprague's "Electricity" if he intends studying this fascinating science.—YOSHI.

[58088.]—**E.M.F. of Leclanche Batteries.**—All magnetic quantities, intensities, &c., are expressed in terms of special units derived from the fundamental units of length, mass, and time. A *volt*, the standard of E.M.F. = 10^8 absolute units (being a little less than the E.M.F. of a Daniell's cell). As a practical unit of current, that furnished by a potential of one *volt* through one ohm (ohm = 10^9 absolute units of resistance) is taken, being 10^{-1} of an absolute unit of current, and is known as one ampère, formerly known as the weber. The E.M.F. of a Leclanché battery, as given in Prof. Silvanus Thompson's work on "Electricity," is 1·48 to 1·61 volt. These cells are no use for lamp work unless the lamp has a very low resistance, and is only required for a few minutes together, as if used to give a continuous current many minutes together the power of the cell falls off owing to the accumulation of bubbles of hydrogen; but if left to itself, the cell recovers after a time.—J. KEAN, Northampton.

[58089.]—**The Wimshurst Influence Machine.**—The sections should be made of tinfoil.—J. W.

[58091.]—**Durability of Clothing.**—I should think "T. H." would find corduroy, similar to that worn by railway porters, &c., the most durable material for clothes, providing he does not study appearance.—T. R. SAXTON.

[58093.]—**Can the Law Interfere?**—It seems to me that the easiest way to settle this would be for "Christianity" to erect the necessary fence himself. It would only cost 10s., and would spare him the painful feeling of wishing for a fatal accident.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[58098.]—**Regenerative Gas Burners.**—I have in daily use one of the "Wenham" lamps, No. 1 (smallest size) burner, consuming 6ft. per hour, and can only say that it is nearer perfection than any other previously tried. The room, 19ft. by 13ft., is well lighted excepting the ceiling and cornice, which are in deep shadow; the burner is fixed 8ft. from the floor and 30in. below the ceiling rose. I think you would find this to answer your requirements; if not, no doubt the next size larger would do so. If you do not want to discard your present fittings you cannot do better than substitute Albo-Carbon burners for those at present in use: they will give you three times the light with half the quantity of gas. If you should happen to live anywhere in my neighbourhood (Ealing), I shall be happy to show you the effect of both kinds of burners mentioned, applied in rooms of equal size. If you will advertise address in 6d. column an appointment could be made.—R. T. LEWIS.

[58098.]—**Regenerative Gas Burners.**—In reply to "Figaro," a room 20ft. square can be fairly well lighted by one No. 8 Bray's regulator union jet, without a globe, and can be brilliantly lighted by one No. 8 and one No. 6. We find that a regenerative lamp in an ordinary room is most offensive, owing to the smell of the hot metal, caused apparently by the charring of the dust floating in the air, and it is also objectionable owing to the strong shadows cast by a small concentrated light. In addition to this, the darkness of the ceiling and upper part of the room has to myself a dismal and unpleasant effect, and, after trial, we are removing one of these lamps, put in as an experiment, and returning to No. 8 Bray's ordinary burners. Regenerative lamps are good for well-ventilated shops and large spaces when used in conjunction with other burners giving a top light; but they cannot be recommended for ordinary domestic use. If heat is the special objection, the Albo-Carbon will be found the best light.—998.

[58099.]—**Electric Bells.**—The size of wire for bobbins of bells, 2½in., 3in., 3½in., is No. 26 silk-covered. For 4in. bells, No. 24 is used. The larger the bell the greater length of wire is required on the bobbins—thus, for a 2½in. bell, 9 yards of No. 26; for a 3in., 10 yards of No. 26: for a 3½in. the same; for a 4in., 11 yards of No. 24.—BOBADIL.

[58099.]—**Electric Bells.**—Frequently answered. Nos. 26 to 30 for small bells; 18, 16, and 14 for large-sized, with greater quantities according to size of magnets. Bobbins should occupy not less than two-thirds the length of the legs, and the wire should be wound on until the coil is as thick as the magnet core, so that the diameter of the finished bobbin is three times that of the core.—S. P. T.

[58100.]—**Solution for Wood Charcoal.**—Try soaking the charcoal in a hot, saturated solution of nitre; if it burns too briskly, use a weaker one.—B. B.

[58100.]—**Solution for Wood Charcoal.**—The querist knows, I presume, that charcoal of the kind he requires can be readily purchased. I suppose that it is treated with a solution of saltpetre.—NUX. DOR.

[58101.]—**The Wimshurst Influence Machine.**—TO "T. D."—I use the light-coloured orange shellac for varnish, which, when properly used, very slightly alters the colour and appearance of the glass; perhaps you have the dark-coloured shellac, and use it too thickly. It is much better to bear with a little objectional colour, and to obtain good results, than to study appearance and fail in the results. Lately I have found several machines having a white, or white hard varnish upon the glasses, which was simply fatal to their successful use. I use thin glass, it gives better results; 15oz. glass is thick enough for plates up to 20in. diameter.—J. W.

[58103.]—**Screwing Machine.**—"W. G. L." might screw in foot-lathe ⅜in. and ½in. bolts: it would be only a makeshift. A bolt and nut machine is made of one spindle, the driving-wheel in centre and loose wheels on each side of it; they screw both ends, the one bolt running out while the other is screwing. It requires two straps, and costs for screwing ⅜in. about £5, larger sizes extra. The dies are rather difficult to describe, yet very simple: a square piece of steel screwed inside the size required, and made to cut and free itself from the shavings.—WESTWOOD.

[58108.]—**Dynamo Particulars.**—Kindly turn to No. 1007 of the "E.M.," where you will find full description of the mode of winding and connecting the wires on the Gramme ring. Mr. W. H. Eaves has also given some very practical and exhaustive articles in Vol. XLI., pages 261 and 564, of the "E. M."—S. BOTTONE.

[58109.]—**Double and Treble Threads.**—I cannot tell how others do this, but I myself manage in the following manner: With double thread I choose wheel to go on lathe spindle (that is, the driver) that will divide into two equal parts, and after cutting first thread, I very carefully take wheel off and turn it round one-half, and then cut the other thread. With three threads I choose a wheel that will divide equally into three parts and change my wheel for each thread.—WESTWOOD.

A Vanished Island.—An official notification from the Danish Ministry of Marine announces that Denmark is poorer by the loss of an island and of an interesting natural object. South of the island Suderoe, one of the Faroe group, a mighty cliff rose sheer out of the sea to a height of from 80ft. to 100ft. Looked at sidewise from a distance at sea, it resembled a great ship in full sail; but seen from Suderoe, it presented the appearance of a monk, whence it received from the Faroese the name of Munken. The Monk was not merely a picturesque object, it was also a valuable landmark for sailors, warning them against a dangerous whirlpool which swept around its base. But it is now only a thing of the past. Last year a portion of the cliff fell down, and this year all that remained was broken off just below the water, leaving in its place a dangerous reef, covered even at low water. Fortunately [illegible] uninhabited, so no lives were lost. [illegible] is noteworthy as proving that [illegible] of the sea, aided probabl[illegible] action of driving ice block[illegible] immense masses of rock co[illegible] cutting them clean across at [illegible]

ANSWERED QUERIES.

ımbers and titles of queries which remain unan- ır five weeks are inserted in this list, and if still ·ed are repeated four weeks afterwards. We trust ·rs will look over the list, and send what information 'or the benefit of their fellow contributors.

ꞩemi-Fixed Engine. p. 68.
?ainting on Velvet, 68.
ꞩpeeding Pulleys, 68.
Running Staffs and Cylinders into watches, 68.
Legal (Drainage), 68.
?ull-up Weight, 68.
'usion, 68.
ꞩecondary Cells.—To "C. D. R.," 68.
Watch Jewelling, 68.
The Isle of Man Steamer, *Mona's Pride*, 69.
Compressed Gases, 69.
?roblem, 69.

)rgan-Accordion, p. 150.
Engine, 150.
The Telephone and the Ear, 150.
ꞩomething Worth Knowing, 151.
Cane Sugar, 151.
Crystallisation (Practical), 151.
Watch Movement, 151.
Locomotive Model, 151.
ꞩtorage Battery, 151.

QUERIES.

.]—**Dutch Grammar.** — Would any corre- t mention the title and publisher's name of a good rammar? I have searched nearly all the book ies, and have also inquired at some of the large ıand shops in Bookseller's Row, Strand, but with- t.—T. D.

:]—**Gravity Leclanche.**—To "SIGMA."—I ır 7in. ordinary Leclanchés, ringing three bells in ıe, and, although bought from good makers, never ;er than twelve months. Would you advise making ıvity cells, made as suggested by Mr. Preece in his ecture (see "E. M.," Vol. XXX., p. 160)? I do not make them until I have had your opinion, because :XXIII., p. 45, you say "there is a certain advantage ıg the contents of the porous cell somewhat dry." ; gravity batteries, of course, the carbon and ıse are always wet. I have read these cells give a electromotive force, not having a porous cell ncreases the internal resistance). Is this the only ge?—J. J. G.

.]—**Incandescent Lamp.**—To MR. BOTTONE. ı a small carbon incandescent lamp, the size of a ch I wish to use as a scarf pin. Will you, through ium of this paper, tell me how to construct a pocket to work same, and how often such battery will 'enewing if in constant use?—AERONAUT.

.]—**Harp.**—I have bought a harp, second-hand, of which, and part of the body corresponding, is ıly rotten. Will some of your correspondents ıform me what would be the best method of repair- ıd what wood to use? I thought of cutting away portion of the body (extending about 1¼in. all making a foot thick enough to keep the body same vith a shoulder on which to drop the body. In ·ts the body is very much pitted with rot; would oil rubbed over the inside preserve it without ; the tone?—J. W. HOWE.

]—**Lathe Heads.**—Will some reader kindly : size of gear wheels and pinions are best for 4½in. ıred foot lathe; also number and pitch of teeth? king one to run with gut band, and wish to have ɔortions correct. Also the best angle for the neck, conical, to run in hardened bearings?— L'S HAUD ULLI.

.]—**Small 3in. Telescope.**—I have one of ıtruments, the o.g. of which seems tolerably fair; s no rack motion for eye tube. Will some of our ay if I can get a rack motion put into it, and the cost? Also what powers a small glass like this ıar?—AMATEUR.

.]—**To Mr. S. Bottone.**—On page 570, you ketch and dimension of Gramme dynamo. Will ıe give me a sketch how to wind the armature, as want to have any cogs on? I wish to wind it in ns. Will the size wire you gave do? Also how ·ers in each section should the armature have? v are the brushes arranged on the commutator?—

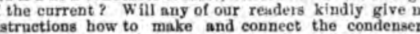
.]—**Welding Iron.**—Can any reader of "Ours" f anything to weld iron plates with instead of I have some to weld like small boxes, and they do to take together at all nicely with sand alone.— IC.

]—**Wheel.**—Can any reader of "Ours" tell me ake a good pair of iron truck wheels, to carry 1 5cwt. and about 4ft. dia., and say what size iron MECHANIC.

—**Bicycle Hubs.**—I have a bicycle, but p the spokes in front wheel. The spokes are to hubs, which are like a mixture of brass and t the holes are all stripped and too large. Could etal hubs put on to axle, with nipples?—C.

·**Quadruplex Telegraphy.**—In looking well-recommended book of Mr. Sprague, I the following decription of the quadruplex — [illegible] is effected on si[illegible]iples ·ng different el[illegible] to be suita[illegible] without effect upon an instrument arranged to work with a larger current." This differs very much from the system used in either this country or America, in which the action of a reversing key upon a polarised relay plays an important part; also, under all circumstances, the same currents pass through both relays (instruments). Then, again, I cannot understand what is meant by "a low force (electromotive?) being unable to pass through a very high resistance." Always thought that if any difference of potential existed between two points, no matter what resistance separated them, a current would flow. If, say, "Sigma" would give a few details of this system of quadruplex working, it would be instructive to students of electrical engineering, ncluding—W. STUART HARRISON.

[58122.]—**Safety Valve.**—Will some reader inform where the increased weight commences. Look at the lever A B C D. Now, when does the extra weight begin: when it leaves B towards A, or when it leaves C towards A, D being the lever support?—J. F. C.

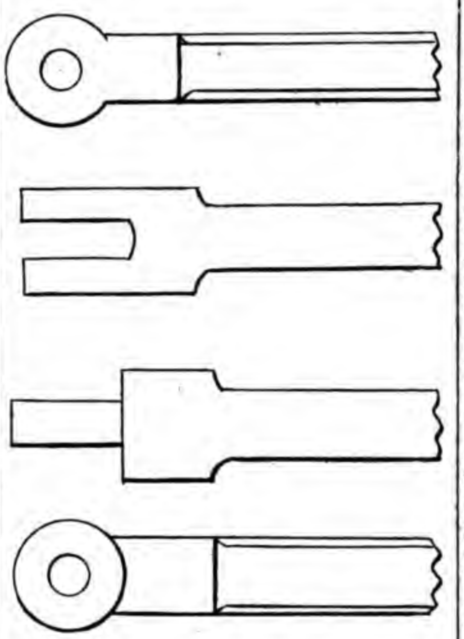


[58123.]—**Motor for Electric Mechanical Clock.** —Will some kind contributor give a description of the above: size of field magnets, armature, and wire suitable to use with four small cells of Leclanché. I have tried Chaster's, King's, and Jones's; but they failed with Leclanché, but very good with Bunsens.—J. E. S.

[58124.]—**Blowpipe.**—I want to make a blowpipe for glass spinning and making small articles out of coloured glass. Wil some reader kindly give me a few hints as to the best way of making one which could be used without gas?—AMATEUR.

[58125.]—**Condenser.**—I have a 5in. induction coil, and if I fit a condenser to same, will it increase the strength of the current? Will any of our readers kindly give me instructions how to make and connect the condenser? How many sheets of tinfoil, 10in. by 4in., will it require? A rough sketch will be esteemed, just to show the method of bringing condenser into circuit.—MERCURIUS.

[58126.]—**Knuckle Joints.**—Will some kind friend (an experienced smith) inform me the best and quickest way to forge knuckle joints and skew joints, as I have a large quantity to forge, and I am not accustomed to the work (I have inclosed drawing)?—YOUNG SMITH.



[58127.]—**Governor Balls.**—I wish to ask any readers if they can tell me an easy method of ascertaining the rise of common governor balls, out of algebra?—MODEL.

[58128.]—**Lathe Surfacing.**—A straight-edge placed across the diameter of a circular piece of work in one position shows it to be slightly convex; placed at right angles to this position across the diameter the work is shown to be slightly concave. What is the cause?—A. WEST.

[58129.]—**Hydraulic Rams.**—Will Mr. Davies, or some other able reader of "Ours," kindly inform me what fall, length, and size of drive pipe and size of delivery pipe it will require to deliver water about a mile at an elevation of 200ft. (about 2,000 gallons a day)?—A COUNTRYMAN.

[58130.]—**Amber Varnish.**—Some time ago, I bought some amber (price about 1s. 6d. per lb.), labelled gum succini. I think it must be what Cooley calls mellite, as it does not melt, and methylated spirits or bisulphide of carbon have little effect on it. Can any obliging reader inform me how to dissolve it? Where can I get real amber for varnish making, and its price?—SIMPLON.

[58131.]—**Differential Galvanometer.** — I wish to make a good differential astatic galvanometer, with rotating coils, and shall be obliged by full particulars as to the winding wire, &c.—J. R. E.

[58132.]—**Electric Lighting.** — Will any reader oblige with the working formula of a dynamo, to light forty 5 c.-p. lamps, shaped like King, Mendham No. 3 dynamo, with a Pacinotti armature?—A. C. W. G.

[58133.]—**Down Draught.**—On my recommendation ·ortoise boiler stove was fitted, in a cellar, to hot-water s, coming from the room above. The chimney consists of cast-iron pipes taken to the outside of the house. At first a height of 12ft. for the chimney was tried, but it was found impossible to light, owing to down draught. Then the chimney was raised to about 25ft; still the same down draught. Then the chimney was taken to a point above the top of the roof, and still it is impossible to use the stove owing to down draught, even after the stove has been alight an hour or more. Can someone explain this down draught, and oblige by suggesting a remedy?—HENDON.

[58134.]—**N.E. Railway Express Engine.**—Can any correspondent give further particulars of the new 8ft. 6in. single mentioned by "Ghilleas Buig Mac Tômae" in reply to query No. 57815? Could anyone oblige with a sketch?—NO SIG.

[58135.]—**G. W. Railway.**—Can any kind reader give particulars of the new broad gauge engine being built at Swindon; sketch, if possible?—NO SIG.

[58136.]—**Transferring.** —I am desirous of transferring outline drawings from paper to cloth, and should be obliged for any information as to a suitable medium, to use with either brush or pen, with which the outline is first drawn on paper, and which afterwards, by pressure or otherwise, may be transferred to the cloth, dye black or other dark shades. Any fair impression of the original paper outline drawing, which may be visible on any coloured cloth, is what I require.—APHIS.

[58137.]—**Safety Jet.**—I am making an oxy-hydrogen safety jet. Can any reader tell me whether the oxygen or the hydrogen nipple ought to be highest, or whether they should be level, to give the best effect? Also about what diam. is best for the oxygen nipple to give the best light? —NOVICE.

[58138.]—**Engineer's Arithmetic.**—Would any of my fellow readers, who are well up in figures, kindly assist me by solving the following questions, and also advise me what books I should get to study, so that I might be able to solve any other questions of a similar nature? A piece of wood, 10ft. long, and weighing 12lb., is acted on by a force of 15lb. through 4ft.; how far down will it sink in the water, and with what force will it come up, its specific gravity being one half that of water? The cylinder is 60in. diam., 4ft. stroke, revolutions 70 per min., the connecting rod is of indefinite length, and the piston is solid and 4in. thick; find at what rate the velocity of the piston is changing at the end of the stroke, and what pressure of steam it has taken to effect the change.—A JUNIOR ENGINEER.

[58139.]—**Resonator for Tuning-fork.**—I have made a large tuning-fork, which yields a very low note. It is either the F close below the bass clef, or an octave lower; but as the first overtone is clearly recognisable as middle C, I conclude that the fundamental sound is that of the first-named F, with about 40 vibrations per second. In the absence of a suitable resonator, I cannot get a proper volume of sound from the fork even when it is struck with padded hammers. Vainly have I tried many tubes of various lengths and diameters, both open and stopped. The last tried was one 7ft. long and 2¼in. diameter, with a moveable plug, and with this there was no resonance whatever. On a closed door the fork gives a very deep and rather powerful note, the vibrations seeming almost slow enough to be counted. Any suggestions as to the best means of bringing out a tone of sufficient power to be heard in a large room will be highly esteemed by—W. H. S.

[58140.]—**Fugitive Printer's Ink.**—Can any reader inform me the composition of the above, which I believe is used to print the name of the bank, &c., upon cheques? It changes colour by age, and if an attempt is made to obliterate the ordinary writing the printed portion of the document disappears.—W. H. S.

[58141.]—**Medical Electricity.**—I wish to make a battery and belt, to use in a case of impaired vital energy, and should feel obliged if one of our electricians will clear up the following for me: Can I make a belt of Skrivanow dry cells, and how are they made? What E.M.F. will overcome resistance of the skin? In what direction should current run, from spine to scrotum or scrotum to spine, or how should it be applied? What is a good work on medical electricity?—ELECTRON.

[58142.]—**To Mr. Wimshurst.**—Will you kindly say how close to each other the glass discs in influence machine should be? If vulcanised washers are put on as recommended in your answer to W. R. Hart, No. 57926, the discs would be ⅛in. apart.—C. L. W.

[58143.]—**Hydrate of Calcium.**—On p. 220 of the MECHANIC it is stated that H. of C. is a remedy for vine mildew. Can anyone inform me how it should be used? Also what is the price of H. of C?—TAUNTON.

[58144]—**Magnesium.**—Would some reader inform me how to solder some pieces of magnesium together, stating the flux and solder to be used, and the process?— R. B. C.

[58145.]—**The City Companies.**—If the chartered companies of London do not now restrain persons exercising certain trades without fulfilling certain conditions, is it because some of the legal privileges which they formerly enjoyed have been taken from them, or because they do not choose to put their powers into operation? Had the chartered companies of London at any time control over tradesmen who practised their trades out of London?—P. BYRNE.

[58146.]—**Registration of Designs.**—Did the copyright in registered designs exist for more than five years under any of the Acts in force previous to that of 1883?—P. BYRNE.

[58147.]—**Lens.**—My lens is without stops. How can I fit these in? Will the necessary arrangement interfere with the rapidity of the combination? Diam. of lens, 1 6-8.—C. J.

[58148.]—**Cotton-seed Oil in Lard.**—Will Mr. Allen, or other of your correspondents, inform me how cotton-seed oil may be detected and estimated in lard? Can the sp. gr. test be relied on, and, if so, is the sp. gr. of lard at 100° Fahr. (0·902 to 0·909) compared with water at 60° Fahr.? Also, can mutton or other suet be detected in the same?—JUVENIS.

[58149.]—**Concerning Canals.**—Will any kind reader say if tricycles are allowed on the path by the side of a canal, or is it considered to be a footpath only?— JUDY.

[58150.]—**Currier's Query.**—I have a shoulder of undressed leather I wish to soften and whiten on the grain, it being very dark and hard, making it hard to stitch and block.—CURRIER.

[58151.]—**Speed of Steam.**—What is the usual speed of steam through the ports of a hor. high-pres. engine, 10in. dia., 20in. stroke? What is the highest allowable with good results?—LEICESTER.

[58152.]—**Feedwater.**—What amount of feedwater should the feedpump supply to a boiler, and how much should be left for injection? How is the pump generally worked (revs. of engine, 100 per min.)?—LEICESTER.

[58153.]—**Flywheel.**—What limits the weight of a flywheel—cost and room only? What limits the diam. compared with the weight? Why not in ordinary flywheels increase the diam. and decrease the weight? If a wheel runs at 100 per min., why not make dia. such that the circum. runs at the limiting speed for c.s.?—LEICESTER.

[58154.]—**Cylinder.**—What should be the thickness of a 10in. by 20in. cylinder, with 50lb. working pressure? I find "cylinder should be designed for stiffness, as that insures strength"; then why take account of the pressure used?—LEICESTER.

[58155.]—**Copying Drawings.**—Which is the best for this purpose, a pentagraph or an eidograph? Is there any less expensive instrument that could be used for this purpose? I know the method of copying by means of squares, but this does not suit my purpose; the drawings would have generally to be reproduced on a somewhat smaller scale. If some kind reader would give me instructions with dimensions [for making a suitable instrument I should be greatly obliged.—FAL.

[58156.]—**Electric Clock.**—Will "Acolyte" (letter 25025) kindly supply, for insertion in the ENGLISH MECHANIC, with the Editor's permission, a drawing to scale of the pendulum complete of the electric clock, together with the solenoids and contact breaker, and the train of wheels he names "step and fetch it," together with plain directions for winding and fitting up the solenoids, so that an inexperienced amateur, like myself, may be able to make one? The subject of an electric clock has always had a great fascination for me, and I should much like to make one.—C. E. F.

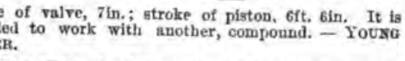
[58157.]—**Coil.**—TO MR. S. BOTTONE, OR OTHERS.—Have just completed an induction coil; bobbin 3in. long, and wound with two layers No. 18 and fifteen layers No. 36 silk-covered, insulated with paraffin wax and paraffined paper between primary and secondary, also wax between each layer of secondary. The condenser is formed of 19 sheets tinfoil, 6 by 2½, connected with c. breaker and screw. In making the above, where the secondary was broken, I scraped and then twisted it together and covered with wax. Will you, please, say whether the contact will remain good? Also what length of spark it ought to give? With a pint bicro. cell it gives a good shock, but can only get spark when wires actually touch. Ought there to be anything on end of wires for discharging—as balls?—RHUMKOFF.

[58158.]—**Tinning Copper and Iron Pans.**—I have a large iron pan, which I wish to tin, also a copper kettle. Would any reader of the "E. M." tell me how to do them, and the best way to harden the tin, so that it will last some time?—FIVE POINTS.

[58159.]—**Engine Pump.**—We have erected a 15 H.-P. engine about 40ft. to 45ft. distant from 20 H.-P. boiler, and cannot get the pump to force the water into the boiler. Will some kind reader say the cause?—C. AND CO.

[58160.]—**Block Boiler Composition.**—Will any of our readers be kind enough to inform me of the process by which this composition is made? One of the principal ingredients is evidently leather. This can be seen and smelt whenever the block is cut or broken. I have been told that superheated steam is passed through the leather to get it into the block form; but I should think some cementing matter, like pitch, must be used as well.—CEMENT MAKER.

[58161.]—**Exhaust.**—Will any of our correspondents give me instructions in plain figures how to tell where the exhaust opens and close? This is an engine that is being made in the shop where I am apprentice. Dimensions of slide-valve and cylinder:



Stroke of valve, 7in.; stroke of piston, 6ft. 6in. It is intended to work with another, compound. — YOUNG FITTER.

[58162.]—**Speed of Crank.**—Will any of our correspondents be kind enough to tell me how to get the speed of the cross-head at different positions of the crank, as it must go faster and slower. Stroke of piston, 6ft. 6in.; number of revs. per min., 40. I do not understand algebra. YOUNG FITTER.

[58163.]—**Dynamo.**—Thanks to Mr. Bottone. I will put on the 3lb. No. 24. Would there be any advantage in first adding 1lb. of No. 18 to each F.M.? "Connect in parallel" I understand to be: connect one end of the No. 24 to left binding screw and wind on left F.M. in the same direction as the No. 18 is wound, and connect to left brush block; right-hand F.M. in a similar manner. If this is wrong, please correct me, as I am only a beginner at dynamos. If connected for a shunt circuit, then the current in No. 24 will only pass round the F.M., and none of it pass to the outer circuit. Is this correct?—BRIAN BORU.

[58164.]—**Enamelling Photographs.**—Will some correspondent please explain the cause of collodion film tearing and stripping from glass plate as soon as it is dry, and sometimes even after they are gelatined. The plates are roughed all round the edge. I have prepared the plates with talc, also with benzole and wax; but with the same result.—G. R. T.

[58165.]—**Magneto Machine.**—TO MR. BOTTONE.—Will you kindly say where I am wrong with my machine? I require it for medical purposes: bobbins, 1¾in. long; iron core, ⅝in. dia., wound with seven layers No. 24 c.-c. wire. I have five magnets, ⅝ by ¼, 12in. long, bent horse-shoe, 2½in. between centre of legs. Each magnet will bear its own weight, with keeper, easily. Commutator, two insulated rings, one flattened at each side to cause break; speed over 1,000. On revolving bobbins, I cannot get the slightest effect, and should like to know where I am wrong; also if commutator is right.—W. H. M.

[58166.]—**Polarisation in Batteries.**—TO SIGMA.—In reference to our letters 24999 and 25000, with many thanks for the information you have given me, I presume that I must have misunderstood Prof. Thompson in supposing him to speak of 2·394 as the net E.M.F. of zinc with sulphuric acid, when he really meant it to be subject to deduction for the opposing force of the hydrogen, independently of the resistance (properly so called) of the bubbles. But with reference to your own estimate, do 1·464 and ·506 volts represent electrically the tendency of hydrogen and copper respectively to combine with oxygen, or with SO_4, or are these two things practically the same when the acid is dilute, and am I to understand that 2·248 — 1·464 = ·784 volts is the net E.M.F. with acid, and 2·248 — ·506 = 1·742 the net E.M.F. with copper sulphate? The latter figure is surely much higher than the greatest E.M.F. obtainable from sulph. of copper under any circumstances, and therefore I think I must have misunderstood you in some way. Perhaps you reckon the opposing force of the negative plate separately.—A. E. B.

[58167]—**Sanitary.**—What is the best plan of earth closet: especially with the view of utilising the material as a fertiliser for suburban garden?—SEMI-DETACHED.

[58168.]—**Astronomical Asteroids.**—Is it not very probable that the rapid discovery of new asteroids which has taken place lately is but the re-discovery of some that have been lost sight of? Being so minute, they must undergo excessive perturbation, and so be very difficult to follow.—COPERNICUS.

[58169.]—**Action of Steam on Firebricks.**—If steam is injected against red-hot firebricks, forming an arch in a lime kiln, will it have any injurious effect on the firebricks? and, if so, please state how the injury is caused?—PROGRESS.

[58170.]—**Waterworks.**—What are the conditions which have to be observed in selecting a "gathering ground" for the water supply of a town? Upon what data should calculations be based for providing a sufficient supply in all seasons?—Y. N.

[58171.]—**Electric Clock.**—"Acolyte's" description of his electric clock is most interesting, but leaves much to be desired. The designing of an electric clock has long occupied my mind; and of the many drawings I have made, accompanied by models, none have satisfied me, nor come up to my requirements, therefore any hints I can obtain from my more-favoured brethren in the science will be very acceptable. I would ask "Acolyte" to kindly furnish the further particulars (accompanied, if possible, by a sketch) which he has promised, and which I am sure many besides myself will be grateful for.—YOSHI.

[58172.]—**Plating.**—I am plating a few brooches, earrings, &c. Will someone kindly inform me how I can prevent the silver forming on the backs, as I want to do them as cheaply as possible?—J. F.

[58173.]—**Wood Turning.**—Will some kind reader give a few hints on wood turning, such as wringing machine rollers? What tools are used for boring, for shaft rings, &c.?—H. B. M.

[58174.]—**Turning Washing Machine Rollers.**—Will some kind reader inform me if it is possible to fix a chisel to a long T rest to skim the above up quickly and smooth?—H. B. M.

[58175.]—**Vallisneria Spiralis.**—One of the most beautiful sights in vegetable physiology is the motion of the sap seen with a ⅛ objective in the cells of this plant. A scientific friend has generously sent me a small rooted specimen, and I want to know how best to grow it, so that it will become vigorous, healthy, and flourishing?—E. B. FENNESSY.

[58176.]—**Wimshurst Machine.**—Is there any special reason why these beautiful machines are usually made from 12in. to 18in. in dia.? Why not make the plates from 4ft. to 5ft. dia.?—E. B. F.

[58177.]—**Casting Brass.**—What is the white powder which is shaken over the sand mould after taking out the mould, and which gives the brass when cast a clean yellow or copper colour? I have used charcoal, also powdered lime; but the casting comes out black and not clear from the sand.—MOULDER.

[58178.]—**Chalk on Heath Land.**—I should be glad if some of "Ours" would give me some advice. I have bought some £10 building plots of land at Fleet, near Basingstoke, Hants. It is covered with heath. There is about 4in. of dark sandy peat on top, then sand and gravel. The question is, would chalk do good or harm? There is a farmer there who has put chalk on his land, and I am told now it will grow nothing, which I doubt very much. Dung manure very soon sinks through and is lost. Any hints will oblige. I want to make a garden at the back of house. Pines grow well. There is a splendid air here.—LONDON MAN.

[58179.]—**Joy's Valve Gear.**—Will somebody kindly tell me how to proportion the various articulations, the data being length of stroke, length of connecting rod, width of ports, &c., and position of required cut-off; also available stroke of valve?—NEL'S POORT.

Hydrogen in Zinc Dust.—It has long been known that shippers are unwilling to carry large quantities of zinc dust in their vessels, owing to the danger of its getting moist and becoming heated to a dangerous extent. Mr. Greville Williams, F.R.S., has recently made some researches which throw light on this matter. He finds that wetted zinc dust, after drying, gives off nearly double the hydrogen that unwetted dust gives. Hydrogen is absorbed from a moist atmosphere at moderate temperature by zinc dust. It has, in fact, the power of occluding hydrogen after the manner of spongy platinum.

CHESS.

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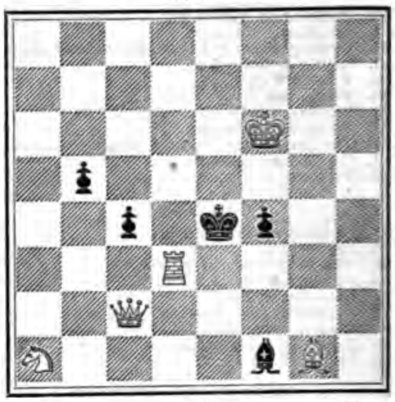
ALL Communications for this department must b addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLXVII.—BY T. TAVERNER (Bolton

Black.



White. [5 + 5

White to play and mate in three moves.

SOLUTION TO 965.

White.	*Black.*
1. Kt-K R 2	1. Anything.
2. R, B, or Kt mates.	

(Three variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 964, by F. O'N. Hopkins, Link, S. Bright (Genoa), A. Bolus; to 965, by Link (very obvio without much defence for Black), C. S. Bright, F. O' Hopkins, C. F. Schönewald, V. S. Pochin, R. A. Benn A. E. Brice, T. W. Searle, T. Dodd, and H. H. Davis.

R. F. SUNDERLAND.—After 2 $\frac{\text{— —}}{\text{P-Q 3}}$ B cannot take P, check would be discovered.

B. FISON AND G. J. SLATER.—Many thanks for problems, which are very acceptable.

A. E. B.—You must have your revenge next time.

V. S. P.—We hope to start a new Solution Tourney the beginning of the year. Shall we put down your

C. F. S.—The only mistake in your notation is in reck ing the squares to which Black's pieces are moved fr white's side of the board. Each colour reckons the posi of its own pieces from its own side of the board.

A. B.—For such an omission in a Tourney you lose, at least, half marks.

The Society of Cyclists.—Last Tuesday eve[illegible] ing the ordinary meeting of the Society of Cycli[illegible] was held at 9, Conduit-street, Regent-street, und[illegible] the chairmanship of Dr. B. W. Richardson. Aft[illegible] the minutes of the previous meeting had be[illegible] passed, and a number of new members elected, th[illegible] chairman stated that it had been decided to hold [illegible] congress of members at Colchester on Wednesd[illegible] June 26, to the following Saturday. The two se[illegible] tions would commence the work of the congress [illegible] the second day, and the last day would be devot[illegible] to excursions to places of interest in the neig[illegible] bourhood. The communications to the society were by Mr. J. Glover, who exhibited and [illegible] plained a new form of tricycle; Mr. D. [illegible] Blyth, "On the Essex Route to Kent;" and [illegible] Mr. and Mrs. Pennell, "Our Sentimental Journey[illegible] Mr. Glover, in his invention, by means of secon[illegible] power levers, aims at preventing what is known [illegible] a "dead centre," and also enabling the rider to [illegible] his speed gearing without dismounting. Mr. Bly[illegible] paper briefly described a route out of the me[illegible] polis by which cyclists could avoid the traffic [illegible] bad surface of the ordinary road. Mr. Pe[illegible] paper dealt with a tour which he, in compa[illegible] his wife, took to Rome. He expressed [illegible] satisfaction with the charges made by the railway companies for the carriage of tri[illegible] spoke very favourably of the roads an[illegible] he received whilst on the Continent. [illegible] was listened to with considerable i[illegible] vote of thinks was accorded to [illegible] Similar compliments to the other [illegible] chairman concluded the proceed[illegible] munications to the society at t[illegible] meeting will include "A Peep [illegible] Tricycle," by Mr. J. B. Marsh.

THE city art gallery at the [illegible] Manchester is the first public [illegible] United Kingdom in which [illegible] employed. The installatio[illegible] and the autumn exhibitio[illegible] a.m. till 9 p.m.

The English Mechanic
AND WORLD OF SCIENCE AND ART
FRIDAY, DECEMBER 4, 1885.

SOME RECENT IMPROVEMENTS IN APPARATUS FOR ORNAMENTAL TURNING.

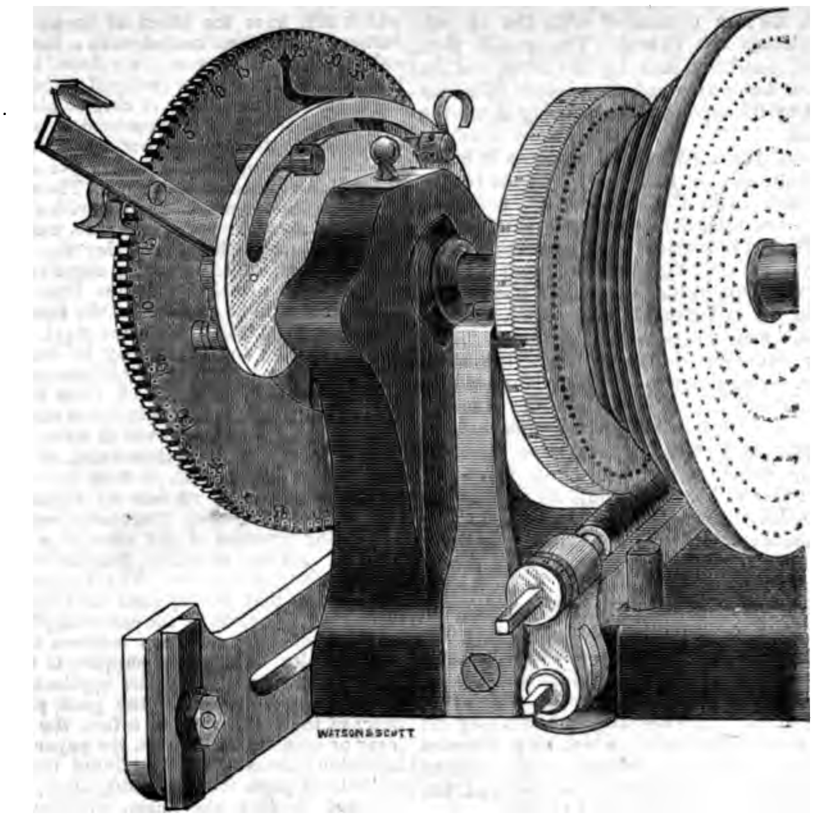
By J. H. Evans.

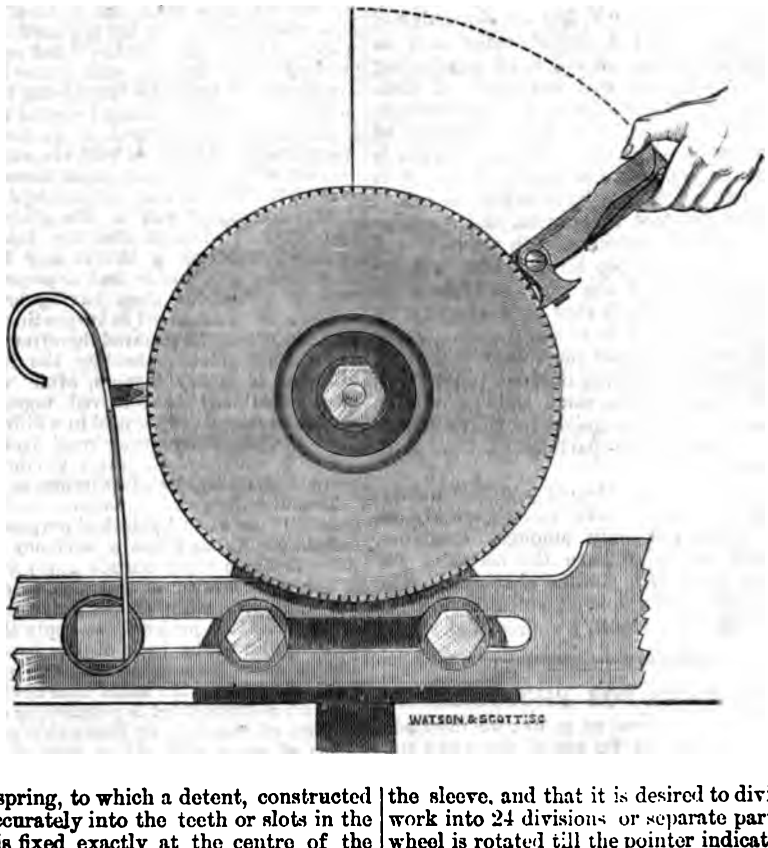
THE present paper will, I hope, be found of considerable interest, as it embraces a most important part of ornamental turning—namely, the accurate dividing of work by an automatic arrangement invented by Mr. T. J. Ashton. The division plate, if not the most important, is one of the most important parts of the ornamental turning lathe, and correct counting is absolutely essential in every piece of work, as any error irretrievably mars what in other respects may be the finest workmanship. All who have been engaged in ornamental turning have experienced the very considerable attention that must be given to this part of the work, and not a few have found that, having nearly finished an elaborate piece of work, the whole has been spoiled by the index pointer having been placed in a wrong hole, either through an interruption, failing light, defective sight, or other cause, while time, labour, and perhaps temper, have been lost.

The liability to error is general, and acknowledged by most amateurs, and various contrivances for counting automatically have been attempted from time to time; but they have failed to accomplish the object with the same amount of precision and ease as that now under our consideration.

In 1882 Mr. Ashton solved the problem, and at the conversazione of the Amateur Mechanical Society of that year, he exhibited his automatic counting apparatus, which I have since been manufacturing with considerable success, and which I shall now describe.

A steel sleeve having a flange in its centre fits over the end of the mandrel in the same manner as the ordinary cap used to retain the mandrel between the collars in the headstock; a ring of steel having two arms of different lengths and definite angles to each other is fitted to the sleeve, and on the side of the flange nearest the lathe-head, and retained in position by a nut and washer, but rotates freely on the sleeve. To the short arm is attached a circular cam having two projections on its periphery: through the one the pin connecting it with the arm passes, the centre corresponding with a continuance of the line of the circumference. A large aperture is cut in the cam, permitting the sleeve to pass through, and allowing perfectly free action to the cam. To the long arm is attached a lever, and this, by means of a strap or link, is connected with the cam; a spring acts on the lever and retains the cam eccentrically. On the outside or left of the flange on the sleeve, the division wheels, of which there may be several, are fitted; but one of 192 and one of 120 will give nearly every division that will be required. The wheel is securely held to the sleeve against the flange by a steel nut and washer, so that it cannot move except with the rotation of the mandrel. The wheels are 7in. in diameter, and [illegible] of the necessary number of divisions accurately cut in its circumference. Over each slot or tooth a small hole is [illegible], and these are numbered as in the division-plate on the pulley. A steel pointer is arranged to stand perpendicularly, so that the number, or numbers, indicated are always in view. A pawl is connected with the [illegible] which falls into the slots in the [illegible]al bar is firmly attached [illegible] the head a[illegible] strong spring, to which a detent, constructed to fit accurately into the teeth or slots in the wheel, is fixed exactly at the centre of the mandrel axis; an arm extends inwards from the spring to about an eighth of an inch beyond an imaginary line, which would be indicated when the circular cam before mentioned is concentric with the mandrel axis.





A semicircular plate is fixed to the back face of the lathe head above the mandrel, having a radial slot cut in it, which carries an adjusting stop with a regulating screw, a second stop being permanently fixed to the plate; the object of the stops being to regulate and limit the movement of the arm to which the pawl is attached.

The action of the apparatus is very simple. I will suppose that a wheel of 120 teeth is on the sleeve, and that it is desired to divide the work into 24 divisions or separate parts; the wheel is rotated till the pointer indicates zero or (120); the detent will then fall into the thirtieth slot, or a fourth of the whole number. The long lever rests on the lower or fixed stop, and the pawl is made to drop accurately into the slot by means of the regulating screw. The lever is then raised to suit the number of divisions required, and retained in that position till the movable stop is brought in contact with it; hence, it follows that each time the lever is raised the pawl will fall into every fifth slot or division. All being now adjusted, the first cut in the work is made; the arm is then pushed up with the left hand, and the lever being pressed on, the circular cam is brought concentric with the axis of the mandrel, and at the same time impinges against the arm connected with the spring, and releases the detent. The arm is then lowered until arrested by the stop, and on the lever being released the detent falls into the thirty-fifth slot and immovably fixes the mandrel.

One of the most tedious patterns in ornamental turning is that known as the basket work, cut with the vertical or universal cutter ; the variation in patterns obtained by the different movements of the division plate in combination with it, are very great : with the apparatus we are now considering, it is effected with much greater facility, and consequent rapidity. Thus, having cut once round at, say, the same division—viz., every 5—the tool is moved by the main screw of the slide-rest exactly its own width, denoted by the micrometer, the detent moved, say, one slot or division, and the same number 5 again taken all round : this will leave the cuts all exactly the same width and length, but one division away from the starting point. This being repeated the whole length of the work, a very pretty basket pattern of a spiral form is produced, and very speedily effected. By varying the space from each consecutive cut, a great number of most effective results are obtained.

The advantages of the apparatus are obviously very great—the ease with which it is adjusted, the impossibility of making an error, the rapidity with which each division is effected by one hand only, and without any necessity for stopping the speed of the lathe, or the turner altering his position.

In describing the improved tool-carrier of the slide-rest in the “ E. M.’ of November 6, I mentioned that I should refer to it in this paper, with the intention of illustrating the great facility and economy of time effected by using them in combination, especially in making a large number of shallow cuts. Thus after the tool carrier is adjusted to the requisite depth of cut, it is made to advance, and the moment the cut is made and the tool withdrawn, the requisite division is instantly made with the left-hand by pressing on the top lever, which will release the detent at the back, as seen in the engraving of the back view of the apparatus.

In this manner I have made a long series of cuts, and produced most beautiful work with a very great saving of time. Moreover, I have executed the same amount of fine work when deeply engaged in conversation, and not paying any particular attention to the work.

This apparatus is of such practical utility, that it is coming into more general use every year, not only amongst amateurs, but with all who have the necessity for dividing work of a similar character. The number already in hand convinces me further that the invention is duly appreciated.

PAPER FILMS FOR PHOTOGRAPHY.

IN the last volume, at p. 406, we inserted a short article on the use of paper as a substitute for glass for photographic negatives, and at p. 471 gave a description of the new sensitive negative paper prepared by Mr. Warnerke. We give now a description of the process adopted by Messrs G. Eastman and W. H. Walker, of Rochester, N.Y., which has been patented in this country and elsewhere. The advantages of gelatinised paper films, instead of glass plates coated with emulsion, go without saying, and need not be recapitulated here. The question the photographer wishes settled is whether the new paper films will do work equal to the glass plates. Messrs. Eastman and Walker prefer Rive's paper on account of its freedom from chemical impurities, fine grain, and translucency, but any other suitable paper may be used. The first coat applied to the paper is an aqueous solution of gelatine, of a strength equal to about fifty grains to the ounce, and, when dry, the paper is preferably passed between calendering rolls, or subjected to the action of any mechanism which will have the effect of burnishing its surface. It is then coated with a film of any ordinary gelatino-argentic emulsion, the gelatine of which has been rendered more or less insoluble by the addition of chrome alum. The solution of the latter recommended is one of ten grains to the ounce of water, which is to be added in the proportion of about five ounces to the gallon of finished emulsion. The operation of coating the gelatinised paper with the sensitive film must be performed in a non-actinic light, and when the film is dry the paper is ready for use, either in taking negatives in the camera, or in printing positives from a negative. If it is to be exposed in the camera it is advisable to attach it to some rigid support. The developing and fixing may be carried out in any usual manner, and after thorough washing the film may be detached from the paper in the following manner :—The fixed and washed film is floated face downward in water ; a glass plate is then introduced thereunder, so that the film being lifted with it may be caused to adhere closely to its surface by a pressure on the back of the paper, preferably secured by the sliding pressure of the edge of a straight piece of rubber or other flexible substance carried along the paper. The application of the pressure may be repeated until contact is secured at all points by the entire displacement of the water and air from between the glass and the film. The paper support is next detached from the film by the application of a suitable degree of heat to the glass plate, the effect of the heat being to soften the gelatine layer or substratum between the paper and the insoluble gelatine film containing the image, so that the paper may be readily stripped off or removed, leaving the image adhering to the glass. The heat may be applied uniformly by placing the glass on a hot plate of metal, or on a water bath, or by the application of warm water. In case the film has dried on the glass, it must be moistened with water before the application of heat, this latter being the method preferred. Any remaining traces of the soluble gelatine may be sponged or washed off with warm water. The glass with the adhering film thereon will be ready for use on becoming dried. If desired, the film may be varnished as usual. A thin coating of wax on the glass or other support will admit of the film being readily stripped therefrom, so that it may be printed from either side, and be used or preserved indefinitely. Thus the glass having been coated with beeswax dissolved in turpentine, the gelatine image may be removed therefrom by applying a moist gelatine sheet to the image, and allowing it to dry thereon, after which the two sheets may be removed together. The operation may be performed in a different way. Thus the paper may be stripped from the film before development, or after the development and before fixing, or after fixing, as preferred.

The film prepared as above described will generally answer all practical purposes ; but in certain conditions it has a tendency to curl, to prevent which the patentees apply at the back of the paper a layer of gelatine to counteract the expansive effect of the gelatine layer on the front. It is preferred to apply this second form of film to the back of the paper at first, and to use a preparation which is practically insoluble and at the same time flexible. The solution recommended is prepared by dissolving 7,000gr. of Simeon's or Heinrich's gelatine in 190oz. of water, and adding 18oz. of pure glycerine, and 60gr. of chrome alum (the latter last, having been previously dissolved in some of the water). A coating of this having been applied to the back of the paper and dried, the face side is covered with a layer of a solution prepared by dissolving 7,000gr. of Nelson's No. 1 gelatine in 140oz. of water, and adding 5oz. of glycerine. The glycerine and chrome alum may be raised in their proportion to alter the degree of flexibility and insolubility. The paper thus coated on each side is passed through burnishing rolls as before, and is then ready to receive the sensitive film of gelatino-argentic emulsion. The subsequent operations are identical with those above described.

THE PHILOSOPHY OF DRINKING LARGELY.

WE do not speak of drunkenness, albeit the poet has taught us *in vino veritas*. What we have now to say relates to the wisdom and reason of drinking largely of fluids which are in the first place and principally solvents and diluents. Not very long ago those unhappy folk who go wearily and sadly, because, forsooth, they are waxing fat, were warned to leave off drinking largely and to minimise the quantity of liquid they consumed. Never before, perhaps, was there a more mischievous “fad” imposed on a too credulous public than this reduction of the amount of fluid taken. Now the obese are, by the rotary madness of the crazy in physic, counselled to drink deeply. This, at least, is a safe policy, and whether or not it does anything in aid of the removal of fat, it will certainly not produce the evil consequences which have in too many cases been brought about by the abstinence from solvents and diluents. Our concern is not with the “anti-fat” movement; with this we have no sort of sympathy, except in so far as an accumulation of adipose tissue may chance to be morbid. Meanwhile there are physiological facts in relation to drinking which ought to be recalled by those who know them, and brought to the knowledge of the unskilled in medicine, because they concern the promotion of health. Thus it is essential that there should be constantly passing through the organism a flushing, as it were, of fluid, to hold in solution and wash away the products of disassimilation and waste. Those who do not recognise the fact that three-quarters by weight of the entire organism is normally composed of fluid cannot fully realise the great need which exists for a copious supply. If there be not a sufficient endosmose, the exosmose must be restricted, and effete matters, soluble in themselves, but not dissolved because of the deficiency of fluid available, will be retained. Take, for example, the uric acid; this excrementitious product requires not less than some eight thousand times its bulk of water at the temperature of the blood to hold it in solution; and if it be not dissolved it rapidly crystallises, with more or less disastrous consequences, as in gout, gravel, and probably many other less well-recognised troubles. We only mention this particular excrement by way of illustration. In all, it may be fairly concluded that not less than three and a half pints should be consumed by any person in the twenty-four hours, and when the body is bulky four or even five pints should be the average. It is, moreover, desirable that the fluid thus taken should be in the main either pure water, or water in which the simplest extracts are held in solution. When fluid taken “as drink” is itself heavily charged with solid matter, it cannot fairly be expected to so entirely rid itself of this burden in the process of digestion and absorption as to be available for solvent purposes generally, although the separation between solid and fluid ingredients of the food is doubtless fairly complete in the processes preparatory to assimilation. The aim should, nevertheless, be to supply the organic needs in this particular abundantly, and with such fluids as are not overloaded with solids, but simple and readily available as solvents. Another urgent reason for drinking freely of bland fluids is to be found in the need of diluents. This is something slightly different from mere solution. Many of the solids of the tissue waste are of a nature to irritate and even disorganise the kidney, if they be brought to that organ for excretion in too concentrated form. There is no reason to suppose that the kidneys are liable to suffer from over-work if the specific secreting power of the kidney cells be not too heavily taxed. If only the products of disassimilation be diluted, so that they can be passed through the kidney by the simple process of exosmosis, the organ will discharge its function without injury or exhaustion. As a matter of fact and experience, those who drink innocuous and unstimulating fluids freely do not suffer from kidney trouble, but are almost uniformly healthy—at least, so far as the excreting functions are concerned. It is a popular fallacy that the kidneys may and ought to be relieved by the determination of fluid to the surface of the body and perspiration. Except in cases of organic disease of the kidney, or where, as in the elimination of a special product, it is desirable to use the skin as an emunctory, the fluid diverted from the kidney is wasted so far as flushing purposes are concerned.—*Lancet.*

CUTTING SPIRAL AND SPUR GEARS ON A MILLING MACHINE WITH A SIDE TOOL.*

I HAVE extended the application of the principle for cutting spiral gears, illustrated and described on p. 185.

If a side-tool A, Fig. 2, is held in fly-cutter holder B, and the cutting-edge A, is perpendicular to the centre of spindle S, then when spindle turning the edge, A describes a plane sur- The outline of this surface is, of course, cir This principle enables us to cut spiral Universal milling machine without attachment. Theoretically, all spiral

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* By O. J. Beale, in the Americ

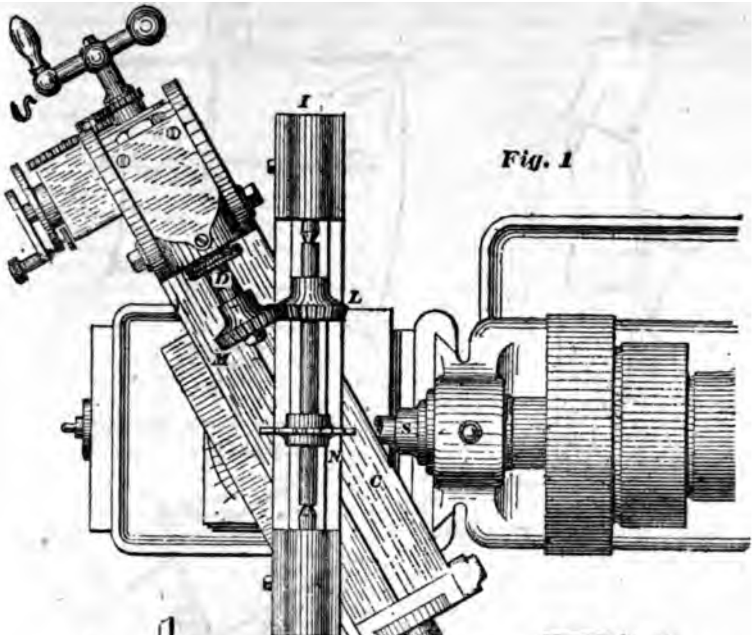

Fig. 1

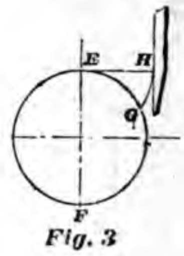

Fig. 3

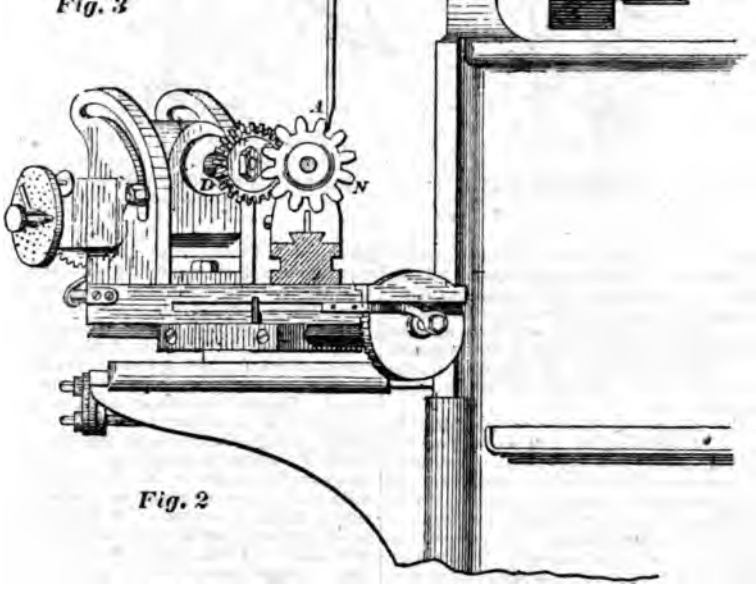

Fig. 2

n this way, but there may be a practical limit ccount of the curved outline of the plane ce developed by the tool.

e end-wise movement of the spiral bed C, Fig. ompanied by the turning of index spindle D, the helical grooves in milling. The spiral C, being set to an angle not perpendicular to utter spindle S, makes the work also move vise as the bed C advances. Now, these moves, when cutting with a side-tool, conform to ondition of unwinding a line from a cylinder, Fig. 3, generating the involute of a circle. circle E F G, from which the line E H uns is called the base circle. The end H, of the E H, started at G, and in going to H, has the involute G H. In the case of our spiral the base circle E F G, rolls upon its upper-part, the line E H, as the base circle rolls; hanging from a horizontal position. This g does not take place directly under the cutter le, but after the gear passes the spindle. nvolute is a form often taken for the teeth of wheels. Such teeth are called single curve In the common system of single curve the diameter of the base circle is ·968 of [illegible] circle. By adhering to a [illegible] to pitch [illegible] the [illegible] the calculations for lead of spiral and angular setting of bed C, Fig. 1, are made upon the base circle of the involute. When the contour of cutter gives the shape to teeth of spiral gears, the lead of spiral and angular setting of bed are calculated at the surface of the pitch cylinder of gear. In cutting spiral gears with the fly-tool, the lead of the spiral should be such as to give the required angular relation of teeth to the axis of gear at the pitch cylinder, but the angular setting must be made for the base circle. This means that the same spiral lead or pitch can be used for different base circles by a simple change of angular setting of bed C. When the tool was in full cut it acted upon one side of a tooth, between root and point of tooth, at each revolution of cutter-spindle. Theoretically, with a tool of right thickness, having two parallel cutting edges on both sides, each space can be finished at one operation. Three spiral gears were made—two right-hand, and one left-hand spiral. It will be remembered that these spiral gears were cut upon the regular milling machine centres, and not upon the arbor shown in Figs. 1 and 2. The left-hand and one of the right-hand gears were placed in mesh upon parallel shafts; the two right-hand gears also were in mesh upon shafts not parallel. The three gears worked very accurately together.

—, by the addition of planer centres I K, Fig. d to spiral bed C, several spur gears were cut. The centres I K, are placed at right angles to spindle S. The equal gears L M, connect the arbor holding the gear to be cut, N, with the index spindle D. When the bed C advances in an angular direction, the centres I K in effect move sidewise, while the spur gear to be cut, N, is turned by gears L and M. Again, we have the action of a cylinder rolling upon its uppermost part, unrolling the line E H, Fig. 3, generating the involute G H. When cutting spiral gears, if we are able to cut a thin spiral gear, we can cut one of any width of face with the same arrangement, but when arranged to cut a thin spur gear it does not follow that we can cut a spur gear of wide face; the spur gear is soon out of reach of the circular path of end of fly-tool, and, of course, cannot then be acted upon by the tool; yet this arrangement is important, as it will enable any mechanic who has a Universal milling machine to get the accurate outline of involute gear teeth.

For wide-face gears, a tool moving in a straight path would give the required results. A machine involving these principles would have considerable scientific interest, but users of gears might not care to pay for the product. In this, as in every machine where teeth are planed, the integrity of the tool must be preserved throughout all the cuts. Should further thought and experiment warrant, it is my intention to construct a machine based upon the principles shown in the foregoing.

RARE MINERALS FOR MANUFACTURING PURPOSES.

IN an article on the above subject, the *Engineer* says:—Recently we inspected Mr. Gregory's museum-like establishment, and among other matters he stated his experience in regard to carbon for diamond drills. The crystalline diamond is not good for boring purposes, because it has cleavage planes, and splits along those planes in boring operations. There is an inferior South African diamond which in the rough is rounded outside, so as to resemble real bort, and it is known as "Cape bort." In use its rounded surface begins to split off, and the ill-effects of the cleavage planes become manifest. It is worth 5s. or 6s. a carat, whilst real bort, which comes from Brazil, is worth 40s. or 50s. a carat. The Brazilian bort shows some traces of crystallisation, or rather of a fibrous radiated structure, but then the pressure acts nearly equally upon it in all directions. The best carbon for boring purposes is "carbonado;" it comes from Bahia, in Brazil, and is amorphous. Some specimens, when fractured, have, says Mr. Gregory, a somewhat spongy texture, others are compact, and bear the same relation to the diamond proper that emery does to the crystallised sapphire. Carbonado is found as small black pebbles in the detritus of rivers; it is associated with gravel, but not usually with the true diamond; its specific gravity varies from 3·012 to 3·416. The compact variety some two or three years ago was worth £4 a carat, now its value is but 30s. to 35s. a carat. The supply is limited, and is in the hands of a few capitalists. It is freely used by Californian mining companies, and for Government work in Australia. The largest consumers in England are the Diamond Drill Company. The commercial advantages of the use of carbonado as compared with steel come out chiefly when excessively hard rocks have to be bored; with soft rocks the advantage, where it exists, is not manifested so strongly. Some of the "crowns," of large drills, 10in. in diameter, armed with the best carbonado, have been known to be worth £2,000 each; each piece of carbonado fixed in such drills usually weighs from four to six carats. The pieces in the small drills used for boring holes for blasting purposes usually weigh from half a carat to one carat. There is an increasing demand for large pieces of carbonado, which in the long run are cheaper in use than the small ones. An interesting geological problem was solved by the diamond drill in boring the deep well for Meux's Brewery in London. The boring passed from the upper oolite direct to the Devonian rocks, which are older than the coal formations, and settled the question that there is no coal under the oolite there, or anywhere to the eastward thereof; but the speculation still holds good that possibly coal may be found in Kent or Surrey. Carbonado is specially useful in dressing mill-stones, and it is reported that it is getting into use in America for turning steel tools. Once a Birmingham firm consulted Mr. Gregory about using a tool for special turning purposes in the place of steel. He recommended a tool made of carbonado, but there were two difficulties in the way. In the first place, the problem of grinding the tool had to be faced; and in the second, it was necessary to build it up of small parts because of the minute dimensions of the pieces of raw material. One or two regular diamond polishers were applied to, but would not undertake work so much removed from their ordinary practice, so the manufacturing firm which required the tool put one of their own men at the work for

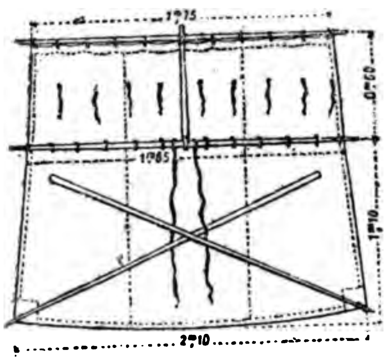

Fig. 1.—DIAGRAM OF THE SAIL AND ITS FRAME.

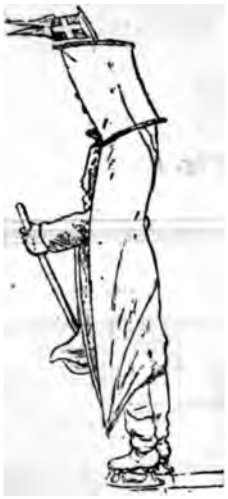

Fig. 2.—DOWN THE WIND FULL SAIL.

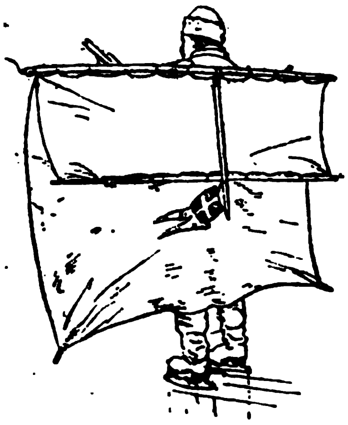

Fig 3.—DOWN THE WIND. TOPSAIL LOWERED.

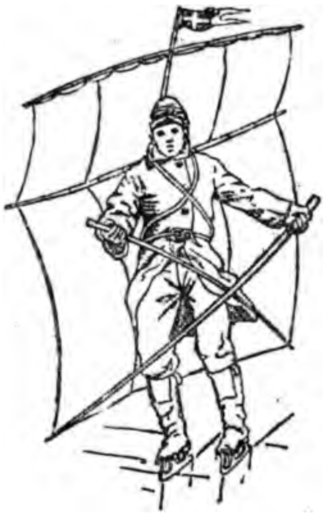

Fig. 4.—STARBOARD TACK.

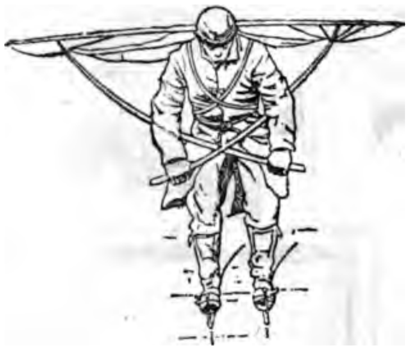

Fig. 6.—IN THE WIND'S EYE.

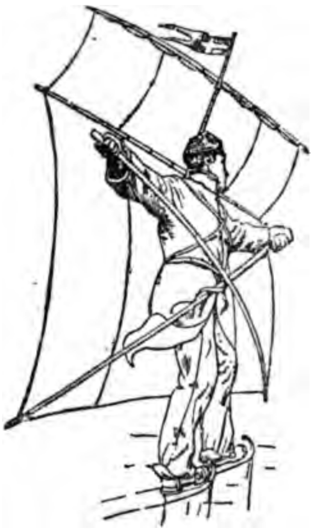

Fig. 5.—LARBOARD TACK.

some months; in the end he overcame the difficulties of his unaccustomed task; a carbonado tool was built up of small segments, and in use it was found to be admirably adapted to the purpose for which it was constructed.

Of late years there has been a greatly increased demand for asbestos; the sources of supply are abundant, especially in Australia; but of late much has been sent to England from the United States which is not really asbestos, but chrysotile, which is fibrous serpentine; it includes most of the silky amianthus of serpentine rocks. It is either used by itself, or to adulterate asbestos. Chrysotile is a silicate of magnesia, and asbestos is a silicate of alumina; the former occurs in fibres about 2in. long, and the latter in fibres sometimes as much as 30in. long; chrysotile contains 12 to 14 per cent. of water. The Greeks named asbestos "amianthus," or "the undefiled," because it could be cleansed by the simple device of throwing it into the fire. At one time asbestos cost about £6 per cwt.; now it can be had from £10 per ton, the difference in price being the result of the operation of the law that supply meets the demand. Mountain leather and mountain cork are varieties of asbestos. Mountain leather occurs in flexible flat pieces, in which the fibres are interwoven; it has much the aspect of leather, and when very compact is known as mountain wood. A sample of mountain leather analysed by Dr. Thomson was found to consist of silica, 57·65; magnesia, 2·06; lime, 10·0; alumina, 9·5; protoxide of iron, 5·8; and water, 21·7. A sample of mountain wood from the Tyrol consisted of silica, 54·92; magnesia, 26·08; alumina, 1·64; protoxide of iron, 12·6; and water, 5·28. Mountain cork from Piedmont—silica, 57·75; magnesia, 10·85; lime, 14·05; protoxide of iron, 18·90; alumina, 1·95; and protoxide of manganese, 1·85. It has a loose felt-like texture, and floats on water.

Beauxite is a valuable mineral for the beds of furnaces and for the manufacture of aluminium; the best comes from Beaux in the South of France; another variety is found near Belfast, and is largely used in the North of England. Cryolite is used as a flux for the beauxite in the manufacture of aluminium. At one time the cryolite itself was used as the source of that metal. Beauxite consists chiefly of alumina and iron, with a little tartaric acid; the white variety contains 21 per cent. of silica. Sometimes beauxite contains enough iron to be regarded as an iron ore. Cryolite, which means "ice stone," is plentiful in Greenland; its composition is aluminium, 13; sodium, 32·8; fluorine, 54·2. It is fusible in the flame of a candle, giving off some of its fluorine, which is at once transformed into hydro-fluoric acid by the moisture in the air. The Americans use cryolite in the manufacture of soda, and of a white glass resembling porcelain.

Among the mineral curiosities we examined in the collection of Mr. Gregory was some elaterite, otherwise known as mineral indiarubber, subterranean fungus, and elastic bitumen. In the early part of the present century the sole source of supply of this curious mineral was the lead mine of Odin, at Castleton, Derbyshire. At present the mine is unworked, but it is exploited at times by workmen who make arrangements with the owner. Elaterite is now said to be found also at St. Bernard's Well, near Edinburgh; Chapel quarries, Fifeshire; a coal mine at Montrelais; at Neufchatel; and on the island of Zante. The Castleton samples are some of them nearly as soft as size, and the remainder of much the same consistency as indiarubber. They are all black or brownish-black by reflected light, and dark orange red or brown by transmitted light. When a large lump is cut through the centre it is often found to be fawn-coloured in the middle, and it darkens by exposure for a few weeks to the air. It is said to be of a very insoluble nature. Johnston records that when he treated a mass of it with ether but 18 per cent. dissolved; by analysis he discovered it to consist of about 85 per cent. carbon, and 12 per cent. of hydrogen, with probably 2 or 3 per cent. of oxygen. Occasionally samples of elaterite are hard and brittle. In the old lead mine of Settling Stones, Northumberland, a mineral resin somewhat resembling elaterite is found in drops more or less rounded or flattened; these drops incrust the rocky walls of the vein. It is hard, brittle under the hammer, does not melt at 205° Cent., burns in the flame of a candle, varies from pale yellow to deep red in colour, and consists of carbon, 85·133; hydrogen, 10·853; ash, 3·256; total, 99·242.

Cæsium is the most electro-positive of all the metals; its affinity for oxygen is stronger than that of potassium, its basic oxide cæsia is a most powerful caustic, which, when heated, attacks even platinum. Cæsium was one of the exceedingly rare metals discovered by Bunsen and Kirchoff in the early days of spectrum analysis. By boiling down 140 gallons of the water of the Durkheim spring they obtained in the saline residue 1gr. of a salt of cæsium. Ordinary lepidolite contains but traces of cæsium, but a variety found at Hebron in the United States, yields 0·24 per cent. of the metal. Pisani, however, in 1864, discovered cæsia to the extent of 34 per cent. in a mineral named pollux, obtained from the island of Elba, in which locality it occurs with petalite. Pollux, of which small specimens are in Mr. Gregory's collection, is colourless, glassy, or gum-like externally, and fuses with difficulty; it consists, by Pisani's analysis, of 34·07 per cent. cæsia, 44·03 silica, 15·97 alumina, 3·88 soda and lithia, 2·40 water, 0·68 lime, and 0·6 iron. Pollux colours the blowpipe flame yellow; it is slowly decomposed by hydrochloric acid, with separation of pulverulent silica.

In the earlier days of his researches on heat, Professor Tyndall sought Mr. Gregory for specimens of rocksalt adapted to his purposes, and it may here be mentioned in passing, that it is a noticeable thing about natural rocksalt crystals, that if they have a blue or pinkish hue, and be dissolved in water, all the colour disappears in the artificial crystals afterwards formed by evaporation. Probably the colouring matter is of an organic nature, and is separated by the recrystallisation. The colouring matter of the quartz crystals known as amethyst, is supposed by geological chemists to be of organic origin.

In a collection of out-of-the-way minerals numbering several hundreds of specimens, many chemical curiosities, besides those we have mentioned, are of course included; but enough has been said to interest readers in an establishment, of the existence of which few English scientific men engaged in original experimental chemical research have not once or more in their lives felt the benefit.

SAIL SKATING.

WHEN the ports of the Baltic are closed during winter, the pilots and Arnager Isle, at Copenhagen, delight to o leisure hours with the exercise of skating

This sport requires much skill and quite a long apprenticeship; but, after a person has become dexterous at it, it offers a very peculiar charm, and, when a swift wind causes him to glide over the surface of the ice, he feels lifted, as it were, and experiences a sensation analogous to that of flight. We give in Fig. 1 a diagram of the apparatus, such as we have seen it employed by the Danish skaters, and such as we have employed it ourselves. The sail, which is formed of a light but strong fabric (Chinese pongee is admirably adapted for the purpose), is stretched over a bamboo frame whose dimensions are given in the cut. The centre crosspiece, which must be placed at the level of the shoulders, is fastened to the skater's body by bands that cross the breast and afterward pass round the waist, so that they may be tied together in front. Large crosspieces of wood, attached to the lower corners of the system, are held in the skater's hands, so that he may trim the sail in one direction or another. When the skater wishes to be carried along by the wind, he must stand very erect, without stiffening his body too much, and bent backward in proportion as the wind blows fresher. Confidence is acquired by practice. Fig. 2 gives the position of the skater going with the wind and under full sail. When the wind is too violent the topsail may be readily lowered (Fig. 3), so as to thus moderate the impulsion derived from the moving air. By inclining the sail in one direction or the other, the skater may tack to the larboard or starboard (Figs. 4 and 5). Finally, when it is desired to move against the wind, by skating in the usual way, the body is bent forward in such a way that the sail lies horizontally, and no longer offers a purchase to the aërial current (Fig 6). The skater can thus return to his starting point, and from thence be driven forward again by the wind.

This exercise is a very agreeable one, and not very dangerous; and the falls that a person gets in beginning are not to be dreaded, because they almost always occur backward. The degree of speed that can be attained by a practised skater is considerable, and yet is less than that of certain ice-boats when these are sailing in high winds. When the skater is tired of using his apparatus, he detaches it from his shoulders, winds the sails around the bamboo sticks, which may be separated from them, and thus has an object that is no more trouble to carry than an umbrella would be. When the winters are severe, it is not unusual to meet upon the ice numerous groups of skaters by sail who are endeavouring to excel each other in speed. Young people are often seen, too, setting out on an expedition over the frozen sea between Denmark and Sweden, and traversing the entire Sound. These latter use the sail when the wind is favourable, but fold up the apparatus when the contrary is the case, and make use of their skates in the ordinary way.

Danish hunters, likewise, often have recourse to skating by sail in order to rapidly reach points where wild ducks and geese have been observed. On one of these hunting excursions we chanced to pursue an unfortunate stray fox over the ice, and competed with him in speed when he was running in the direction of the wind. We came very near catching him in the race.—*La Nature.*

ROTARY OBJECT CARRIER.*

By J. M. Flint, Surg. U.S.N.

THE following described device for exhibiting a series of mounted microscopical objects, without the inconvenience of a change of slides, though probably not entirely new (few things are so), is yet original so far as the writer is concerned, and has been found efficient in practice. As described it is arranged for showing foraminifera, which are viewed as opaque objects, with a low power. The selected foraminifera are mounted on small brass discs furnished with a stem, by means of which they may be carried in a "Beck's disc holder" when it is desired to make a thorough study of the specimens.

Ordinarily these discs are inserted in thin wooden slides of regulation size and kept in the usual boxes made for the purpose, until the series is complete or ready for transfer. In order to protect the specimens from dust or injury, and at the same time maintain their accessibility, movable covers are constructed and secured as follows:—A score or more of curtain rings, not flattened, are slipped upon a squared rod of wood, and brushed over freely with thick shellac. On the following day, before the shellac has become hard, the rings are slightly separated in pairs. When the pairs are firmly united, a thin glass cover is secured to the upper surface of each pair, and thus a little box cover is formed, deep enough to inclose the [illegible] Now, by driving two small [illegible] wooden slide, at the proper [illegible] enough so that the heads of the tacks will just enter the groove between the rings, a simple catch is formed, by means of which the cover may be secured, and also be removable at pleasure.

For exhibition—and for convenience of reference as well—these discs, bearing the specimens and the covers, are transferred to a thin circular plate 6in. in diameter, in this case made of three or four sheets of cardboard glued one upon the other. This makes a firm plate, not liable to warp, and in which holes may be readily bored for the insertion of the discs, and the tacks driven to secure the covers. By inserting the discs as near the edge of the plate as possible, a line 15 or more inches in length is obtained on which to display the objects. The circular plate bearing the specimens as above is made to rotate upon a pivot passing through its centre in such a way that the objects are brought successively into the field of the microscope.

The manner of support of this pivot and its attachment to the stage of the microscope must depend upon the instrument used, which, however, should have a stage with mechanical movements, and the attachment be made to the upper stage-plate, thus giving control of each object when brought to the field in the same manner as if it were mounted upon the ordinary slide. The writer, having a Beck's first-class stand, constructed a pivot support out of a piece of thin board (cigar-box), 2in. wide and 3in. long, the pivot being a common wood-screw inserted near one end, and carrying a wooden nut to steady the revolving plate, and the attachment to the stage-plate being effected by means of four small screws driven nearly home on the under side of the thin strip bearing the pivot, the heads of the screws being so arranged that they slide into grooves on the stage-plate, which ordinarily carry one of the clamps for securing the object slip. A more elegant, but not more efficient, support of brass has since been obtained of the instrument maker.

Shallow notches made with a round file on the edge of the revolving plate, into which drops the curved end of a light spring, serve to inform the observer when the object is in the proper position in the field. The space within the circle of object is utilised for labelling the specimens.

Though requiring much verbiage for a description which may still seem not very clear, the apparatus is really very simple, and was entirely constructed by the writer out of materials at hand. Designed solely for the purpose mentioned—the exhibition of foraminifera—yet with slight modifications it seems capable of serving a more general purpose. Transparent objects might be mounted on small squares of glass, made transferable from wooden or glass slips to the revolving plate as above, the necessary holes being made in the plate to allow the passage of light from below.

The convenience of such an arrangement is obvious, whether for exhibition of objects to the unskilled (the only manipulative skill required on the part of the observer being adjustment of focus), or for personal reference and comparison, a series of specimens being examined in this way as readily as if they were plates in a bound volume.

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[*] [illegible]ly Microscopical [illegible]

THE SO-CALLED DESICCATION OF ROTIFERS.

AT the last meeting of the Queket Microscopical Club Mr. Henry Davis read a paper, and exhibited specimens of *Philodina roseola*, confirmatory of the theory (first propounded by him in 1873) that certain rotifers in drying utilise their gelatinous secretion in coating themselves with an air-tight shell, which effectually resists the desiccating effect of the air-pump and of somewhat high temperatures. The specimens referred to were collected by the Rev. Ed. J. Holloway from a gutter of his church at Clehonger, on strips of paper placed there in the rainy season and removed when dry. On these, in large red patches, were dry groups of rotifers perfectly free from the sand and débris necessary to support the opinion of Lewes and others that such débris was the only protective. The very visible coating of these externally-dried rotifers softens under the action of moisture, and, after a few minutes immersion in water, the microscope shows them struggling into renewed life and activity.

Dr. Hudson says: "Mr. Holloway's beautiful groups prove Mr. Davis's case beyond a shadow of a doubt. I have whole pavements of dry philodines glued together; moreover, prolongations of their glutinous secretion may be seen stretching from one to another."

Mr. John White, the boat-builder, of Cowes, has designed a fishing-vessel on lifeboat principles which will not sink if overwhelmed and filled with the sea. He has already built two of these vessels of 30 tons.

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

THE second meeting of the session was held on on the 11th ult., at King's College, Strand, the President (Dr. Dallinger, F.R.S.), in the chair.

The President said that before proceeding to the ordinary business of the meeting, it fell to him to take notice of what was to all present a personal sorrow, and to their society a sorrow in a pre-eminent degree; he referred to the lamented death of Dr. W. B. Carpenter. For his own part he could only speak of him with the utmost reverence. He had been in correspondence with him for some years upon subjects in which they were mutually interested, and in the course of which he had found him ever ready with advice, and not less so with his constant urbanity ready to place all that he possessed, mentally or physically—the stores from his brain or from his cabinet—at the disposal of those who needed such help to enable them to accomplish work which they had taken in hand. The Fellows of the society knew, so far as had been made public, the circumstances of the unhappy incident which had deprived them of a man who had occupied so high a position in biological science, and they could not but lament that he had thus been taken from them, as they might almost say, before his time. Those who had followed his labours and had been acquainted with his work from its earliest time, would remember that he was one of the first of those who gave a true foundation to the science of physiology; they would know how his works had become a power in themselves in the days immediately touching those in which they lived; they knew how his energies had been directed towards the promotion of the interests of medical science, and how his efforts had been successful in giving to the interests of science generally a meaning and an influence which they had not previously possessed. To them it was his work, as it related to the microscope that claimed their special notice, and they were well aware that he had made this instrument especially his own: and they knew how he had at his fingers' ends all that was known in connection with it—at least up to a certain time—and not only so, but he was also well acquainted with all that workers in this field of science were doing around him, and to whom his ready sympathy was at all times extended. His deep and untiring interest in all the work which the microscope could do had no small share in enabling it pre-eminently to preserve its position as an instrument of research in the study of pathology and histology. They knew also how, in addition to subjects such as these, he had taken up such subjects as that of the foraminifera, and that he had worked them out, not merely as regarded tabulating or classification, but as to thoroughly investigating the structure and development of the organisms themselves. Throughout the greater part of his life he had been carefully familiarising himself with the structure and the advances made in the instrument itself, and although he might not have been associated so closely with it of late as was formerly the case, yet he had looked on with the greatest interest at the wonderful advances it had made—perhaps with considerable conservatism, but yet with a mind wide enough to follow and to recognise the real progress which was taking place. As a society, they could not but feel that they had in his departure sustained a heavy loss: he had been one of their most honoured presidents, and in many ways he had brought honour to their society; whilst his versatility and his genial temper in debate would be features clear in the recollection of all who had known him. Personally, he, for one, felt that he had lost an honoured friend and valued scientific helper. He had lost a thread in his scientific life, and should ever regard the memory of their departed friend with an affection which would endure as long as memory remained. It was, therefore, with the deepest feelings of personal regret at the circumstances of the occasion, that, on behalf of the council, he begged to move the following resolution—"That this meeting has heard with the deepest concern of the death of Dr. W. B. Carpenter, C.B., F.R.S., a past president of the society, and one of the most eminent of microscopists, desires to record its sense of the great loss which science in general, and microscopy in particular, have sustained by his decease, and to express deep sympathy with his family under their bereavement."

Dr. Millar having seconded the motion, it was put to the meeting and carried unanimously.

Mr. J. Beck said he should like, knowing the prominent position which Dr. Carpenter had occupied amongst them, to propose that the society should be represented at the funeral by one or more of the Fellows of the society.

It was agreed that Prof. Stewart, one of the vice-presidents, should attend on behalf of the society.

Mr. Crisp reminded the meeting that it was arranged some time ago that they should give in the *Journal* photographic portraits of all the presidents of the society; a full-page plate of Sir R. Owen, as the first president of the Microscopical Society, and another of Mr. Glaisher, as the first president of the Royal Microscopical Society after its charter had been granted, the other presidents being given in two groups of eight. Proofs of the portraits were upon the table for the inspection of the Fellows. In view of criticism as to the general effect of the groups, he might mention that the trouble which had been required to get them into order was beyond anything that could have been supposed, arising from the very various character of the originals and otherwise, and their thanks were largely due to Mr. J. Mayall, jun., for the pains he had taken in the matter. As to the style of the particular portraits, he might say that nearly all the photographs had been selected either by the persons themselves, or by their families, as being those which they considered to be the best.

The President said that the death of Prof. Robin, announced at the previous meeting, created a vacancy in their list of Honorary Fellows, which it was proposed to fill up by the election of Prof. H. De Lacaze-Duthiers, whose nomination would be suspended in the usual way, and brought forward for ballot at their next meeting.

Mr. Beck exhibited a modification of the "Star" microscope, which could be folded up into a small compass as a portable microscope, and Mr. Crisp exhibited a microscope in which the adjustment was made by winding a piece of cat-gut on an axle.

Mr. Jno. Mayall, jun., exhibited and described the Trouvé-Helot electric lamp for microscope use, worked by a portable battery of six cells, each containing two zincs and three carbons. When not in use the elements were lifted out of the bichromate solution, and retained in position at the top of the vulcanite case, whilst by a simple arrangement they could be lowered into the exciting liquid when needed, and any number of the cells could be connected up as required. The photophone consisted of a small incandescent lamp, fitted in a cylinder with a condensing lens in front. The best way to use it was to commence with three cells, and then as the light got weak—which would occur in about an hour—to increase the number in circuit until the whole six were in use, each additional cell enabling the light to be kept up for about twenty minutes, or about two hours in all, with fairly continuous amount of light. He thought that M. Trouvé had, to some extent, sacrificed efficiency to portability. The ebonite case for the cells appeared far too slight for the purpose, considering that it contained sulphuric acid. He had the promise of one of the Jablochkoff dry batteries for exhibition at the soirée, and he was told that this would maintain a light efficiently for ten or twelve hours consecutively. He had seen the working of the Trouvé lamp at Antwerp, where it was successfully used by Dr. Van Heurck, who made a number of difficult observations with it. He used it with some care, only employing a very little battery power to begin with; but the light was so perfectly under command, especially for purposes of oblique illumination, that he certainly saw some of the most brilliant effects produced by it. He thought a more powerful battery than Trouvé's was needed, and then a resolving power, approximating to that obtained with sunlight, would be got. Dr. Van Heurck had a dynamo in his house, and could, therefore, employ incandescent lamps of any desirable power, and with such advantages he had certainly shown him (Mr. Mayall) the strongest and finest resolution that he had ever seen by artificial light.

Mr. Michael said that the practical difficulty in the use of electric lamps of this kind was not only as to the quantity of light obtainable, but also as to its quality, because it was only when burnt at its full strength that they got a white light; at other times it was either red or yellow. If any means could be devised by which they could get even a very small point of constant bright light, it would be very much better. Under present circumstances, if they reduced the quantity of the current, they at once reduced the quality of the light.

The President said he quite agreed with Mr. Michael in his remarks as to the desirability of getting a constant quality of light as well as a sufficient quantity. He could see that the advantage of a lamp like this was the exceeding ease with which it could be applied to any point they wished, and he had long felt that if anything of this kind could be well and easily applied it would be a very efficient aid to research.

Dr. Matthews believed that in point of economy it would be very much better to obtain more or less light by immersing the whole of the plates, more or less, in the liquid than to immerse the whole of them and then only to use one or two at a time, because the others would meanwhile only be wasting by chemical action.

Mr. J. W. Groves exhibited a very large microtome made under the directions of Mr. J. W. *Barrett, M.B.,* for the purpose of cutting sections of large substances. One particular advantage was that both the razor and the object were immersed in spirit, so that the sections when cut floated off without any danger of adhering to the blade.

Mr. J. Beck said he had not yet had an opportunity of examining this apparatus; but it occurred to his mind very vividly that he saw one very much like it in 1865, which was used for cutting sections 8in. across. He believed he saw it at Utica, where it was being used to cut sections of an entire human brain.

Mr. Badcock described an unrecognised specimen of *Actinophrys*, which he submitted to the meeting for identification. The central bodies were described as being very bright when seen under the microscope, they were of a sarcodic character and apparently of an amœboid nature, and were furnished with long and very fine setæ.

The president remarked that the organism had a very *Actinophrys*-like appearance, but he had seen so many variations in form that he thought this might very likely prove to be only a variation, though if there were many specimens found under similar conditions it might be regarded as a new species. It would hardly be safe to conclude much from a single specimen.

Dr. W. B. Turner's paper "On Some New and Rare Desmids," was read.

Dr. E. Giltay's paper "On the Amplifying Power of a Lens or Objective," was read, by which he criticised a note on the same subject by Prof. Abbe.

Mr. Crisp gave a *résumé* of his paper on "The Limits of Resolution in the Microscope," in which he pointed out that when monochromatic light and photography were used in place of white light (line E), the limit of resolution rose from 146,543 lines to the inch, to 158,845 and 193,037 respectively.

Dr. Maddox asked if it was likly that photography would depict details which the eye could not see. Theoretically, it had been shown, by what Mr. Crisp had stated, that this might be possible, and, in practice, he had always thought he could detect in a good negative details which he was unable to make out by direct vision.

The President said that there appeared to be reason for supposing that such would be the case. Prof. Koch, some six years ago, mentioned the case of a bacterium in which he could not see the flagella with the microscope, but had potographed them.

Mr. J. Mayall, jun., said that some years ago he had been in correspondence with Dr. Woodward on that very point, and he had stated that, in his experience nothing whatever could be seen by the aid of photography which the eye could not see with the microscope—using monochromatic light.

The President said that Prof. Koch published his results at the time, and sent them to him, and he remembered that he stated that though the flagella were suspected, he was unable to detect them with the eye; but that he had done it with the camera.

Mr. Mayall said that the point to which he referred related simply to Nobert's lines. He had himself taken the same view of the matter as that now mentioned; but Dr. Woodward took the opposite side. He thought he could count the lines more readily in the photographs; but Dr. Woodward said it was not so in his experience. The correspondence was commenced in consequence of a criticism published by Dr. Woodward in a paper in the *Monthly Microscopical Journal* in 1870.

Dr. Lavis's paper "On the Preparation of Sections of Pumice Stones and other Vesicular Rocks" was read.

Professor Stewart said that sections were made in this way by Professor Moseley, in which the hard and soft tissues were shown together. Copal was the medium employed in mounting.

Mr. Crisp called attention to the fact that amongst the Cantor Lectures to be delivered at the Society of Arts this session, there was a course on "The Microscope," by Mr. J. Mayall, jun., commencing on Monday, the 23rd Nov., and continued on the four following Mondays. For the purpose of illustrating these lectures, Mr. Mayall would exhibit several of the instruments belonging to the Society, and also many from his (Mr. Crisp's) collection. The first lecture would be on "The Origin of the Microscope, and its Construction to the date of the Application of Achromatism." A limited number of tickets for the course of lectures would be placed at the disposal of the Fellows of the Society.

It was arranged that the Council had resolved to close the Library on Wednesday evenings at 9.30 instead of at 10 o'clock, as formerly. The Fellows who attended on Wednesday evenings had always left by 9.30, and it was unnecessary to keep the Library open later.

THE Prince of Wales has consented to open the Mersey Tunnel in the beginning of January next. It had been intended that the line should be opened about the middle of the present month, but the Prince's arrangements rendered that impossible.

SCIENTIFIC NEWS.

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DR. THOMAS ANDREWS, F.R.S., died at Belfast last week in his 71st year. The deceased was for many years vice-president of Queen's College, Belfast, and Professor of Chemistry in that institution. Distinguished by his classical researches into the liquefaction of the gases, Dr. Andrews was chosen president of the British Association at the Glasgow meeting in 1876, and in his address said that "as we approach the liquid state [of normally gaseous bodies], or even when we reach it, the problem becomes more complicated, but its solution even in these cases will, it may confidently be expected, yield to the powerful means of investigation we now possess." Less than 18 months after these words were uttered the problem was practically solved, and it was known that all the gases could be liquefied, and even solidified, if adequate pressure and lowness of temperature could be obtained. Dr. Andrews resigned his offices in 1879 in consequence of the state of his health, and now that he has gone to his rest we remember him as one of the pioneers of science.

The death is also announced, in his seventy-first year, of M. Henri Bouley, the president of the Academy of Sciences, Paris. His first published work was on the Foot of the Horse, while a cyclopædia article from his pen was long regarded as a standard authority on hydrophobia.

Dr. Rabuteau, a biologist and therapeutist of some distinction, died recently in Paris at the age of fifty years.

Mr. Frederick Swanwick, for many years confidential assistant and private secretary to George Stephenson, died the other day at his residence near Chesterfield, in his 76th year. At the opening of the Manchester and Liverpool Railway, Mr. Swanwick drove the Arrow, one of the eight locomotives which took part in the procession on that memorable day, Sept. 15, 1830.

Our readers will be sorry to learn that Mr. Clement E. Stretton, C.E., Vice-president A.S.R.S., has met with a sad loss in the death of his wife. They will understand why letters and questions addressed to him remain unanswered for a time.

Prof. Huxley, in resigning his position as president of the Royal Society on Monday last, said: "I am happy to say that I have good reason to believe that, with prolonged rest—by which I do not mean idleness, but release from distraction and complete freedom from those lethal agencies which are commonly known as the pleasures of society—I may yet regain so much strength as is compatible with advancing years. But, in order to do so, I must for a long time yet be content to lead a more or less anchoritic life. Now it is not fitting that your president should be a hermit, and it becomes me, who have received so much kindness and consideration from the society, to be particularly careful that no sense of personal gratification should delude me into holding the office of its representative one moment after reason and conscience have pointed out my incapacity to discharge the serious duties which devolve upon the president with some approach to efficiency."

The medals in the gift of the Royal Society were presented as follows: — The Cop[illegible] to Prof. Auguste Kekulé, of Bonn, for his re[illegible]searches in organic chemistry; the Da[illegible] Prof. Jean Servais Stas, of Brussels, f[illegible] his researches on the atomic weights; a [illegible] Royal Medal to Prof. D. E. Hughes, for his el[illegible]ctrical and magnetic researches; and a Royal [illegible] Medal to Prof. E. Ray Lankester, for his service[illegible]s to embryology and animal morphology. [illegible] The two latter gentlemen received the medals [illegible] in person. Prof. Kekulé's medal was receive[illegible]d by Pr[illegible] Williamson, foreign secretary of [illegible] the soci[illegible] and Prof. Stas's by the Belgian Min[illegible]ister. [illegible] G. G. Stokes was then elected presi[illegible]dent, an[illegible] new council list, as given on p. 22[illegible]0, adop[illegible]

It is stated that a pension of £3[illegible]00 per[illegible] has been offered to Prof. Huxley, [illegible] in re[illegible] of his distinguished scientific se[illegible]rvices[illegible]

Sir Joseph D. Hooker has [illegible] directorship of Kew Garden[illegible] filled for many years, his c[illegible] Gardens extending over a years. Mr. W. T. Thiselton Dyer is to be his successor.

The meteoric shower at the end of last week seems to have been well observed, and to have been exceptionally brilliant in some parts of the world. Thus from Naples we learn that "nobody remembered so fine a display"; from Teheran the shower is described as "magnificent"; from Athens "brilliant." In London, although the night of the 27th ult. was almost fine—for the season—the shower can scarcely be described as brilliant. Prof. Gautier, of Geneva, observed a number of meteors on the 27th ult., the radiant point of which was near Chi Andromedæ. At Greenwich, despite the clouds which occasionally intervened, nearly 3,000 meteors were counted between 6 and 11 p.m. In the hour 6-7 they often appeared at the rate of 40 per minute; about 9 p.m. the rate was about 20, and by 11 p.m. only two or three. In the earlier part of the watch the general characteristics of the meteors were short path, slow motion, slight trains, and whitish colour. About 8.22 two meteors rivalling Venus in brilliancy appeared almost simultaneously at some distance from the radiant point, and traversed an arc of about 15°, the first in the direction of Alpha Ursæ Majoris, and the second due south. Both were followed by well-marked trains which lasted about 4secs.

The Christmas lectures at the Royal Institution will be delivered by Prof. Dewar, who will commence on Dec. 29th, his subject being appropriately "The Story of the Meteorites."

The measurement of the 700 photographs obtained at the French stations during the transit of Venus in 1882 is about to be commenced (!): it is expected that the work will occupy at least fifteen months.

"Clark's Star Guide" is the name of a list of the most remarkable celestial objects visible with small telescopes, which is being prepared by Latimer Clark, F.R.A.S., and Herbert Sadler, F.R.A.S. It will be published by E. and F. N. Spon, 125, Strand, and, judging by the specimen-page sent us, will be very useful to amateur astronomers and the owners of small telescopes. Amongst the contents will be a long list of the most useful test objects for telescopes of various sizes.

M. Trouvelot thinks that the Nova in Andromeda is connected with the nebula in appearance only.

MM. Henry Frères have completed the great 30in. object-glass for the Nice Observatory, and have handed it to M. Gautier, who hopes to have the equatoreal finished by April next.

At the meeting of the Anthropological Institute last week, a number of ethnological objects from different parts of the world were exhibited. The president, Mr. F. Galton, exhibited, on behalf of Mr. J. E. Billings, of the United States Army, a collection of composite photographs of skulls. There were in all 20 photographs, forming four series, referring respectively to Sandwich Islanders, ancient Californians, Arapahoe Indians, and Witchitaw Indians, and each composite was the mean of six adult male skulls. Dr. Edward B. Tylor exhibited some Australian Tunduns or bull-roarers, and explained the manner in which they were used. Mr. J. Theodore Bent read a paper on insular Greek customs, in which he described many ceremonies now used by the Christian inhabitants of the islands of the Ægean Sea that were obviously derived from or survivals of ancient Pagan customs. Mrs. Bent exhibited a collection of Greek dresses, drapery, and other objects from the islands referred to in the paper. Mr. J. W. Crombie read a paper on the ame of hopscotch, in which he traced the igin of the game to a period anterior to the roduction of Christianity, and showed that early Christian times children had some h idea of representing in this game the ress of the soul through the future world, hat the division of the figure into seven s was on account of the belief in seven ns.

h has been made of the fact that a vessel l lately in London from America with a of petroleum in bulk. The cargo really d of 177,000 gallons of refined or burning wh ch was carried in forty-five cylin- at 6ft. in diameter, stowed The oil is pumped f barge to a house on the vessel's deck, whence it is distributed by pipes to the cisterns, which are all connected to a vertical tank fitted with a gauge-glass, so that leakage and alterations in volume can be readily detected. Considerable competition is expected shortly between American and Russian petroleum producers, for when the pipe line is laid from Baku to Batoum, steamers specially fitted for oil carrying will supply all the districts on the Mediterranean.

Iodol, a dark powder obtained from Dippel's oil, soluble in three parts of absolute alcohol, but only in 5,000 parts of water, will probably supplant iodoform, as from experiments made with it in the Royal Surgical Institute of Rome, it is found to be an excellent local antiseptic, rapidly effecting a healthy change in such troublesome sores as "indolent ulcers."

Prof. T. Sterry Hunt, LL.D., recently brought before the American Institute of Mining Engineers at Halifax, Nova Scotia, a notice of an electrical furnace invented by him for reducing refractory ores, which promises to be of great interest. Quartz used per se is found to have a specific gravity of 2·06 to 2·07, it being changed into a colloid form which is no longer quartz. Portions of it are found to have sublimed and condensed in botryoidal forms, transparent and glossy, like hyalite. The groups of silicon crystals, seldom more than 0·001 m. in diameter, are described as being beautiful.

Shipbuilders and shipowners in the North are again exercised by the mysterious behaviour of some steel plates which, though annealed and otherwise treated in the most careful manner, were found to be cracked after they had been riveted to the frames.

Dressing Stone.—A new process for smoothing, polishing, and fluting stone by machine power without the use of edge tools—the invention of Messrs. W. and T. Brindle, of Upholland, near Wigan—is now being developed by them, in conjunction with Messrs. M. Powis Bale and Co., of Appold-street, Finsbury. The process consists essentially in causing a revolving or reciprocating surface of iron to alternately bear against the surface of the stone to be worked, and then parted from it sufficiently to receive a layer of fresh sand and water between the rubbing surface and the rubbed. The rubbing surface is held down by a spring, but at intervals is raised from the rubbed surface by an eccentric cam. For fluting and similar operations a series of round bars of wrought iron are mounted in bearings and made to revolve; at the same time they are given a reciprocating movement. The block of stone to be fluted is placed on a trolley and run under the bars. Sand is sprinkled automatically over the bars or rollers as they revolve. For recessing, edge moulding, and similar purposes, rubbing discs are mounted on vertical spindles arranged to lift automatically for about half a revolution in every four. Several different types of machines are now in active operation. An advantage claimed for this process of working over hand labour with hammer and chisel, or machine work where cutters are forced into the stone, is that the surface of the stone is left perfectly smooth and "unstunned," and better capable of withstanding atmospheric influences. It is stated that fluted, recessed, and ornamental stone is now being sold by the inventors at 75 per cent. less than similar work produced by hand.

Malleable Nickel.—The manufacture of malleable nickel, as the result of M. Garnier's experiments, has been realised by the addition of ·3 per cent. of phosphorus or manganese; and others have found that by adding one-tenth to one-third per cent. of magnesium, it is practicable to weld the nickel thus obtained to iron and steel, roll it out in sheets, and shape it into tubes, pipes, &c. A series of tests made with the solid malleable nickel gave the following results:—In the case of a ·465in. round bar, there was exhibited a limit of elasticity of not far from 60,000lb., a tensile strength of about 96,000lb., with an elongation of seventeen per cent. and a contraction of area of 50·6 per cent. A second, ·44in. in diameter, had an elastic limit of nearly 41,000lb., a tensile strength of about 79,000lb., an elongation of 20·25 per cent., and a contraction of area of 45.5.

A SUBSTITUTE for gum-arabic has been found which may possibly be of use as a mountant. By heating milk with a little tartaric acid, the casein is coagulated. This casein is then treated with a solution containing six parts of borax to one hundred parts of water and warmed. It speedily dissolves and forms a very tenacious, durable, and inexpensive adhesive medium.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE LUCERNAL MICROSCOPE—HYGINUS N.—WARMING CLARET—DIAGONAL SOLAR EYEPIECE—CALCULATING SUNRISE AND SUNSET—BARLOW LENS—THE "EASTMAN" PHOTOGRAPHIC PAPER PROCESS—THE SOLAR FORE AND AFTER-GLOWS—THE NOVA IN 31 M. ANDROMEDÆ—A MIRACULOUS 2in. TELESCOPE—MEASURING THE POWER OF A LENS—IDENTIFYING PLANETOIDS.

[25055.]—IN connection with the last footnote to column one of Dr. Royston-Pigott's excellent article on p. 231, it may not be uninteresting to observe that Adams's Lucernal Microscope was rather a camera obscura than a camera lucida: in fact, that it was constructed somewhat on the principle of the Solar Microscope, but with a lamp substituted for the sun as the source of light. A full description of it, illustrated by engravings, will be found in Rees's *Cyclopædia*.

Let me hasten to assure my valued old friend, Mr. Neison (letter 25014, p. 238), that nothing could have been more foreign to my intention than to be "far from complimentary" to the selenographers (himself included), who have of late years done so very much to extend our knowledge of the lunar surface. I have not seen a copy of the first edition of Beer and Mädler's "Map of the Moon" for more years than I care to count. The last time I ever did was at Worthing, in Sussex, where the late Rev. Wm. Read, F.R.A.S. showed me one. I have never set eyes upon the copy in the library of the Royal Astronomical Society in my life, and hence am wholly unable to theorise as to the way in which Mr. Rand Capron was deceived. Knowing his scrupulous care and accuracy as an observer, I accepted, without doubt or cavil, his allegation that he had found Hyginus N laid down in Mädler's Map; and proceeded to moralise upon it. If what he discovered was not intended for Klein's formation, I can only say, in the historical words of Lord Shaftesbury's parrot, "Sorry I spoke."

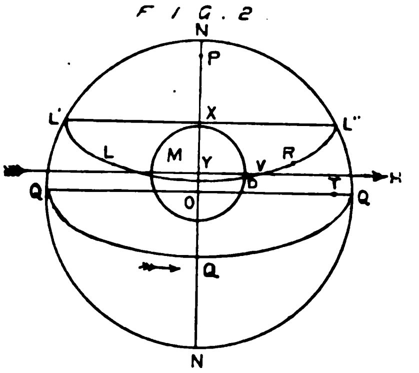
I have asked my butler to answer Mr. Mashiter's query (58069), on p. 249, and he says, "Decant the wine, and place it in the corner of the fender until the chill is *just* off."

In reply to "C. W. T." (query 58079, p. 249), the reflecting surface in a solar diagonal is outside of the field lens of the eyepiece—in fact, the tube carrying it screws into the eye end of the telescope, and projects the image of the sun through a subsidiary piece of tubing (of course, at right angles to the optical axis of the telescope), and it is into this side tube that any and every eyepiece, negative or positive, fits.

If Mr. Robertson (query 58085, p. 249) will turn back to letter 14349 (Vol. XXVII. p. 264), he will find a detailed account of the method of computing the time of sunrise and sunset in any given latitude, with an example worked out at full length. Speaking roughly, sunrise and sunset occur at the same hours of the same days of succeeding years of 365 days each; but, of course, when leap year comes in, this shifts such times one day backwards. For example: On January 1st, 1883, the sun rose in London at 8h. 8m. a.m., and set at 3h. 59m. p.m.—a condition of things which again obtained in 1884. But 1884 was leap year, so that at the end of 365 days it was (not Jan. 1st, 1885, but) Dec. 31st 1884, when the sun rose at 8h. 9m. a.m., and set at 3h. 58m. p.m.; while, on Jan. 1st of the current year, the times of sunrise and sunset were respectively 8h. 8m. a.m., and 4h. 0m. p.m. These, though, are only approximations to the actual instants of these phenomena, and, for anything approaching accuracy, the formula to be found in the volume and on the page of the ENGLISH MECHANIC referred to above must be employed.

Occultations," prefix all the quantities in column Y by the sign +, except that of γ Leonis, which is – ; and in the "elements" for December given in

F I G. 2



page 200, all the quantities in column Y are to be prefixed by the sign +.

Page 180, first column, in computing the latitude scale, the log. of unity (1.) is 10·00000 (from which log. 9·86927 is to be subtracted), and not 19·00000 as printed.

Same page, second column, line 24, make x' an X, and line 26, make y' a Y.

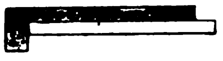
In my next letter I shall tell how a solar eclipse is to be computed by this method, with an example fully worked out.

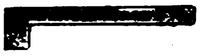
Chas. L. Woodside.

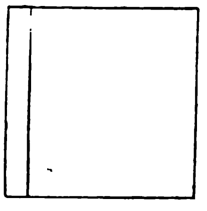
Boston, Mass., Nov. 11.

A METHOD OF EQUALISING THE THICKNESS OF SLIPS WHEN USING AN OIL-IMMERSION CONDENSER.

[25062.]—It is necessary that an oil immersion condenser should have a fairly long focus; otherwise it would be of no use if the slip happened to be rather thick. If the slip is thin, it will be found impossible to keep the oil contact when the condenser is in focus, unless you increase the thickness of the slip by uniting a thick cover glass to the back by oil. It will be found very difficult to do this without oiling the stage when the microscope is inclined. The oil between the condenser and the cover glass is sure to unite with that between the cover glass and slip, and then the cover glass falls, upsetting the whole arrangement. I have found the following plan to answer admirably.







A piece of glass 1in. square, upon one side of which, close to one edge, a strip ⅛in. broad, is fastened by shellac, is oiled to the back of the slip; the ledge hooking over the edge of the slip prevents it slipping down. (Read before Q. M. C., Nov. 27th, 1885.)

London, Nov. 28. **Edward M. Nelson.**

HYDRAULIC RAMS EXPLAINED.

[25063.]—In reply to "Ram Fitter" respecting the notice as to where he can see the explanation of the waste-valve opening, I may say that if he will communicate direct with me at 78, Earl's Court-road, Kensington, I will send him a number of the paper or journal wherein he will find these words:—"The reason why these light valves open is through the fact that water is exceedingly elastic, and when it is by the pulse valve suddenly arrested, it becomes slightly compressed, and rebounds, which, on its recoil, allows the valve to fall, or here a partial vacuum would be the consequence." These words I wrote over five years ago; but I cannot see advertising other journals or books in our English Mechanic to satisfy one or two of its readers; but, of course, as "Ram Fitter" has asked for the source, I will give it to him on application, but to no others.

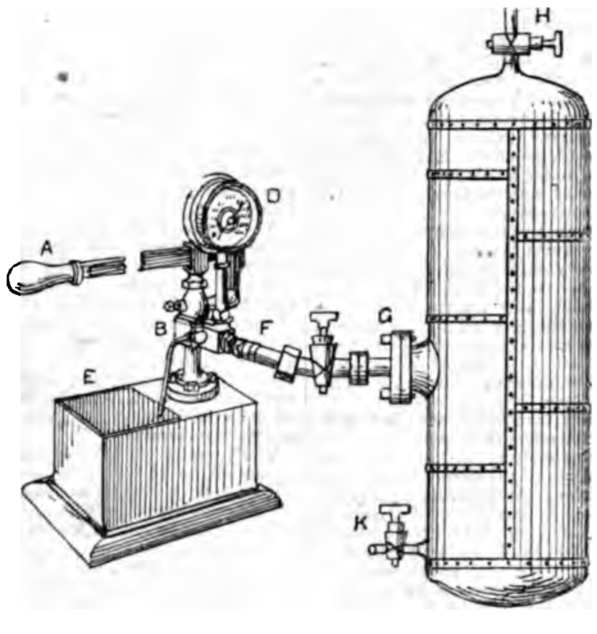
Perhaps I should say that in almost every journal for which I have written I have invariably found something to write about on the hydraulic ram: so that I really do not know where to pick upon half the sources. Even the English Mechanic, of which I am *one of the very first contributors*, contains much of my writing on rams; but to ask me where to pick upon any particular letters or other matters would entail upon me much unnecessary trouble.

Of course, I am always ready, willing, and even pleased, to give information to any one seeking it through these columns, not only on account of imparting knowledge, but from the fact that this journal is the first that ever I wrote for, even in its first number, when we little expected that it ever would become such a museum of science, and highly useful medium for scientific correspondence, which, in a great measure, I feel myself indebted to, and to its numerous writers; even as "Ram Fitter" has, in your last issue, expressed himself towards me.

I will shortly send some more experiments; but before doing so I would prefer making a few more tests, with a view of ascertaining more of the relationship between the heights to which water can be forced under different heads, sizes, and lengths of trunk-piping, which I especially want for a particular purpose.

P. J. Davies.

[25064.]—In reply to "W. A. S.," who, on p. 264 of the "E. M.," says "that when a vessel bursts under hydraulic pressure, the pieces do not fly off as they would under air or steam, and hence the value of hydraulic pressure for testing boilers, &c." This he puts forth for comparative purposes; but it is evident that there is a wide distinction between the water impounded between the walls of the trunk of an hydraulic ram, and that of a testing machine for testing boilers; whereas, in the former, the water is compressed more at one point than another—viz., at the waste valve head the molecules receive their greatest pressure, which pressure diminishes according to the length of the trunk towards its entering point, which enables the water at the lower end to contract and expand (if expansion must be the term) in ratio; but with the hydraulic testing machinery the molecules of water receive equal pressure at all points, which makes a wide difference in the comparing of the two processes; in fact, there is no comparison whatever. Besides, if "W. A. S." had ever seen water put under severe pressures, such as from two to three tons to the square inch, or even that of sufficient to test boilers as in the accompanying diagram, he would know that when testing, the following is always noticeable. Say that the boiler has been subjected to its extreme or bursting pressure, and every part of the machinery, pipes, and boiler to be accurately filled with water. Now, just shut the cock Q, and open the air-cock H, in the accompanying diagram, when the water is under pressure, and notwithstanding the handle A to be kept stationary, and the cock Q to be closed; yet a good drop of water will be found to come out at the air cock H, which shows definitely that water can be compressed, and that, too, without subjecting it to the enormous pressures, as some would have us believe.



Of course, there is a vast difference between testing boilers with a highly compressible material—namely, air—and that of water, yet "W. A. S." introduces these enormous extremes for analogous purposes.

Perhaps "W. A. S." would be inclined to say that this exuding water from the boiler may be due to the elasticity of the metal; if so, my answer is, that I have seen the same phenomenon when testing the ram cylinders of a hydraulic press, even though it may be from 8in. to 15in. in thickness.

"W. A. S." refers to it being strange that I have not given this information before. I have, in my writings, and also in one of my lectures on Rams in the year 1876, at the South Kensington Schools, referred to this very same thing, and used the identical words; but I prefer to explain the action of the ram working with heavy beat valves, it being all that an ordinary plumber requires; he, in fact, does not require these phenomena explained, and for my part I prefer the heavy beat valve for *continuous* action rams, and therefore my simple explanation is preferable, and to clear up the point of a valve working on an entire closed pipe, as to whether it is the metal or water which gives the elasticity, that is easily proved by the use of thin and thick pipes, which, on testing rams at the Royal Engineers' school at South Kensington some years ago, during the stay of the sappers and miners, we found that the recoil was the same with all classes of pipes.

So far as regards the ram working with an inner valve and secondary air chamber, which was the case with "Melting Mechanic's" ram, I contend that this is not wanted in the question, as the question, as I understand it, has resolved itself mainly into what is the real cause of the light valve falling against the statical pressure unassisted by a second reason or cause. Keep to this, and then my explanatory answer I will stand by, and more than this, beyond the shadow of a doubt will prove it by the use of lead pipes from ⅛in. in thickness to the inch. I speak of lead pipes as they are considered very inelastic in comparison with other metals.

So far as regards the backing water from the air chamber valve assisting the recoil, I have never once questioned that point, but on the contrary used these words, "that this in badly-made rams is of great importance," and in order to facilitate this action, John Blake, in the year 1880, took a patent for a process for assisting this, and he states in that patent as follows, when speaking of the ram's action: "Some of the water enters the air vessel and compresses the air, the elastic force of which forces down the delivery valve, and causes the water under the valve to recoil"; surely this should be taken for what it means.

So far as regards the heavy waste valve, I h[illegible] fixed them weighing over a hundredweight, [illegible] they work exceedingly well, but there are ver[illegible] people who can manage to make these heavy [illegible] to work "softly," which is the desideratum [illegible] obtained; they either make them so th[illegible] will not rise, or that they knock the ra[illegible] out.

Has "W. A. S." taken into co[illegible] the water in the trunk of a ram act[illegible] of impulse, like a conical spring?

FIG. 1.

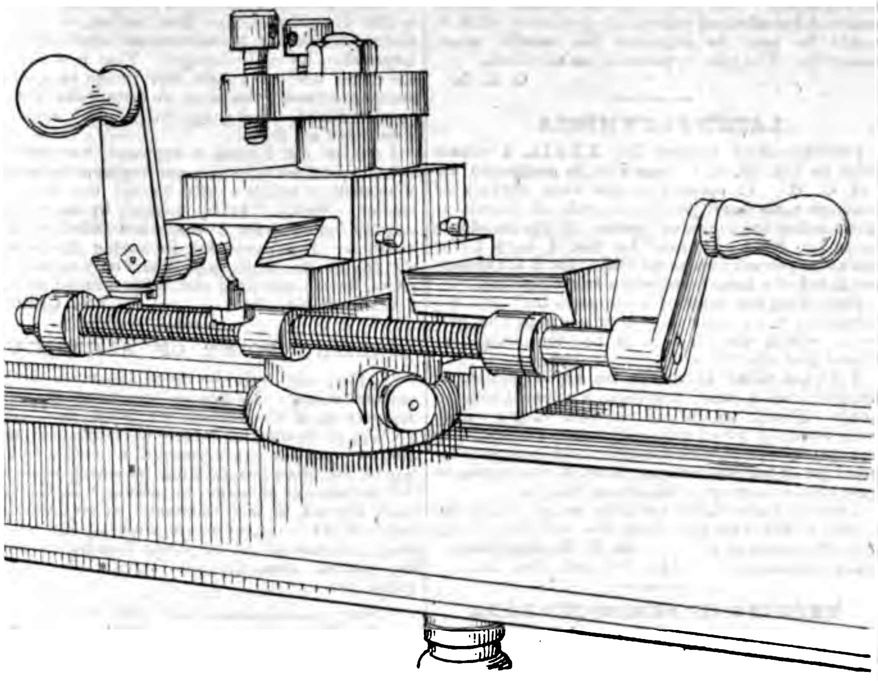
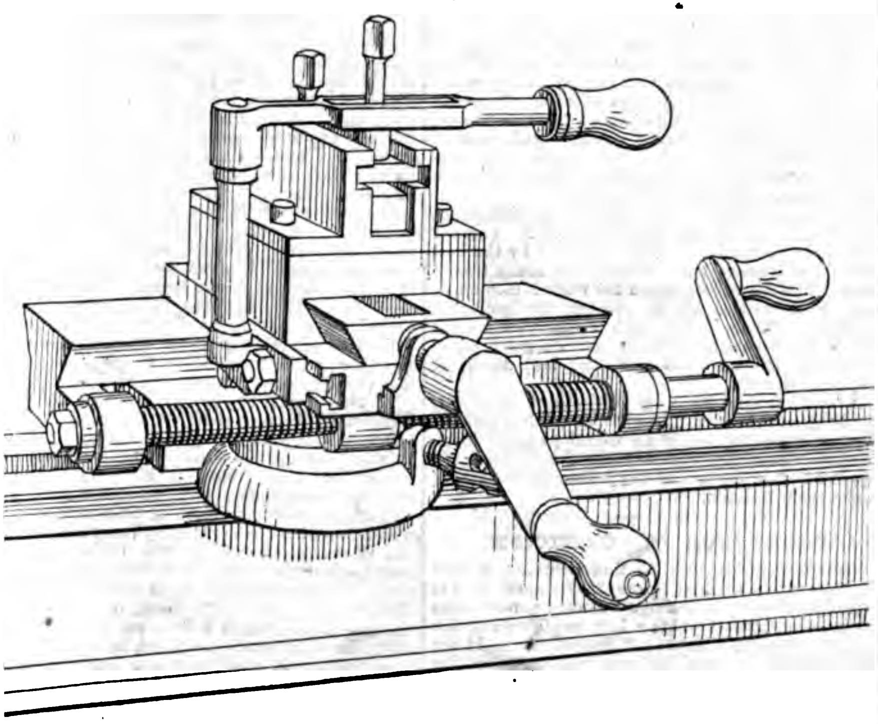


FIG. 2.



COMBINATION SLIDE-REST.

5065.]—I WAS much gratified by the tenor of J. L.'s" report on this new design in slide-rests our issue of Nov. 20th. I submitted this par-ar one (which had been made for an order), to J. L.'s" criticism, because I knew that he was ys interested in anything pertaining to lathes lathe work. He has correctly described my ct in designing it, to be the easy transformation light metal-turning rest into one suitable for mental work. I am not a maker of ornamental s and appliances to any great extent, but have ned myself to the manufacture of such tools e required by the amateur and professional eer; hence it may be that objections may be by some experts to certain parts of the de- and if any such will kindly give their , I shall be very glad. An objection which legitimately be raised is, that after a few wear for metal work, the top leading screw would have so much "play" as to be com- ly useless for fine adjustments. Supposing the case, it would be possible to over- difficulty by placing a regulating screw [illegible] right side of the top slide, detach- [illegible] as the pillar upon which the

sleeve and fast [illegible]

change wheels is optional. It was my main idea, in placing the leading screw thus in front, to provide for a large change wheel for very fine screw-cutting, or for self-acting. I believe no other rest is capable of effecting this, owing to the nearness of the screw to the lathe bed. Mention is made of the theoretical disadvantage of the screw pulling on one side of the slide. I admit the theory, but the practice is common enough—all screw-cutting lathes, almost without exception, being thus arranged.

As the general appearance of these rests may be a matter of interest to your readers I send photographs of one showing it as for metal-turning (Fig. 1) and for ornamental work (Fig. 2). I may mention that I have patterns for all sizes, from 3½in. to 5in. rests, and shall be pleased to let any of your readers have castings from them if they would like to make for themselves.

W. S. Brown.

CUTTERS AND OVERHEADS.

[25066.]—I BEG to join "F. A. M." (23019) in hoping that we may hear further from F. Baker. My guess at the "defect" differs from the former's, for I imagined it to consist in the use of only one clamping-nut for two adjustments, rendering likely a derangement of one while adjusting the other, and hampering the ready use of the slide for feeding. "F. A. M." remarks on the probable noise of toothed gearing at the high speed mentioned. It has often occurred to me that the use of either frictional or spiral gear in these cases would be of advantage, as securing quiet and smooth motion, and I should much like to know if either has been tried.

"A., Liverpool" (57784) asks as to the respective merits of chain or rod connection between the crank and the treadle. I may mention that I asked this question lately of the manager of Whitworth's London office, and he gave a decided opinion, founded on experiment, in favour of chains, properly fitted. I believe a very smooth motion might be had by the use of eccentrics and large pulleys on the treadle, connected by endless steel bands, as used on the "Otto" bicycle.

There are two points as to which I should like to have the opinion of "the talents." The first, whether a gut-band or a flat belt is best for a 4½ screwing lathe; and, second, as to the roller or drum, which "bulks large" in most designs for an overhead.

Its only merit seems to be that it permits a movement of the band following that of the slide-rest—a movement largely impeded, however, by the fixed guide-pulleys.

Its demerits appear to be that it limits the range of speeds available, and that it must afford a very poor grip to a round band. The last objection might be overcome by the use of a belt, as, e.g., on the elaborate overhead illustrated by Tangye on their amateur lathe; but this involves clumsy pulleys on cutter spindle, and more accurate lining of the pulleys to prevent the belt jumping off than is necessary with a gut-band. The joints of a belt also must be sewn, to insure smooth running over guide-pulleys.

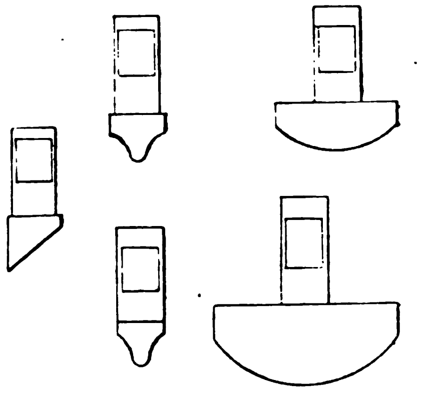
On all these accounts it seems to me that a cone pulley, sliding on a grooved shaft, would be preferable to a roller.

I had written thus far before reading "Trebor's" letter (28035). I see he uses the sliding pulley I suggest above, and altogether has a very neat gear. I should have thought, though, that the work would have been in the way of the horizontal cords, unless, indeed, his cutter-frame is a very tall one, and that the driving-pulley would have scarcely had sufficient grip of the cord for a heavy cut, especially when using the guide-pulleys; in which case, if I understand it rightly, the cord can only touch about a fifth of the driver's circumference. What sort of work does "Trebor" accomplish by the aid of his gear?

Nov. 28. **Faber.**

WHEEL CUTTERS—To "A., LIVERPOOL."

[25067.]—THE following are some of the cutters used. Wheels of ¼in. pitch have been cut in brass,



but that size requires three cuts. None of the other difficulties that you are apprehensive of have been experienced.

F. Baker.

LATHE MATTERS, &c.

[25068.]—I AM very glad to see "Lathe Matters" brought forward again. I hope "Trebor" and the other lathe-men who contributed such interesting matter will send us some more notions next week. It is always interesting to see an original arrangement like "Trebor's" overhead. I judge there must be more friction than even in the arrangement described by Mr. Evans, since there are two extra centres—that of the idle wheel H on the shaft C, and that of the pulley D. I should fear the band would slip on the cast-iron driving pulley on shaft C when the jib is in use, as it then appears to embrace but ⅓th of the circumference of that pulley. The hint about the whipcord band I appreciate, as I have noticed the jar of the passing hook and eye on my band marks the work.

I am interested to hear Mr. Wenham prefers the swing arm overhead, and believe that "J. K. P." said much the same; but neither of these gentlemen do ornamental work, and they do not feel the want of greater speed. In the Holtzapffel form, when fluting, the barrel must surely be horizontal; then, since the left-hand end of the shaft must remain at a fixed height, so must the right-hand end. What, then, will happen if the length of short band does not suit? Is there required a separate short band for each cutting frame? Perhaps someone who uses the Holtzapffel overhead will kindly enlighten us?

I have just been cutting a brass wheel, and fully appreciate the heavy spindle illustrated by Mr. Wenham. I found a great speed very important, at 1,600 rev. it took about three minutes to get through a tooth, whilst at 3,000 only half a minute.

Mr. Brown's slide-rest, described by "O. J. L.," I think very good and ingenious. It would, no doubt, be well to have a second "precision" screw and nut to replace the ordinary long screw when doing ornamental turning. The lever arrangement and stop action seem very good: the only thing wanting is the height adjustment.

I think "A., Liverpool," must indeed have referred to carpenters' squares, and that "O. J. L." is quite right in saying "if the square is inaccurate the result will be the same," whether you square all the way round or half-way round each way; in either case, wherever you meet, you will find the error of the square multiplied by four: the only difference is, that if you work both ways round to the back, you can "split the difference," and so get the back parallel with the front. **F. A. M.**

LATHE MATTERS.—To "F. A. M."

[25069.]—We have never had any difficulty in adjusting the pulley, as it will swing nearly all round. The bevel wheels are of steel, such as are used for sewing-machines. It is under consideration to substitute guide-pulleys. The spindle is only ⅜in. diameter, and the cutters are ¼in., so you see it would not do to slot the spindle; no difficulty is ever experienced with the cutters.

The above-mentioned wheels are rather noisy; but not so much, considering the amount of work it does. **F. Baker.**

[25070.]—To "O. J. L.," as well as to "W. S. B.," I may mention that what I had in view, anent carpenters' squares, was that, in my experience amateurs usually consider that, when they purchase a square in an ironmonger's shop, it is true to begin with, and will always remain so, whereas in practice it is constantly getting knocked about and tumbled off the bench, and therefore requires to be often tested and trued up in the manner which "O. J. L." describes. Any flywheel ought, in my opinion, to be balanced; but what I object to is unbalancing it altogether in order to cause it to come to rest off the dead centres. The connecting rod that I prefer to the chain and pulley affixed to treadle, has its hook shaped nearly square, with the corners rounded off, and its inside filed up as a pair of V's in a screwstock are; then a piece of lignum vitæ similar in appearance to one of the dies of said screwstocks is fitted into these V's, and is almost everlasting; of course it only embraces half the circumference of crankpin. I may here mention a wrinkle for some of our wood-turners: having a "Cushman's self-centring chuck," and wanting to turn up a wooden disc. I cut the head off a coarse 2in. wood screw, fastened this in the chuck, bored a hole in the centre of disc, and screwed it on until firm against three jaws, and find that it answers admirably.

A., Liverpool.

LATHE OVERHEADS.

[25071.]—"Trebor" has described an overhead of which I hope opinions will be given, because it has, as is claimed, decided novelty of arrangement which commends itself to my own mind. I allude to the endless cord which drives the cutters and drills. I see great advantages in this as not needing to have hook and eye, and being always ready at a moment's notice. Hooks and eyes do not run well over small pulleys, as we all know, and the spliced and waxed whipcord is just the thing to give grip and run smoothly. I do not quite so well like the upper tension rod, but I dare say it answers its purpose. Keeping the revolving shaft low down will add much to the steadiness of the whole, provided the cord is not in the way of anything when in that position. The almost universal adoption of the overhead shaft in its higher place, instead of lower, makes me think that there are certain reasons for adopting that position known to practical ornamental turners; because otherwise there can be no question that the lower the shaft is, the less vibration will it produce, and the more rigid will be the apparatus. The cords are more out of the way of one's head, too, in the position shown. The secret of the novel arrangement of endless cord lies evidently in the use of the fast and loose pulleys, and this is a very ingenious arrangement. The length of the endless cord is constant for all-sized pulleys of apparatus, while it would be easy to augment the weight when desirable. The plan appears to me excellent.

O. J. L.

LATHE FLYWHEELS.

[25072.]—Not having Vol. XXVII., I cannot refer to "D. H. G.'s" remarks, as suggested by "H. C. B." It appears to me that makers of machine tools work entirely by rule of thumb, as many lathes are rendered useless by the standards being too light. It may be that I have never worked a properly-balanced lathe, for I am always reminded of a lame horse when treadling fast.

Regarding the centres, I suppose they are not turned to the correct angle, or perhaps the grit (with which the air here is heavily charged at times) gets into them.

I do not think there can be any objection to hardened split steel bearings, as mentioned in query (57905), as the old German lathes which were formerly fitted with split brass bearings are now being refitted with mandrels and split parallel bearings of hardened steel. Most of the mandrels have single bearings, with conical tailpin.

There is a mistake in my letter on p. 205, in the middle of the 19th line from the top, 21in. being printed instead of 28. **A. F. Shakespear.**

Lüttichaustrasse, 14 III., Dresden, Nov. 28.

TRUEING UP SCREW-THREADS.

[25073.]—I was much interested with the discussion which took place a short time ago in the English Mechanic on the making of accurate screws.

I wish to bring before your correspondents the following method of giving the final true-up to a screw-thread.

Make a frustrum of a cone of the same section as the V-tool used for cutting the thread. Use this as the lap, say, with the ordinary drilling spindle, mounting the latter in the slide-rest with its centre the same height as, and its axis at right angles to, the lathe-centres. Charge the lap with bort or Turkey-stone, and follow the instructions previously given by Dr. Edmunds. May I ask some one to pass an opinion on the above?

Will someone give a few hints on the following, including circular and straight work? I never seem able to equal the polish obtained by the best makers in brasswork, no matter how much time I spend. More especially when the work is lacquered, and I have used oil to moisten the polishing medium. Then, again, with ebonite, I cannot obtain the beautiful gloss we see on good work. What are the mediums used, and best means of applying them?

I think a few hints on subjects of this sort, pointing out the pitfalls, as "O. J. L." has done so well in carpentry, would be useful to many more, besides myself, who wish to make their home-made apparatus look decent, if the Editor would kindly make room for them. **S.**

COURTEOUS (?) CRITICISM.

[25074.]—I regret to find that Mr. Edwin Holmes (letter 25034, page 260) should so far forget himself as to indulge in such personalities as those expressed in the last paragraph of his letter in to-day's English Mechanic. If my assurance in letter 24937 was not sufficient for him, then I am very sorry for it. After this uncalled-for exhibition of feeling by Mr. Holmes, I decline to hold any further communication whatever with that gentleman. **W. S. Franks.**

Liverpool, Nov. 27.

TO MR. HOLMES.

[25075.]—I hope Mr. Holmes does not expect me to reply to his cavilling and jeering comments on my letter. When he ceases to ape at being witty in order to make others look foolish he may be worth noticing.

I think Mr. Franks has very justly described his mode of handling correspondents, and Mr. H. has well earned the name of a "carping hypercritic."

What "J. C. L." means by sending Mr. Knott's observations I cannot tell, since they exactly agree with my statement that we cannot magnify the stars.

I suppose Mr. Knott was experimenting on the spurious discs. I don't know the article quoted; and he shows that by reducing the aperture the spurious disc was enlarged about one diameter.

"J. C. L." (unlike Mr. Holmes) treats a correspondent respectfully and without mean jeering, and so merits respectful reply.

To be brief, we cannot magnify the stars. Small apertures show the spurious discs larger than large apertures. We do not, as with the planets, &c., see the real body and magnify it directly according to the power of the eyepiece used. For instance, if you use, say, an eyepiece of 100 diameters on a planet, its image is 100 times larger: by using another eyepiece of 200 power, the image is 100 diameters larger than before, or it is 200 magnified; that is, it subtends an angle 200 times larger than its real diameter. This is not so with the stars; but, as I said, the image of a star remains practically the same, no matter the telescope or power used. But surely "J. C. L." ought and does know all this.

I am, as Mr. Ferguson supposes, very gratified to know of the kind and encouraging expression of our excellent and lamented friend, the Rev. Prebendary Webb. It is, indeed, by no means a solitary instance, for I was much indebted to his kindness. I am grateful in saying the same of his friend Mr. With, who is not only an excellent artist, but an excellent and noble-minded man.

Widford, Nov. 30th. **G. Calver.**

MELTING POINT OF ALUMINIUM.

[25076.]—It will be news to most of your readers to learn that the melting point of a metal depends upon the size of the piece used (letter 25045); of course, a larger *quantity* of heat is needed to melt a larger piece of a metal, but the size of the piece has nothing whatever to do with the *temperature* at which it melts. "B. C. R." is quite correct in his statement as to the melting point of Al lying between those of Zn and Ag, and I am not at all surprised that he has melted his plates. According to Roscoe the melting points are—

Zinc	433°	centigrade
Aluminium	700°	"
Silver	1,040°	"

Wm. John Grey, F.C.S.

Newcastle-on-Tyne. Analytical Chemist.

BALL BEARINGS.

[25077.]—As the properties of ball bearing seem to be at present under consideration, I should like to say a few words on the subject. Mr. P. Ibatson, in his letter in the "E. M." las week (No. 25020), furnishes several good reas for the profitable adoption of ball bearings i cycles, and states their advantages; but, in m opinion, he has neglected a very, perhaps *the* mo important feature. About a year ago, I wrote letter in the "E. M." on the subject, and mentioned the following advantage as one of the most important properties, and since then, I hav come to consider it a far more important matt It is this: A cycle frame cannot, of course, poss absolute rigidity, and thus, if any frame extensi supporting a bearing be somewhat distorted wi respect to the other parts of the frame, the a supported will be crossed so to speak, in its bearings (bearing on opposite edges of them).

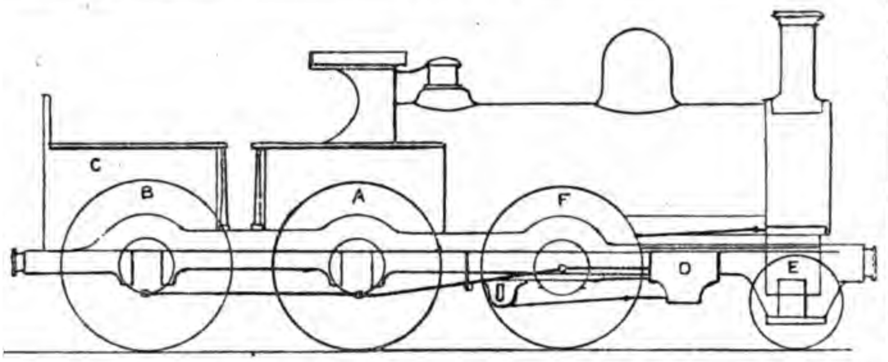
If the bearings be plain, the conseque increase of friction will be enormous, and th bearings will tend to "gall." On the other ha if the bearings be ball, then, as the ba touch the axle round a circle (theoretical and not a cylinder, any distortion, as abo will only convert this circular trace into an ellip whose two diameters are nearly (very nearly) eq and thus the pressure on the balls as they r round, although increased at various parts of circle, is not excessively so, as with plain bearin This is of especial importance, in my opinion the case of the frame extensions (in a tricycle) carry the pedal shaft, as these, in many insta do not admit of effective triangulation. In tricycles, when considerable force is being ap to the pedal, these extensions will be *seen* to b and in some machines this bending slackens chain. If these crank bearings were plain, doubt, the extra force required would be appreciable. Many people talk of the easy of their plain-bearing bicycles; but I think be found that their bicycles have *solid* forks are otherwise much heavier built, so as to be be able to resist bending and torsional stresses. also think that if the 19lb. racers of the pre day were fitted with plain bearings, the in distortion of the forks would make it impo to attain the present great rate of speed.

A. W. Manton, C.T.C.

27, De Bergh-street, Cardiff.

COMPOUND LOCOMOTIVES.

[25078.]—Herewith I send a sketch o compound goods engine which is now being b Crewe, and is intended for main-line work. wheels A and B are coupled (as shown in th and are driven by the high-pressure eng The pair of wheels F are driven by th pressure engine E. The tank, G, will hold gallons of water, and is to be fitted with a bottom pick-up. The leading axle will be as in the express compounds. The weight on the wheels F will be 15 coupled wheels, A B, 24 ton- more tender goods engines Mr. Webb has also con

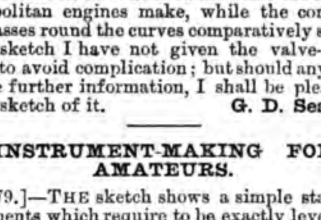


eeled tank engines for Metropolitan work, but as not commenced working yet. In this engine valves are on the top of the cylinders, which :hink is an improvement. An engine of ; type should answer well on the Metro- itan Railway, which abounds in curves—e.g., stminster Bridge, the Mansion House, Monu- nt, and between Earl's-court and Addison-road. ould name many more, but these will suffice, and one who has been at one of the stations ntioned must have noticed the noise the ordinary tropolitan engines make, while the compound 3 passes round the curves comparatively silently. my sketch I have not given the valve-gear in ails to avoid complication; but should any reader uire further information, I shall be pleased to d a sketch of it. **G. D. Seaton.**

INSTRUMENT-MAKING FOR AMATEURS.

25079.]—THE sketch shows a simple stand for ruments which require to be exactly level, such alvanometers, for instance.

. is the base of the instrument. It is supported the adjustable screw C, and by a piece of wood attached to A by a screw, upon which it can turn



Hy. The stand is levelled in one direction by fting B, and in the other, by screwing C up or vn.

: may be made by soldering the broad brass d of a carpet nail, or of an "ornamental nail," he head of a wood screw. Its points should be nded. Both screws to be brass.

Glatton.

. NEW APLANATIC POCKET LENS.

25080.]—WILL you allow me in your columns lraw the attention of microscopists to a new ket lens brought out by Zeiss, of Jena? I have n much interested in simple microscopes for e years; this new lens, which I have put to cial tests, is the best I have yet seen.

Extreme field $\frac{5}{8}$in., of which $\frac{7}{16}$in. is flat; power. Compare Zeiss Steinheil of same power: field ., of which $\frac{1}{16}$in. is flat. As Zeiss makes a nber of different pocket lenses, I send catalogue . (127) for identification.

Edward M. Nelson.

Nov. 28.

M. S. & L. SINGLE ENGINES.

25081.]—I WAS glad to see in your last week's e (letter 25052) that Mr. Turner calls attention the M. S. & L. 7ft. 6in. single engines. Your ders will not fail to notice that there are several narkable points in them. The wheel base, t. 9in., is unusually short for so great a weight 40 tons 12cwt., and gives the engine a somewhat mped appearance; one would have expected it on a line abounding in curves, like the S. & L., a leading bogie would have been pted, and the driving wheels placed further k. The weight on the driving wheels, 17 tons wt., is, I believe, the greatest ever put on one of wheels, the G.W. and G.N. 8ft. singles ing a ton and a half less; consequently, slip- is reduced to a minimum, and on a greasy rail [illegible] get away at the start much quicker engines, which is of course a re the journeys are so short arrington, and thence pity that diameter

17½in., which would have given a tractive force of 93·6lb., equal to that of the G.N. 8ft. singles, and more suited to the weight of the engines. (The new G.N. 7ft. 6in. singles have, I believe, 18½in. cylinders.)

So far the work that Mr. Sacré's engines have had to do has been mostly light, and I have observed that with their usual load of six coaches, and on a fairly level road, they run at about 60 miles per hour, or a trifle under—e.g., Urmston to 15th mile post (C.L.), 10 miles in 10¼ minutes; Sankey to St. James, Liverpool (C.L.), 15 miles in 16 minutes; Tuxford to Barkstone (G.N.), 22¼ miles in 22½ minutes. There is nothing remarkable in these runs, as much smaller engines, such as L.N.W. "Lady of the Lake" class, or the old G.E. 7ft. singles, do similar work; but what the M. S. & L. engines can do with a heavy load and on the steep gradients between Sheffield and Manchester, I have not had the opportunity of observing; possibly Mr. Marten or some other correspondent can throw light on the subject.

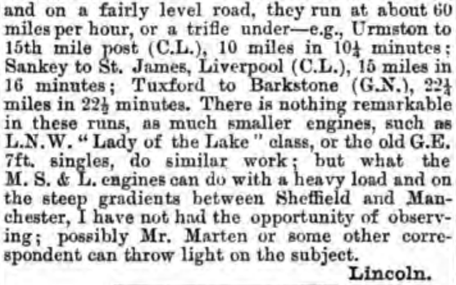
Lincoln.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[57360.]—**Chronometer Balance.**—I think "Wen" is wrong. If what he says is right, then the weight of a balance wheel is of no importance in a watch. It is the weight and diameter together which regulate the speed at which the spring can move it. The reason why ships' instruments are gimballed horizontally is, I think, because the up and down motion of the ship makes the weight of the parts variable relatively to the ship, this variation being then borne by the bearings.—LEICESTER.

[57710.]—**Breechloading 82cwt. Gun.**—In the accompanying sketch the breech-block (A)



which contains the vent is shown in section; it drops in a hole F in the metal of the gun (E). On the front of the block is a copper ring (B), which is angle-faced to fit against a soft iron bush C, which is screwed into the A tube of the gun D; the ring is kept on the seating by screwing up the breech-screw G. The breech-block is prevented from falling too low by a cross-bar at H, which rests on the right and left edges of the orifice F. There is also a handle K for lifting the block.—L. A. L.

[57719.]—**L. and Y. Express Engines.**—There is a misprint in Mr. Seaton's reply to above—viz., the diameter of the coupled wheels is given as 6ft. 6in., whereas they are only 6ft. The dimensions given are applicable to Nos. 813—832 (ordinary link), and also to 833—842 (Joy's valve gear). I hope Mr. Seaton will shortly be in a position to enlighten us as to the new G. N. R. 7ft. 6in. singles. —G. H. H.

7756.]—**The Wimshurst Influence Ma- ,—To "C. D. C."**—The difference in the size of the balls is not sufficient. If your small ball is half an inch in diameter, the larger ought to be nearly 2in., about ¾in. to 1½in. forming a good proportion. If the coating of your jars is too high, you cannot expect length of spark. Do not have more than one-half the height of the jar covered with tinfoil.—J. W.

[57757.]—**To W. H. Eaves, Coventry.**—I cannot pretend to criticise Mr. Edison's formula, and I cannot say what the ·018 represents. The amount of current that a wire will carry, varies from 5,000 ampères per sq. in., in thin wires, to 1,000 ampères per sq. in. in thick wires or rods. Make your armature on the same principles as the one described in my letters on the 30-lighter. Size of armature 6in. by 4in., core 1in. thick; wind it with three layers of No. 22 double s.c. For the F.M. you can make them Edison type, use massive cast-iron pole pieces, and yoke; for the electro-magnet cores, use two pieces of wrought iron, 8in. long and 3in. in diameter; wind as series with 20lb. of No. 16 double c.c. With the dynamo so constructed, you will obtain 110 volts at about 1,500 revs. per minute.—W. H. EAVES, Coventry.

[57758.]—**Plumbing Joints.**—This plan (page 265) seems dreadfully roundabout. Being short of the necessary teeth to hold a blowpipe and retain the use of both hands, I have several yards of ¼in. indiarubber tubing so as to attach to the nearest gas-burner; on the other end is the blowpipe with the small cap removed. Now open out the end of one piece of pipe with the taper boxwood plug, pare it clean inside with a sharp knife (keep the end down while doing this); cut the end of the other pipe true and taper it a bit with knife or rasp; set both tightly in place perpendicularly against the nearest bench, apply a pinch of powdered rosin, then take the lit pipe in one hand, the solder in the other, go all around it, and the job is done.—A., Liverpool.

[57813.]—**Gramme Dynamo.**—To Mr. W. H EAVES.—Your machine would certainly be considerably improved by annealing the F.M's. But at the same time you must remember that a large shrinkage takes place in cast iron during the process of annealing, so that now the machine is fitted together, I do not think it would be practicable. Try coupling the magnet-bars in parallel arc; also examine the F.M. bars where they join the yoke, to see if they make perfect contact.—W. H. EAVES, Coventry.

[57813.]—**Gramme Dynamo.**—I am obliged to Mr. H. W. Needham for the simple rule he gives. It may be useful to some of our amateur electricians; but I can assure him it is not new to me, and also, despite his assertion to the contrary, I still believe the poles, as shown in my sketch, to be correct. I have always been led to believe that the N. pole of a magnet was similar in its properties and effects to the N. pole of the earth. Great confusion is caused by the simple fact that the north-pointing end is commonly called the N. pole of the needle, when, in fact, the contrary is the case, the N. pole of the earth attracting the S. pole of the needle, so that the end of the needle which points to the north is its S. pole. A similar confusion is caused in the case of a voltaic cell by the negative plate being called the positive pole and the negative pole called the positive plate, thus assuming that the respective plates are + and − above the liquid, and − and + below it. I hope this explanation will satisfy Mr. Needham, and that in future he will consider whether he is right himself before he attempts to correct others. —W. H. EAVES, Coventry.

[57825.]—**Belting.**—Better have a rubber belt. —E. G. M.

[57829.]—**Boiler.**—See the back numbers for directions; but, better still, rivet your iron boiler, and then "sweat" the joint with spelter. The safe pressure depends so much on the way the work is done, that it is impossible to give any definite idea of what such a boiler will stand.—ESSAR.

[57830.]—**Power of Engine.**—The power of an engine is calculated by the following formula: $\frac{2\,A\,P\,R\,S}{33{,}000}$, where A is area of piston in sq. in., P pressure in lb., R number of revolutions per minute, and S stroke in feet.—ESSAR.

[57836.]—**Stove.**—The only way is to drill or cut the piece out. Can be made smoke-tight by pinching lid down on ordinary red lead packing. S. T. M.

[57841.—**Burning Kerosene under Steam Boilers.**—Kerosene being a preparation from petroleum—it is burning oil—is not likely to be used under steam boilers. It is the dead oils, creasote, &c., which are used for the purpose, and they are usually injected into the furnace by means of a jet of steam, the nozzles of both supply-pipes being in close proximity, but at about right angles to one another. In No. 608 the querist will find an illustration of the sort of burner used, but there are several modifications.—NUN. DOR.

[57847.]—**Black Oil for Harness.**—Put 2oz. of black rosin into a glazed pipkin, and place over a gentle fire. When melted, add 3oz. of beeswax, and as soon as it becomes liquid remove from the fire and stir in ½oz. of fine lamp-black and ½drachm of Prussian blue, in fine powder. Stir, and add turpentine until as thin as required. Apply with a rag, and polish with a brush, as if it were boot-blacking.—SABBAS.

[57850.]—**Plumbing.**—If querist cannot refer to the practical articles by Mr. Davies which appeared a few volumes back, he should procure that writer's book, which is published by Spon, 125, Strand.—S. R.

[57853.]—**Lubricant.**—Washed hog's lard mixed with equal quantity of finely-powdered plumbago. —S. R.

[57854.]—**Kapp Dynamo.**—The specification of the patent would be the best source of information.—NUN. DOR.

[57856.]—**Fairy Lamps.**—The querist should say which lamps he means. If Swan's, he can obtain all particulars of the maker.—NUN. DOR.

[57864.]—**Magneto-Electric Machine.**—TO MR. BOTTONE.—Have looked through Dredge's, but cannot find any mention of the Victoria machine, so should be glad if you would give me more exact information when you have your copy returned. But you recommend testing the resistance of the armature while running with a bridge and coils, and say the R. is very different while running to when it is standing still. Of course it is. A running contact is never so good as a stationary one, and therefore the brushes would introduce extra resistance. This resistance would not be taken into account when the machine was generating current, for sparks would form, which would lower the resistance of the contact. Again, if you test it near the F.M.'s at all, a current would be generated which would destroy your balance and prevent you obtaining the proper resistance. There are several better methods of testing the resistance while running.—P. C., Hornsey.

[57869.]—**American Fire-Escape.**— Does the querist mean the one in which ladders are elevated telescope-fashion by means of gearing and a winch? —S. R.

[57873.]—**Tom Thumb Hot-Air Engine.**—I would advise "An Old Reader" to read the description again. The piston is not fastened to the dish-shaped vessel, but to the metallic disc inside, which is separated from the other metallic disc by a flexible diaphragm of vulcanised india-rubber covered with canvas. The metallic discs are driven backwards and forwards, or upwards and downwards, by the hot air, connection between the two sides being prevented by the rubber diaphragm, which is clamped between the rims of the two halves of the dish-shaped vessel.—S. R.

[57880.]—**Staining and Varnishing Wainscot and Distempering Walls.**—This is rather a "large order," and I think the querist might profitably look up his back numbers. Brush the walls, and wash down with hot water and a scrubbing-brush. Then put on the first coat, which is made of whiting, size, and colour, with 1oz. of alum and 1oz. of soft soap to 6lb. of whiting. The finish coat omits the soap but retains the alum, and is best used when at a temperature which "jellies" the size. Try the colours on paper first. Can "slightly stain pitch pine" with porter, permanganate of potash, or bichromate of potash. Grease can be taken off with hot lime, soda solution, benzine, &c. One gallon of varnish will cover from 26 to 40 superficial yards—according to how it is put on.—NUN. DOR.

[57881.]—**Bleaching Rosin.**—I suppose rosin might be bleached by dissolving in ether, and treating with animal charcoal or some other decolorising agent; but really I don't think it is worth trying, unless by varnish makers who want to make a "cheap" article.—NUN. DOR.

[57884.]—**Leather Reviver.**—Restore colour with an aniline dye that suits, and finish with glair—that is white of eggs beaten to a froth and allowed to stand. Pour off the liquor—that is glair. —S. R.

[57890.]—**Concave Reflectors.**—I believe zinc will take a coat of silver from the alcoholic solution of the nitrate; but it is better to coat the zinc with copper in the alkaline bath, and then silver the copper in the usual manner.—NUN. DOR.

[57891.] — **Electric-Current Regulator.** — Doubtful whether it is possible to do what is required, as no battery is "constant" enough.— S. P. T.

[57893.]—**Electric Light.**—The spent bichromate liquid is of no use.—S. R.

[57915.]—**Hot-air Engine.**—There is a brazed cylinder, filled with charcoal and quite airtight, inside the displacement cylinder B, as shown in the drawing, page 246, No. 1,078. The sizes of Stirling's model working cylinder A, 3in. long, 1⅝in. diam.; flywheel, about 1ft. diam.; air heater, or displacing cylinder B, 2½in. diam., and 10in. long; the pillars of the frame are 16in. high, and the pillars for the flywheel about 9in. The engine will stand on a space nearly 12in. by 8in., and is about 27in. high. I have given particulars of a smaller engine in previous replies.—J. SUTCLIFFE.

[57934.]—**Dynamo.**—The plates must be about 8in. by 6in. and about $\frac{3}{16}$in. thick, with a flap projecting at the top for connections. They are bored all over with holes ⅛in. diameter, as close together as possible, except two strips passing through the centre—one down the length, and the other across the breadth—forming the shape of a cross, and a narrow strip round the edges to give strength to the plate. The holes are filled with red lead, mixed with water only, and the plates are then dipped in sulphuric acid (1 to 10), and instantly taken out and allowed to dry before putting in the cells to form. Do not let the plates dry again after they are once placed in the cell. As a storage cell gives about two volts, if the number of volts required to light the lamp be divided by 2, this gives number of cells required. A 10 c.p. lamp takes from 20 to 30 volts. In charging each cell must get a little more than 2·25 volts. About 30 plates will be wanted, or, if the plates are made 1ft. square, or, say, 10in. by 12in., 20 plates will be wanted.—BUNSEN.

[57956.]—**Arc Lamps.** — TO "LEAR."— My correspondent is quite mistaken if he thinks that the lamp described is a toy. It is a modification of the "Lever" lamp, which gained golden opinions at the Crystal Palace Exhibition of 1883. It is said that imitation is the sincerest flattery, and it would appear that the merits of the lamp must be great, since it has met with imitators of all its points (except its low price) on all sides—the Gulcher, the Hawke, the Girard, &c., being all closely allied forms. The original form of the "Lever" lamp will be found figured and described at p. 378, Vol. XXXVI. of the ENGLISH MECHANIC.—S. BOTTONE.

[57994.]—**Gas-Engine.**—Our gas-engine once had an ailment which your complaint reminds me of. Its cause baffled every attempt to discover it, until we looked down the exhaust pipe, which went up through the roof. At the point where it passed the slates and flashing, the carbon had accumulated, until there was not more than a ½in. hole to exhaust through. This pipe was removed, and one with a larger bore substituted, so we have had no further trouble in that direction.—FRED. BAKER.

[57996.]—**Metal Spinning.**—There is a certain knack required in turning out well-spun metal-work; still the difficulty is not overwhelming. The tools have much to do with it, and I do not quite like the look of the tools sketched in Vol. XXXIV. Different metals also require a different treatment. If "Fal" will state a particular case, I will help him as far as my ability goes. I must add that I can spin myself, and have for years had very able spinners under me.—ANGLO-DANE.

[58014.] — **Astronomical Objects.** — Whilst "F.R.A.S." was descanting in one column on the nuisance of using the same sign to represent totally different things, the compositor in another department was giving extra point (for the thousandth time, shall I say?) to his caustic remarks. In my reply to this query I wrote "stars less than 3″ apart"; but the printer, reading the ″ *his* way, made it 3 "inches"! I need scarcely say that *seconds* were meant, and that the division of 3in. stars (supposing any to exist) would be quite beyond the finest of instruments—even those marvellous small apertures whose doings were wont to be vaunted in your earlier vols.—ARTHUR MEE.

[58037.]—**Wimshurst Machine.**—According to Prof. S. Thompson, carbonic-acid gas causes the spark to appear white. Vacuum tubes may be obtained filled with this gas, which would do for an experiment.—P. C., Hornsey.

[58037.]—**Wimshurst Machine.**—It is impossible to use any induction or frictional machine for electric lighting, as the electricity it gives is only of very high E.M.F. with scarcely any current.—C. T. C.

[58039.]—**Floating 100lb. Cylinder.**—Total weight of water to be displaced = 125lb. = 2 cub. ft.; but only half cylinder is immersed. ∴ cylinder must contain 4 cub. ft., and as its length is 10ft., its area must be 0·4 c.ft., or a diameter of 8½in. T. C., Bristol.

[58039.]—**Floating 100lb. Cylinder.**—Weight to be floated including that of cylinder = 125lb. Capacity of cylinder required to float 125lb. = 2 cubic feet. But as you require your cylinder to remain only half-submerged, you must double the capacity, and say 4 cubic feet. A diameter of ·72 feet would give this $({\cdot}72)^2 \times {\cdot}78 \times 10 = {\cdot}4043 \times 10 = 4{\cdot}043$ cubic feet.—ELAG.

[58039.]—**Floating 100lb. Cylinder.**—You want to displace 125lb. of water—that is, 2 cubic feet; the cylinder must be 4 cubic fee
only want half immersed, hence—

$$\pi r^2 \times 10 = 4$$

$$r^2 = \frac{4}{31{\cdot}46} = {\cdot}1239$$

$$r = {\cdot}35\text{ft.} = 4\tfrac{1}{4}\text{in.}$$

Hence, if you make the diameter 8½in.
err a little on the safe side.—L. A. L.

[58040.]—**Lathe.**—I don't think gut
able for such a large lathe. In my ex
have found gut bands a most confou
ance; for when you change your speed t
on pulling it out of the V groove often
hook or eye off. If the thread of the ho
is sharp, it soon cuts away the gut; if du
away easily. With a good leather b
sewn together, and broad enough for th
grip ought to be sufficient without n
initial tension so great as to make her
Perhaps, as you say, a wooden speed c
better effect the object. Undoubtedl
wheels would run lighter than cone-poin
latter often don't fit well, and bear who
points or outsides. Of course, with frict
the axle rolls over, not rubs the surfac
rubbing is transferred to the wheel centr
MANTON.

[58043.]—**Wimshurst Influence M**
I should advise "Vulcanite" to obtain
trician's catalogue, such as King, Men
Dale's, as he can perform a number of i
experiments with apparatus there descr
of which he can make himself.—P. C., H

[58044.]—**Safety Valve.**—Divide ar
by ·7854. The result will be the squ
diameter.—ELAG.

[58044.]—**Safety Valve.**—Diameter
1in. area = 1⅛in. very closely. Rule i
the required area by ·7854, and take the s
of result—

Diameter of ½in. area = 0·8in
" ¼in. " = 0·57i
" ¾in. " = 0·98i

—T. C., Bristol."

[58044.] — **Safety Valve.** — The f
$d = \sqrt{\frac{\text{Area}}{{\cdot}7854}}$; or in words, "To find
meter, divide the area by ·7854, and e
square root of the quotient." Thus, 1 sq
divided by ·7854 = 1·2718, and the squa
this is very nearly 1·13in. You can find
diameters from the rule or from this c
by remembering that similar areas var
as the squares of their homologous meas
—L. A. L.

[58045.]—**Sugar of Lead**—Is prepar
gesting litharge (PbO) in dilute ac
$(C_2H_4O_2)$, or by exposing thin sheets of
chamber to the joint action of air and a
vapour. A mixture of carbonate and a
lead is formed on the surface of the sheet
the coating has become thick it is scrape
dissolved in a slight excess of C_2H_4O
avaporating the solution until a densit
obtained, the lead acetate crystallises
MEM. SOC. CHEM. INDUSTRY.

[58045.]—**Sugar of Lead.** — Lead
$[Pb\ (C_2H_3O_2)_2 + 3H_2O]$, commonly call
of lead, is made on a large scale by d
litharge (PbO) in acetic acid $(C_2H_4O_2)$, th

$$\begin{array}{l} PbO + 2C_2H_4O_2 = Pb\,(C_2H_3O_2)_2 + \\ 223 + 120 = 325 + \end{array}$$

It crystallises well, and is soluble in 1½ p
at 15° C. The commercial salt usually
excess of lead oxide in the form of basic
a solution be made of this commercial salt
water, it becomes turbid; again, if a sol
made in distilled water, and left expo
atmosphere, it will also become turb
turbidity is due to the carbonic acid g
which is present in spring water, and
acting upon the lead compounds to form
bonate $(PbCO_3)$. Sugar of lead is ver
in alcohol (C_2H_5OH).—ERNEST HANWE
lotte-street, Hull.

[58048.]—**Windmill for Turbine.**—
be done; but why not use the windmill
supply the power required, and save—1
tank and work of erecting; 2nd, cost of
3rd, loss of power through friction, &c., in
the water from the dam to the tank; 4t
power through friction and imperfect effi
the turbine? Perhaps you will say the
would go day and night without watching,
can work by day with the reserve pump
night; but a 400 gallon tank, with 20f
only store up 80,000ft.-lb., which
velop 1-h.p. with the best turbine f
The idea of making the turbine
tank is impracticable. I think
you cannot create energy.—L. A

]—**Hot Dynamo.**—If it is only the ıt get hot, it is all right, they should reach imum heat in about three hours, it would fe for them to go above 220° Fahr. A l ready rule is that the various parts of no are all right so long as you can bear l on them.—W. H. EAVES, Coventry.

]—**Safety Valve.**—Pressure on valve ¼in. = ·0491lb. for every pound pressure in 'herefore for 100lb. = 4·91lb., and five much for 500lb., and so on. You had ve a dead weight for the pressure, and do ı complication and friction of lever. If have a lever, let the weight of ball be th of lever 15in., made of 1in. by ¼in. ıay, ¾lb.) The weight of lever alone will b. pressure. Graduate lever 2½in. from or 200lb., of course using the 2lb. ball, 2½in. for every additional 100lb.—T. C.,

]—**Electrical Units.**—I see that the ıs made one or two slips in the printing of r to query 58059. "H_2SO_4 has a much less influence" was put instead of "H_2SO_4 has ıs electrical resistance"; and in mentioning ıal resistance of a cell as 5 ohms instead , though ·05 would have been nearer the . L.

]—**Electrical Units.**—Very many) those gentlemen who have so kindly my query; but unfortunately, they have here I was. May I further trouble them ᴇ, supposing that a double fluid bichro- 'uller battery, for instance (of any num- ls requisite) will give me, say, 1·5 ampères ½ volts resistance for three hours, what size of immersed surface of zinc will e same current to be got from the battery ɾreater period attainable, and if this is to what extent can it be done, and what ıecessary for the calculation? Of course, ive element would be increased with the s required.—FINEM RESPICE.

]—**Electrical Units.**—In the latter part s" reply to this question in last week's gives, as solution of problem, Ohm's $\frac{S E}{S\rho + R}$ for coupling cells in series, $\frac{\times 1{\cdot}6}{0 + 36} = \frac{8}{3600} = {\cdot}002$. This is surely a should it not read $= \frac{8}{136} = {\cdot}059$ (nearly,) I misunderstood it? If I am right, then, ıe he gives, coupling in series would prove itable than in arc, rather than vice-versa, s on to say.—F. A. F.

]—**Bends in Stove Pipes.**—"Hendon" the correspondence regarding "A Curious ɔe." It is no answer to his query. I can- ıink it would interest many to know how in question are made in practice. Hope der will be kind enough to give those l the benefit of his knowledge on the -HENDON.

]—**Back-pressure of Compound.**— ıssure in h.p. cylinder is always rather n pressure in l.p. cylinder. Of course, inually varies with boiler pressure used ff in h.p. cylinder, which is very generally 'ut-off in l.p. should be such that absolute ıt end of stroke equal about 3lb. or 4lb.— stol.

]—**Backing Millstones.**—Use plaster and any heavy stone to make up the I prefer Keene's cement to plaster of ll you have to do is to put enough water until it is like a soft mortar, and then on.—T. C., Bristol.

]—**Hot Brasses.**—Oil ways at sides of ıes not much use. Take out the brass and ın. hole down the bottom, but not quite and it will be all right.—T. C., Bristol.

]—**Flywheel.**—Say shaft of millstone at $\frac{11}{15}$, 100, or, say, 80 revs., and you must en pulley to suit driver on engine. Say of engine is 9ft. and makes 100 revs., then quired $\frac{100}{80}$ × 9ft. = 11¼ft. Better use a engine shaft, say, 4ft., and one on shaft C., Bristol.

]—**Conversion of Photo. O.G. into** ɔe.—Your querist does not state the gth of his 4in. lenses. I should think ves would be too deep for telescopic pur- . A.

]—**Warming Claret.**—Place the bottle *fender* or on the mantel about half an *before* it is wanted.—H. A.

-**Warming Claret.**—Claret is at its *t 70°*. Put the bottle near the fire for kept in a warm room, heat ıe fire.—TEL.

—Accordin

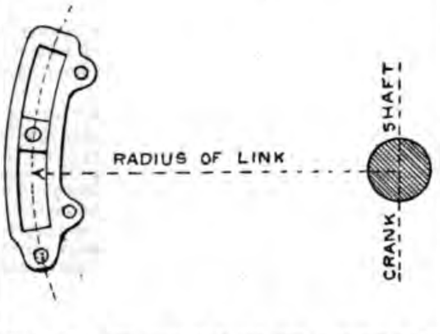
m and ma

jars are apt to be eaten through by acid after a time.—P. C., Hornsey.

[58071.]—**Link Motion.**—Radius of link must be struck from centre of crank shaft, and length equals three to four times travel of valve.—T. C., Bristol.

[58071.]—**Link Motion.**—The radius of the link is found by placing the valve at half-stroke; then, from the centre of crank-shaft to the centre of pin for taking the valve block, describe a circle, the distance between the eccentric rods end being usually three times the throw of the eccentric.—J. GRAHAM.

[58071.]—**Link Motion.**—A good proportion for the length of the link is three times the stroke of the valve; but if your engine is small, I should advise you to make it rather longer than this; but the stroke of valve has nothing to do with the curve of the link. You have simply to strike your curve from the centre of the crank-shaft to the centre of the pin of your valve-spindle, as shown in sketch; then when you have your link set out, you can easily get the proper lengths of eccentric rods.—T. R. SAXTON.

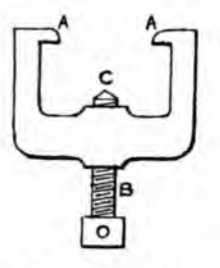


[58072.]—**Pressure in Boiler.**—Taking working strain on single riveted brass at 1 ton per sq. in., you have ⅛in. to burst, say, 280lb.; safe working pressure $= \frac{280}{6} = 46$lb. I should not advise you to test boiler to more than 100lb., or the firebox may show you something.—T. C., Bristol.

[58073.]—**White Lead.**—Look up articles on "Simple Exercises in Technical Analysis."—A MEM. SOC. CHEM. INDUSTRY.

[58074.]—**Bicycle Repairs.**—To get cranks off, first get 2ft. of ¾in. round or square iron, flatten one end for 1in. up and to ⅛in. thick; then bend it at right angles 1in. long, bend the other end at right angles 2in. long on the opposite side. Let someone hold the bicycle up; place the thin end of the tool behind the crank close to the spindle; then give a few smart blows with a heavy hand-hammer on inside of the other end of tool, and you will succeed. To take deep rust marks out, smooth file and emery cloth.—W. TAYLOR, B.

[58074.]—**Bicycle Repairs.**—A very handy crank remover is the following, which any machinist can easily make. It should be made of tough steel. A A are jaws which go behind the crank-boss, and screwing up the pin B, the point C bearing on the centre of the axle, pulls key and all away. B should have a fairly fine thread, yet be strong. The jaws A need to be made to suit the individual bicycle you have, as they need to be very strong, and some bicycles have the cranks close up to bearings. Have never heard of Cann and Co., Holborn Viaduct; as far as I know, only the great cycle makers have their depots there. Deep rust marks are very hard to get out. Use emery and oil, or file (smooth); but if your forks are hollow, beware.—A. W. MANTON.



[58079.]—**Sun Diagonal.**—In a first surface reflecting sun diagonal the solar image falls on a plate of glass set at an angle of 45°, it is then reflected into the eyepiece. In Chambers's "Astronomy" there is a diagram of a sun diagonal.—H. A.

80.]—**Re Horse-Power of Locos.**—The n an article some time ago, stated that the Great Britain, G.W.R., had developed 950 h.p. as a maximum, and the Gladstone, L. B. and S. C. R., 1,040 h.p. The Gladstone has cylinders ¼in. larger in diameter than the Great Britain. I have the cutting, if necessary, to verify this.—GREAT BRITAIN.

[58083.]—**Sal-ammoniac.**—Sal-ammoniac (NH_4Cl) may be obtained by neutralising the distilled ammoniacal liquor of the gasworks with muriatic acid (HCl) and evaporating the solution to dryness; or, by subliming a mixture of sulphate of ammonia $(NH_4)_2SO_4$, with common salt ($NaCl$), thus—

$$\begin{array}{ccccccc} (NH_4)_2SO_4 & + & 2NaCl & = & 2NH_4Cl & + & Na_2SO_4 \\ 132 & + & 117 & = & 107 & + & 142 \end{array}$$

The sublimed salt is a tough, fibrous mass. It dissolves readily in water, and crystallises in arborescent forms belonging to the regular system. On heating the salt it volatilises completely without melting.—ERNEST HANWELL, Charlotte-street, Hull.

[58084.]—**Electric Lighting.**—For electric lighting and other work requiring some power I find nothing will beat the Bunsen, as modified by Burke and Holmes, which, if properly made, do not smell in the least. I shall be sending a description of a modification of mine in a week or so.—P. C., Hornsey.

[58084.]—**Electric Lighting.**—MR. BOTTONE or H. EAVES.—Your four cells will light one 5-c.p. lamp. I do not think it would light two well. If you have plenty of mercury at the bottom of the porous pot, it will keep the zinc well amalgamated, and the zinc need not be removed. The fact of the switch being in the circuit makes no difference in the amount of chemical action in the cells, it being simply used to make or break the circuit.—W. H. EAVES, Coventry.

[58087.]—**Pork Pies.**—A lady friend informs me that the whole process of making the paste must be gone about near the fire. The crust must all the time be moulded from within, and this can only be attained by practice.—ARTHUR MEE.

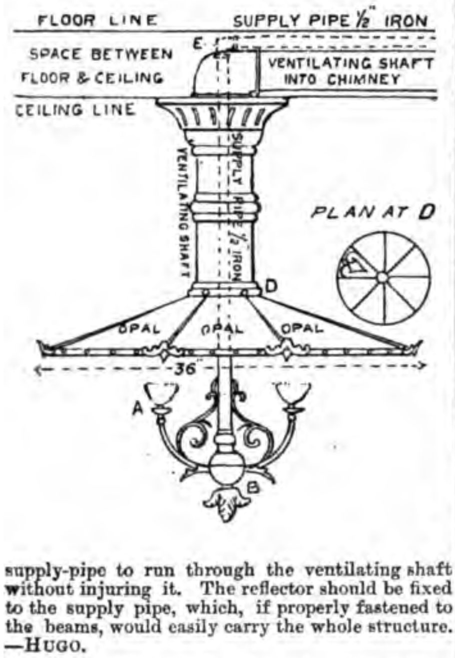
[58087.]—**Pork Pies.**—Chop a quarter of a pound of suet very fine, mix it with a quarter of a pound of butter and a pound of good dry flour, put in a pan, place it to become hot, and butter and suet melted, then knead it into a stiff paste; place it before the fire, covered with a cloth till required. Cut the pork fine, fill the crust made high, then place in the top, press it tight with finger and thumb, brush over with white of egg, bake in a very hot oven.—A. M. C.

[58088.]—**E.M.F. of Leclanche Batteries.**—You will find your first three questions answered in any textbook on electricity. The number of cells required depends on the resistance of the lamp, which in any case they will only light up for a few minutes, as has been explained in this paper over and over again.—J. K. B.

[58098.]—**Regenerative Gas-Burners.**—If "Figaro" wishes to increase the light in his room, I should say he could do so to the best advantage by the adoption of these burners; but if heat is an objection, do not think of employing them, for it is an undisputed fact that the great defect in regenerative burners is the tremendous amount of heat developed in burning. There is one of them in the office in which I am engaged, consuming 6ft. per hour, and also a gas fire. When I light the former, I immediately turn out the latter, and even then, in the space of less than half an hour the temperature of the room is raised from 6° to 8° Fahr If you determine to adopt these burners, and require more light than a 6ft. size would develop in one room, the best plan is to use two, each consuming, say, 4ft. per hour, as the heat developed by the two together will not be so great as that given off by one light consuming 8ft. per hour; and there is also this advantage, that one alone can be used if the full power is not required, because it may not be generally known that it is a very bad plan to turn these burners down very low, as they are liable to smoke and choke themselves up with carbon.—LEVER.

[58098.]—**Regenerative Gas-Burners.**—The only regenerative gas-burner that I ever tried for domestic purposes is anything but a success. Unless the room is very lofty, so that the burner could be high up, he would find the heat greater than from his chandeliers. There is also considerable expense and trouble to get the ventilating shafts in, and it would be quite impossible to have a burner of this description in a room without special ventilation. Even if "Figaro" is prepared to do this, I would recommend him to try the following plan:—Have a reflector made, as the rough sketch, put a ventilating shaft in the space between floor and plaster, run it into the chimney, or to an outside wall, and I think you will have a nice, light, and tolerably cool room, and all for about a quarter the cost of a regenerative burner, which is, in my opinion, only fit for lighting halls, &c. They are also a lot of trouble to keep clean. References to sketch:—A. Six arms and burners;

Bray's batswing with wind-guard to be used. B. Cock here; or, better still, a cock fixed in the wall or elsewhere easily reached. E. If a hole of the right size is cut here nicely, it will allow the supply-pipe to run through the ventilating shaft without injuring it. The reflector should be fixed to the supply pipe, which, if properly fastened to the beams, would easily carry the whole structure. —HUGO.



[58102.]—**Electrical.**—To render this problem of general interest some explanation appears necessary.

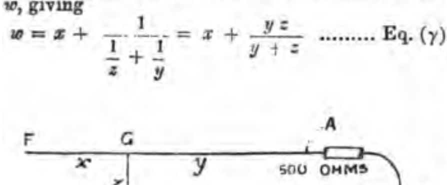
x is the resistance in ohms of the wire F G.
y " " " G A.
z " " " G C.
500 " " " A B.

First, C is put to earth, and a current sent from F through x, z, all else being insulated. The total resistance is I. This gives $I = x + z$...... Eq. (α). Next, both C and B are put to earth, and the current sent from F. The total resistance is now W, giving

$$W = x + \cfrac{1}{\cfrac{1}{z} + \cfrac{1}{y + 500}}$$
$$= x + \frac{(y + 500)\,z}{y + 500 + z} \text{ .... Eq. } (\beta).$$

Lastly, both C and B are put to earth, and the current again sent from F. The resistance is now w, giving

$$w = x + \cfrac{1}{\cfrac{1}{z} + \cfrac{1}{y}} = x + \frac{y\,z}{y + z} \text{ .... Eq. } (\gamma).$$



We have these equations (α), (β), (γ) to find x, y, z. The values of x from (β) and (γ) are respectively

$$W - \frac{(y + 500)\,z}{y + z + 500} \text{ and } w - \frac{y\,z}{y + z}.$$

Therefore, substituting these in (α), we get

$$I = W - \frac{(y + 500)\,z}{y + z + 500} + z = W + \frac{z^2}{y + z + 500}$$
$$\text{and } I = w - \frac{y\,z}{y + z} + z = w + \frac{z^2}{y + z}.$$

Dividing one equation by the other,

$$\frac{I - w}{I - W} = \frac{y + z + 500}{y + z} = 1 + \frac{500}{y + z}.$$

Subtracting 1 from each side,

$$\frac{W - w}{I - W} = \frac{500}{y + z} \text{ .... Eq. } (\delta).$$

But from above

$$I - w = \frac{z^2}{y + z}.$$

Therefore, by division,

$$z^2 = \frac{500\,(I - W)\,(I - w)}{W - w}$$
$$z = 10\sqrt{\frac{5\,(I - W)\,(I - w)}{W - w}}$$

So from (δ),

$$y = \frac{500\,(I - W)}{W - w} - 10\sqrt{\frac{5\,(I - W)\,(I - w)}{W - w}}$$

And from (α),

$$x = I - 10\sqrt{\frac{5\,(I - W)\,(I - w)}{W - w}}.$$

—F. B. ALLISON.

[58110.]—**Barlow Lens.**—See No. 440 (p. 605), where other references will be found.—ARTHUR MEE.

[58111.]—**Dutch Grammar.**—Ahn, "Neue Holländische Sprachelehre," 2s. Ahn, "Concise Dutch Grammar," 3s. 6d.—F. W. L.

[58111.]—**Dutch Grammar.**—(1.) Ahn, F. "Concise Grammar of Dutch, with Selections from Best Authors"; translated from German by Henri van Laun. London, 1877. 3s. 6d. (2.) Calisch, J. M., and Witcomb. "Guide to Modern Conversation, in Dutch and English." Published in Berlin, 1879. 1s. 6d.—WAHBEM.

[58111.]—**Dutch Grammar.**—Ahn's, translated by Henri van Laun, and published by Trübner and Co., Ludgate-hill, price 3s. 6d., is good, although not so effective in teaching power as Otto's grammars. Unfortunately, there is no Dutch grammar published in his style that I know of.—B.SC., Plymouth.

[58112.]—**Gravity Leclanche.**—TO "SIGMA."—I do not see how they can have a higher E.M.F., in fact the reverse would be probable; when the cells are only half-filled with liquid, the atmospheric oxygen finds its way in and is absorbed by the carbon, and so contributes to the action of the manganese. This could not occur in the gravity form. I have not myself tested the relative merits, so I should not care to express an opinion which might mislead.—SIGMA.

[58113.]—**Incandescent Lamp.** — TO MR. BOTTONE.—A sulphate of mercury battery, made of slabs of graphite about 3in. by 3in., covered with a paste of sulphate of mercury, over which is placed a piece of moist flannel and a zinc slab, of the same size, the whole being inclosed in an ebonite box, is about the most convenient form for "fairy" lamp lighting. Three or four of such may be required, according to the resistance of the lamp. The E.M.F. of this battery is pretty high, about 1·54 volts. Of course it requires replenishing after use—say, after three hours' run.—S. BOTTONE.

[58115.]—**Lathe Head.**—Pinions, say, 1¾in.; wheels, 5¼in.; 1in. broad, and ⅜in. pitch. Get them from Lloyd's. Angle of mandrel about 10°, with a conical shoulder, say, 60°. Different makers vary. A mass of correspondence in last Vol. *re* this.—T. C., Bristol.

[58116.]—**Small 3in. Telescope.**—I am afraid that "Amateur" would not care to pay for two reasons—firstly, the draw would have to be slotted and a rack fitted in; secondly, there would have to be a pinion turned, fitted with a pinion cock and milled head. Probable cost at a first-class firm 15s. —READER.

[58116.]—**Small 3in. Telescope.**—Don't go to the expense of having rackwork to your telescope until you are satisfied of its quality. Try it on Saturn, and also on some double stars, as ε Lyræ, which it should easily show quadruple, with a 10 mag. star between the two close pairs. You will, with a little practice, be able to focus almost as easily without a rack as with by twisting the tube slightly in or out. I often use a 3⅞in. without a rack, and do not experience much inconvenience. It would, however, be a simple matter to get a piece of tubing made to screw into the eye end having about 1in. of rackwork. If your o.g. is good and your stand firm, you should be able to use powers up to about 250 on suitable double stars, and up to 200 on planets on good nights. As a general rule, however, much lower powers than these will be most useful, especially if you are—as I infer that you are—a beginner.—MAGISTER.

[58116.]—**Small 3in. Telescope.**—In regard to your rackwork consult Mr. Lancaster. As to powers, Chambers gives for a glass your size—20, 55, 110, 200. There has been any amount of information on this subject in back numbers, even as late as last week!—ARTHUR MEE.

[58117.]—**Gramme Armature.** — TO MR. BOTTONE.—The cog form of armature has been proved to be far superior to the ordinary ring form, by the classic experiments of Prof. Silvanus Thompson, in March, 1884. Still, if you wish to try your hand at the plain ring, you will find full details as to mode of winding, &c., at pp. 261 and 564, Vol. XLI. of the ENGLISH MECHANIC.—S. BOTTONE.

[58118.]—**Welding Iron.**—Your sand may not contain sufficient silica. Try some good glass pounded up.—A., Liverpool.

[58120.]—**Bicycle Hubs.**—There is no absolute necessity for you to have new hubs, as the nipples could be screwed into the holes in the old one; the holes would bear to be retapped, as the nipples would be larger than the wire.—OS.

[58120.]—**Bicycle Hubs.**—You might turn the hubs down to smaller diameter, tap larger holes for larger spokes; the holes in the rim will have to be reamed the size of new spokes. If the holes in rim have much taken out, you will have to re-countersink. If you have to take much out of the hubs to get a full thread, the spokes will look cumbersome. You could get new gun-metal hubs cast off the old ones; but it would be a difficult matter to set the new holes. You can get new hubs, ready set, drilled, and tapped on the shaft; but they might not be the same distance for the forks to fit, or the bearings to run on the same place; the shafts made now are for ball bearings. "C." had better refer to "Bicycle Repair," No. 58074, Vol. XLII., No. 1,079 ENGLISH MECHANIC, before doing anything. I would almost advise the adoption of latter answer.—W. W.

[58120.]—**Bicycle Hubs.**—I am afraid that many riders share your experience. Your hubs may be too soft for the purpose, so that the thread is easily stripped if not carefully screwed in. I think, also, that if the wheel was loose—i.e., the tension of the spokes very unequal, the sudden pulls might effect the stripping. Even if your hubs were ever so good, if the thread in the hub were larger than the thread on the spokes, stripping is certain to take place, owing to the shearing away of the top of the threads when the stress came upon it. I know this for a fact, for even with so small a wheel as a 44in. one I could not keep the spokes in; many were always getting loose, others stripped. I was told by the repairer that the holes were screwed a size larger than the spokes (No. 11). I had it re-spoked, and have not had a spoke out since, which proves that the hub was not at fault. If I might advise you, I would get a competent person's opinion on the state and quality of the hubs, and if they were considered satisfactory, I would drill the holes out larger (providing, of course, the hub be wide enough), and have it re-spoked, not with nipples, but with good butt-ended spokes. I feel sure this would give satisfaction. If your hubs are considered bad, they must be unsoldered from the steel collars, and new G.M. flanges put on. I do not consider nipples as good as butt-ended spokes: they are not so easy to adjust (by an amateur), look clumsy, are more expensive, of course, and are, I am told, more liable to "dither" loose.—A. W. MANTON, Cardiff.

[58121.]— **Quadruplex Telegraphy.**—One reason why my "Electricity" is, as Mr. W. Harrison says, "well recommended," is that I always make it a point not to write about or try to explain anything which I am not myself thoroughly conversant with. I have had nothing to do with quadruplex telegraphy, and I only devoted two pages to the whole subject of the telegraph, because, as I say in the opening remarks, "practical knowledge can be given only in the technical works." To these I must refer those who wish to understand the working, the few remarks I have made were only intended to give a general idea to ordinary readers, and, of course, they are meant to be construed in connection with the principles explained throughout the whole book. Of course, as Mr. Harrison says, "If any difference of potential existed between two points, no matter what resistance existed between them, a current would flow." Doubtlessly, a current, but not necessarily a perceptible one. The conditions involved are not those treated § 1087, p. 588. The plan I described, merely to give an intelligible idea to people without going deeply into the subject, involves what may be treated as two galvanometers connected to the circuit, one wound with a few turns of low resistance, the other with many turns of high resistance. Then the distant operator can select which of these he will actuate, or each can be placed at the disposal of separate operators; a small current from a source of high potential will actuate the high-resistance instrument, but would fail to produce any effect on the other, while by other conditions of E.M.F. a current would actuate only the one of low resistance. Of course, in practice quadruplex telegraphy involves a careful balancing of very delicate and complicated conditions, which I have not studied myself sufficiently to attempt to explain, and would have been of interest to very few readers.—SIGMA.

[58122.]—**Lever of Safety Valve.**—The weight begins directly it leaves D (the fu but you cannot get the weight nearer than rule.—T. C., Bristol.

[58122.]—**Safety Valve.**—This questi properly stated, as you don't say whether to be considered as the f which the lever is to rest to explain it is that w ated, then any weig pressing equal to its it as far towards A f

), then will it exert a pressure equal weight, and on moving it another :e it will equal three times its weight, ., Liverpool.

afety Valve.—If I understand your D is fulcrum, and C point at which produced by the weight W (hung on communicated to valve. Now, if W at C—i.e., over the valve centre—of tual weight on the valve would be ; the extra weight imposed by the W were suspended at B, the valve y 2 W (if B C = C D). Similarly, pended at A, if A D = 8 C D, the ted by 8 W. If W be suspended at nth of B C away from C, on the side ies, then the valve is weighted by

$1\frac{1}{10}$ W, and so on. Therefore, the

ht on the valve produced by the W increases (from W itself at C) as load from C towards A. This only case where the fulcrum occupies the nery. Of course, also, the effective by W on the valve decreases (from ou move from C to D, and is zero at ition for W, I believe, is never used alve.—A. W. MANTON, Cardiff.

lowpipe for Glass Spinning, &c. ur" will apply to Mr. Fletcher, , Warrington, for an engraving of oil furnace, he will see in this a model petroleum lamp for glass work. The lied for the furnace, has two large for glass spinning or fine work—in possible blowpipe jets are made from awn to a point and broken off. It is that the lamp itself may be too 'Amateur's" work; but it will be a regards constructive details. It is le blowpipe lamp with which $\frac{1}{2}$lb. of be melted in a crucible.—998.

ondenser.—It is difficult to say off- ch tinfoil a coil will take when only h of the coil is given; it is better to ll the maximum effect is produced; tinfoil is insulated from the next by affined paper, slightly larger in width each alternate sheet of foil should h end, and when sufficient has been s are folded over; one end is now he spring of the contact breaker and he pillar which carries the regulating

overnor Balls.—Do you mean that t to be used? If so, divide 187·5 by of revolutions of the governor, and ult. This will give you the distance m the point of suspension to the cen- in which the balls revolve, and the should be, say, one and a half times l speed.—T. C., Bristol.

athe Surfacing.—Rest appears to ner the collar of mandrel is not true, ndrel against tail-pin is out of truth. ol.

Lathe Surfacing. — Either the e slide-rest is untrue—most probably if you can shake the mandrel at any volution. If you cannot, take screw st and see can it be shaken any- much depends upon the manner in k is fastened to face-plate, what sort of what configuration.—A., Liver-

Amber Varnish. — Gum succini is amber varnish, and chloroform will .—OS.

own Draught.—Would not a cowl C. D. R.

own Draught.—I experienced the ast year as "Hendon," and could not (a Musgrave's slow combustion) to a very rapid rate. It occurred to motive power of the draught, the n out of it by the cold air acting on ; I have accordingly this year cased common roofing asphalte, and with lts. The stove is now under com- e drip from condensation nearly done course, if near the fire, he must use bustible substance. Does the fault, in the cellar itself, from an in- ly of air from outside?—J. T. S.

own Draught.—"Hendon" will ind that the house to which his draws the greater part of its supply om it, and the stove pipe referred to for cold air, and can hardly be made smoke. I can safely say that under le circumstances, so long and so small d to variation of the r his stove bu a mass of

pipe can never be warmed by a "Tortoise," or indeed any other stove, for its whole length, even if the balance or equilibrium of air inside and outside the cellar were obtained. Only an open fireplace and brick flue will do here.—J. W. W—S.

[58136.]—**Transferring.**—There is a method of accomplishing this by pricking holes along the lines of the paper pattern. A mixture of finely-powdered rosin and colouring matter is inclosed in a muslin bag and rubbed over the paper, which is previously placed on the cloth, the object being to force the rosin and colour through the holes. This will, of course, leave pattern on the cloth. If a warm iron is passed over the cloth, it will soften the rosin and cause the colour to adhere.—OS.

[58137.]—**Safety Jet.**—I have two safety jets in which the oxygen nipple is slightly below the hydrogen tube, and the opening is very minute indeed, about as large as the point of a pin. Make them small first, and bore them larger if you cannot get enough light. I presume that the jets are of the usual pattern—viz., the oxygen nipple inside the hydrogen tube. You would find the "mixed" jets more economical with your oxygen.—MAGISTER.

[58139.]—**Resonator for Tuning Fork.**—If on a closed door the fork gives a rather powerful note, why not make a box of Swiss pine about 18in. square and 6in. deep, and use this as a resonator? I think you will find it give good results. Try it first on any empty box you may have handy. The pine should be about $\frac{1}{4}$in. thick, the same as used for pianoforte sound boards.—C. D. R.

[58139.]—**Resonator for Tuning Fork.**—For a tuning fork of 40 beats per second you require a tube 7ft. 6in. long and not less than 6in. diameter, if you wish to get the full tone, and a diameter of 12in. would be better. The tube must be smooth and hard inside, as stiff as possible, and airtight. If you close the tube at one end you can get the correct length for any diameter by pouring water into it until the fork resonates in the strongest degree when held over the mouth. Narrow tubes require to be longer than wide ones on account of the principle of resonance which acts by reflection, and the inside of the tube must be smooth for the same reason. I would advise you to use a globe resonator of 2ft. diameter, and cut the ends of your tuning fork to give only 124 beats per second, which you will find much easier to work with.—J. SUTCLIFFE.

[58141.]—**Medical Electricity.**—The so-called galvanic belts are constructed of discs of zinc and copper connected together in the form of a chain, and whatever action takes place is caused by the acid perspiration from the skin upon the discs. How this should effect a cure in any disease has never been explained. I have no doubt there are numbers who have faith in them; but I have never come across anyone who had received any benefit. There is a firm at the present moment advertising "a preparation of natural electricity" in the form of pills at so much a box. When people are to be found who can be induced to part with their money for such a transparent humbug as this, Carlyle's words apply indeed. In cases of paralysis and some forms of nervous disease, the application of a current, by means of a magneto machine or battery and coil, has, no doubt, helped a cure; but the charlatans who advertise that "electricity is life" in the shape of a box of pills, trade upon the assumption that "the public is an ass, sir."—C. D. R.

[58142.]—**The Wimshurst Influence Machine.** — TO "C. L. W." — The nearer the glasses are together, the better the results. You will generally find that the glasses, when cut from ordinary glass, have a slight curvature in their surface. Place the concave surfaces inside, and let the plates be about $\frac{1}{8}$in. apart at the circumference for general purposes. This will give the best results.—J. W.

[58143.]—**Hydrate of Calcium.**—It is rather difficult to say what this is. Probably it is hydrated oxide of calcium, which I should translate into slaked lime.—OS.

[58143.]—**Hydrate of Calcium.**—This is the chemical name for slaked lime, and the price depends very much on locality. As it seems unlikely that such an elaborate name should have been used for so very common and well-known a substance, the probability is that some chemical was used, the name of which has got somewhat mixed up in transit through the reporters. Considering the use to be made of it, I should expect the sulphohydrate is the substance meant, and gas-lime is a rough form of this mixed with other things.—SIGMA.

[58147.]—**Lens.**—I have seen very effective stops made from blacked pieces of card, fitted tightly into the lens-tube, and this is all I would advise a non-mechanical man to attempt: it will lengthen time of exposure, for which see any amount of nation in back numbers.—OS.

[58147.]—**Lens.**—In the centre of the combination saw a slit half-way down, then fit in two circular flanges about $\frac{3}{8}$in. broad, one on each side of the slit, to keep the light getting in by the stop. The rapidity of the lens will be interfered with to the extent that the flanges diminish the aperture; but practically that would be very little.—B.SC., Plymouth.

[58149.]—**Concerning Canals.**—I should say the path by side of a canal was not a footpath, but a towing path. What would become of your tricycle if you met a horse and boat—canal on one side of path, and, as happens sometimes, a muddy ditch on the other?—OS.

[58149.]—**Concerning Canals.**—The towing and other paths along the canals are the private property of the company, and it is a trespass even to walk on them, unless on company business, just as on a railway. Certainly, tricycles would not be tolerated for a moment, as there would be great danger both to their riders and to the towing horses B.SC., Plymouth.

[58149.]—**Concerning Canals.**—The towing-path belongs to the owners of the canal, who can prohibit the riding of a tricycle on it. If "Judy" has any respect for the rights of cyclists, she will not even attempt to ride a cycle on the towing-path, nor on a foot-path, or a bridle way. Many of those who are dressed in a little brief authority would put a stop to cycle riding in the streets if they could: it would be unwise to give them an opportunity of adversely criticising the actions of a cyclist.—ESSAR.

[58151.]—**Speed of Steam.**—Area of ports about $\frac{1}{20}$ area of cylinder. If piston runs at 300ft. a minute, steam would travel at 6,000ft. per minute through ports. Steam would probably be cut off at half stroke. 6,000ft. is usually taken as maximum proper speed of steam. Arrange area of ports to suit this.—T. C., Bristol.

[58153.]—**Flywheel.**—You won't find two engines by different makers alike in this respect. A large flywheel gives the steadiest running; but three to four times length of stroke is usual for diameter,, and the greater the amount of expansion used the heavier the wheel.—T. C., Bristol.

[58154.]—**Cylinder.**—As regards cylinders, they would all stand 300lb. or 400lb. pressure—the smaller sizes up to 12in., at any rate. They are generally made thick enough for reboring once or twice, say, 1in. for 10in. cylinder.—T. C., Bristol.

[58157.]—**Coil.**—Increase your battery power. You cannot expect much spark from so small a coil. —C. D. R.

[58157.]—**Coil.**—TO MR. BOTTONE OR OTHERS.—Contact not good unless soldered. Such a coil should give a good $\frac{1}{4}$in. spark, with a pint bichromate, and a perfectly irresistible shock. Carbon points fastened to the ends of the wire are generally used for discharging. Your coil is evidently not a brilliant success.—S. BOTTONE.

[58157.]—**Coil.**—To twist two ends of wire together, and then put wax on the joint, did not, I must say, show a great amount of common sense. It is a wonder the wax did not run in and spoil the whole affair. The joint should, in all cases, be soldered. I don't think your coil will give any spark worth having. No. 18 is much too thick for so small a coil; but it will do very well for giving shocks.—OS.

[58159.]—**Engine Pump.**—Either your pump is of faulty construction, or your feed-water is hot enough to vitiate the necessary vacuum by its vapour.—A., Liverpool.

[58159.]—**Engine Pump.**—Are your valves tight? If so, pump ought to force unless you are trying to pump too hot, in which case the vapour acts as a spring and prevents pump drawing. T. C., Bristol.

[58159.]—**Engine Pump.**—Have you examined valves, also shipping of plunger? or is the water too far from pump? If they are all right, and pump will not work, fit an air-vessel to pump-end of feed-pipe, and a check valve on boiler-end, if there is not one already. Also see that the feed or top-valve in pump has the proper amount of lift.—PATRICK.

[58160.]—**Polarisation in Batteries.**—TO "SIGMA."—As the full explanation of the points involved in "A. E. B.'s" question occupies twenty pages of my "Electricity," including a good deal of tabular matter, I can only answer superficially without going into details. Besides the deduction made for the chemical reaction, there is another for the effect of the negative plate. In the case of the Daniell, the result is due to the difference of the intrinsic energies of zinc and copper sulphates. But these energies have not as yet been so exactly ascertained as to make our figures absolute. The production of each salt involves several stages of change of energy, and even the relative solubilities, which sometimes give up energy and sometimes absorb it, affect the final result. I cannot do better than quote my statement as to hydrogen, §546. "Here we have the explanation of the rapid failure of the power of the single-acid cells, such as the Smee. The E.M.F. tested in such a way as to prevent its working, as by condensers, or against a very high resistance, is much larger than this (Volt ·784). Clark gives it as 1·098, and as only ·487 when working; the difference is probably the energy absorbed in rendering hydrogen gaseous; for under the first condition (high resistance and very small current) the hydrogen set free does not actually become a gas; it either forms a liquid (metal) film on the plate, or enters into a partial union with it, or is dissolved in the liquids; and the energy which would be required to gasify the hydrogen is therefore available for E.M.F." Again, in §554, I say, "The force of setting hydrogen free is set down as 1·464; this is an excess, no doubt, for it is the force of combustion of hydrogen, which includes the latent heat of gasification of oxygen: in full work, however, the batteries do really appear to absorb this amount, for the counterforce of hydrogen coating the plate makes it up. Taking the force when hydrogen is not actually set free, we may obtain the latent heat or energy of gasification."—SIGMA.

[58161.]—**Exhaust.**—You do not give the lead. Cannot do this by "plain figures"; better use Zeuner's diagram method for this. I make it as follows (neglecting lead, which won't make a great difference): Cut off at 4ft. 9in., exhaust opens 5½in. from end, and closes 14in. from other end.—T. C., Bristol.

[58162.]—**Speed of Crank.**—Maximum speed of cross-head may be taken at that of crank, or $6\frac{1}{2}\text{ft.} \times 40 \times \frac{22}{7} = 646\text{ft.}$ You cannot very well work the intermediate speeds by arithmetic alone, as you appear to have no knowledge of algebra or trigonometry.—T. C., Bristol.

[58170.]—**Waterworks.**—Sufficient watershed must be got to give 30 gallons per day per inhabitant, calculated on the minimum yearly rainfall of the district, and storage provided to hold six months supply; add to this ample provision to meet existing rights, such as mills and works deriving their water from the same source.—B.SC., Plymouth.

[58171.]—**Electric Clock.**—In reply to "Yoshi," I am sorry to say that I am unable to send a drawing of my electric clock to this week's "E. M.," owing to my being absent from home. I shall be pleased on my return home to make a drawing to scale of the pendulum, and give all the necessary connections, as requested.—ACOLYTE.

[58172.]—**Plating.**—If "J. F." will cover all parts required to be left in their original state with beeswax or Turner's cement, or shellac, paraffin, wax, &c., will rectify the error.—READER.

[58172.]—**Plating.**—Apply melted paraffin with a small brush and subsequent warming, so as to get a thin, even film. If using hot electrolytes try a solution of shellac in alcohol.—B. B.

[58172.]—**Plating.**—You can cover the backs of brooches, &c., with shellac varnish; but I would not advise its use. The quantity of silver used, in any case, is very small, and you can get a good profit at 6d. a dozen, and plate them all over.—OS.

[58173 and 58174.]—**Turning Washing-Machine Rollers.**—Just an auger for boring up for spindle while roller runs in a boring collar. You can fix a chisel in slide-rest, but it must slope very much; I make a tool for the slide-rest with edge at suitable angle—say, 30° from perpendicular.—T. C., Bristol.

[58175.]—**Vallisneria Spiralis.**—This plant may be grown in an ordinary aquarium. An inverted propagating-glass answers well, or even a large glass pickle-jar will do. Plant in 2in. of peat or leaf-mould, and pour in sufficient clear rain-water carefully; when it has settled, drop in sufficient washed river sand or fine gravel to cover mould about 1in. The sand is only for appearance sake.—A. BARTLETT, Bath.

[58175.]—**Vallisneria Spiralis.**—It will grow perfectly well if it is planted in fine sand and gravel at the bottom of a bell glass filled with water. It should be kept in a warm place—say a greenhouse. It ought to flourish under these conditions.—R. A. R. BENNETT, Walton Manor Lodge, Oxford.

[58176.]—**The Wimshurst Influence Machine.**—TO "E. B. F."—There is no reason why the size of the influence machines should be limited. Many have been made of large size, and several are in process of construction. The plates of the machine at the Inventions Exhibition were 7ft. in diameter. Plates from 16in. to 18in. in diameter are convenient for general use.—J. W.

[58177.]—**Casting Brass.**—Try dusting with burnt cork.—G. B.

[58177.]—**Casting Brass.**—"Moulder" had better try what is generally used, pea powder, sprinkling as before very lightly.—READER.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

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QUERIES.

[58180.]—**Screw-cutting Lathe.**—Will anyone inform me the proper angle of a 10in. screw-cutting lathe?—CENTRE GAUGE.

[58181.]—**Sugar Inversion.**—I should feel obliged by someone having practical knowledge of sugar inversion informing me the quantity of sulphuric acid required to invert 5cwt. cane sugar, the time and quantity of water it takes; also temperature required, and whether any unpleasant taste or smell is contracted by the sugar in the process. If so, the best and most economical means to remedy it.—MALTOSE.

[58182.]—**Nickel-Plating.**—Being desirous of nickel-plating some small articles, I made up Pott's solution (double acetate of calcium and nickel), as recommended in a back number of the "E. M," but am troubled with frothing at the cathode, and can get only an imperfect deposit, covered with black streaks. Would someone kindly say what is wrong, and if Pott's solution is easily managed? I have tried both Bunsen and Daniell battery.—J. M. D.

[58183.]—**American Organ.**—Will anyone interested in the above kindly give instructions how to make a double-exhaust bellows, and also a self-adjusting bellows valve, as used in some of the Mason and Hamlin's organs, as I want to increase the power of my 2½-row instrument by adding another half-row solo set? At present I have one row of 8ft., one of 4ft., and half of 8ft.; and what other half row should I add to improve it?—R. V.

[58184.]—**Balancing Locomotives.**—I should be glad if any reader would explain how to determine the radial distance in the following formula, given by D. K. Clark, for finding the position of balance weights in outside cylinder single engines. Rule: Find the total weight in pounds of the revolving and reciprocating masses for one side—viz., the piston and appendages, connecting rod, crank, and crank pin; multiply by the length of the crank in inches, divide by the radial distance in inches of the centre of gravity of the space to be occupied by the counter-weight. The result is the counter-weight in pounds to be placed exactly opposite the crank. Note: The crank, for the purpose of calculation, is to be taken as the extra material applied between the spokes of the wheel to form the crank; and the weight and centre of gravity of this extra material having been ascertained, the calculated equivalent weight, as applied at the crank pin, is to be employed in the calculation.—E. M. S.

[58185.]—**To Fiddlers.**—Can any fiddler reader, who has been similarly affected, tell me how to reduce a swelling in the neck produced by violin practice? The gland is not affected, and there is no pain. The skin has gradually grown to twice its proper thickness, remaining, however, soft and pliable.—SILAS.

[58186.]—**Hot Water Circulation.**—I wish to heat bath, bedroom, attached conservatory, and my hall from the kitchen boiler; total length of pipe, 120ft., with nine bends; 9ft. from boiler to upper floor, 10ft. down to lowest point under hall floor. Will the water ascend 12in. to 15in. and enter boiler at its lowest part again? Will the 10ft. descending column of water overcome this rise, having first to traverse, before entering boiler, 50ft. horizontally, and would 2in. pipe suffice?—ANGLO-ITALIAN.

[58187.]—**To Mr. Wimshurst.**—I am constructing one of your machines as described Oct. 16, and am in a fog. Will you kindly help me by answering fully the following difficulties? What distance should the glass plates be apart, and should they not have some insulating material between them screwed to each boss to hold them firmly in position? If so, what is the best to use, and thickness, and how are the plates best secured in position? Should not the spindle for glasses be more than 10in. long, the two bushes, being each 4in., and the stanchions each 1in., occupies the whole length, and leaves nothing to attach the neutralising rods to, which I expect require to be attached to the ends of the spindle by means of the brass tube? Leyden jars—are these simply glass tubes open at both ends, or have they bottoms of glass like ordinary Leyden jars? I am at a loss to understand how the bottom circuit is connected up. Also, is it not necessary for the brass tubes to have a length of chain attached to them to reach the bottom of the jars, as I do not understand the stick of wood, unless it is meant that the jar is filled with shavings up to the brass tube?—ONE IN A FIX.

[58188]—**Photographic Lens.**—A person who sells optical goods has supplied me with two landscape lenses. Both are about 8in. focus; but the diameter of one is 2in. and of the other 1¼in. The vendor could not tell me what advantage increase of width in the lens gives, although he could tell me of the wide difference of price it makes. I will thank some brother reader to say if I can use wider diaphragms with the wide lens, and so get more rapidity and light in the picture. If this is not the advantage of the wide lens, what is?—FIANGUS.

[58189.]—**Photography.**—Will some reader kindly furnish me with particulars how to make a changing box and give a sketch of it?—AMATEUR PHOTOGRAPHER.

[58190.]—**Lettering Book.**—I have bound a considerable number of books. I should be pleased if any reader of "Ours" would teach me a method of lettering backs, suitable for—AN AMATEUR.

[58191.]—**Legal.**—Would Mr. Wetherfield kindly give me his opinion on the following case? B. owes me £[illegible]. He is a country gentleman, living on his landed estates. These were left him by his father, and entailed; but as he is getting old, in case of his death, I want to know if I shall lose my money, as the son will come into the property at his death? I hold bills for the amount, which are from time to time renewed?—W. H. S.

[58192.]—**Coils.**—TO MR. BOTTONE.—I am a bit puzzled with the following:—I bought a medical coil of foreign make, and find, when taking it to pieces, that the secondary coil was simple uncovered copper wire, No. 40. I was under the impression that both coils must be thoroughly insulated. Certainly this coil had several wrappings of paper after each length of coil had been laid on with wax, but nothing further. Any information relating to the above will be gladly received by—CATHODE.

[58193.]—**Brass Castings.**—Would some reader inform me what mixture of brass to use for small deep castings to bring a red face on them?—A. GARNER.

[58194.]—**Wimshurst Machine.**—Will Mr. Wimshurst kindly answer me these questions in your and ENGLISH MECHANIC? How thick may the glass be for a [illegible] diam. disc? May it not, with advantage, be ¼in. thick, and what is the particular name that the glass goes by? Shall the hole in each disc be of the same size? Are there [illegible] washers screwed on to the inside of each boss to keep the plates apart, and does the inner end of each boss project beyond the inner surface of the disc by about 1-16in.? [illegible] not the tinfoil on the outside of each Leyden jar carried right down to the bottom of the tube, and the inside tinfoil not more than half-way down?—IN THE DARK.

[58195.]—**Magnet.**—Would some reader describe [illegible] to make a long pull magnet, and the size of wire to [illegible] with three No. 2 Leclanchés, and lift ½lb. 1in.? [illegible] magnet will not do this a solenoid would do as well.—JEFFERY.

[58196.]—**Sea Anemones.**—Will some reader [illegible] how to manage these? Had a dozen brought from [illegible] month ago. Do they feed? What on? How? As [illegible] object to open, I fear they will not live. Shall be glad [illegible] know of any book with particulars.—W. A. N.

[58197.]—**Oil Waste.**—Can any of our readers [illegible] inform me how to extract oil from and bleach oily [illegible] what chemicals to use, &c., the probable cost of [illegible] a small place, what book would give the most [illegible] and what use could be made of the oil, &c., extracted?—ANXIOUS.

[58198.]—**Cement.**—I have made a keyboard [illegible] harmonium. Will any kind reader give recipe of [illegible] for sticking celluloid covering on ditto?—J. A. D.

[58199.]—**Backing Plates.**—What is meant by "[illegible]ing" plates, mentioned in No. 1079 "E. M.," p. 267, [illegible] and 15 from top?—G. PARK.

[58200.]—**Pyrology.**—I hope "B. C. R." will [illegible] have a full description of his hydrocarbon blowpipe [illegible] I feel sure it would be a most useful tool for other [illegible] besides pyrological research.—G. PARK.

[58201.]—**Bellows Body.**—I should be much [illegible] for instructions for making a bellows body for a [illegible] My camera is a sliding body, ½-plate one, of, I believe, [illegible] fair quality. Would it be worth while attempting to [illegible] a bellows body for it?—G. PARK.

[58202.]—**Photo. Lens.**—What is meant by [illegible] and focal length of a lens? What is the usual [illegible] glasses in a ½-plate lens? I have one marked "[illegible] Dallmeyer, London, 2328." The diameter of [illegible] 2 1-32in. Is this likely to cover more than ½-plate [illegible] PARK.

[58203.]—**Polishing Iceland Spar.**—I should [illegible] to know how to do this well; especially the final [illegible] It would also be useful to know how long it takes to [illegible] out the general operations which may be recommended [illegible] G. G.

[58204.]—**Brick Burning.**—Would any of our [illegible] conversant with the subject, have the kindness to [illegible] me as to the best and cheapest form of kilns in [illegible] common brick burning, where only one kiln is [illegible] Is there such a kiln in use as a "Riddle bottom up [illegible] circular"?—BRICK BURNER.

[58205.]—**Worm Wheel.**—"J. H." has mis[illegible] me by giving information on the worm. I gave [illegible] ticulars of worm, as it is necessary before he can [illegible] worm wheel. He can assume what diam. he likes [illegible] wheel, therefore I hope that now he will give the [illegible] bevels on the worm wheels, as in the question, [illegible] to his sizes.—CONSTANT READER.

[58206.]—**Chain Sheave.**—The answer to [illegible] tion by "J. H." cannot be brought to practise by [illegible] says: Measure the 20 links and the [illegible] circumference. I find that [illegible] I cannot get it divisib[illegible] polygons, and, there[illegible] that point by giving al to ease them if they do not work. I should)r some other reader, to inform me how I can ertain fit ?—CONSTANT READER.

Grinding and Pulverising Ma- require to grind to a very fine powder flint hippings. Can any correspondent inform me iod of doing so? "Pottery Tech" kindly in a recent number how flints are pulverised orcelain; but it seems a tedious process. I iable to obtain information respecting the rising machines in the market, except from nd they say the cost of repairs and renewals think the reverse. I have seen them grind iarse as sand, but think there must be ex- when set to grind fine. Is that so?—A. J. S.

'an-Eidolon.—Can anyone tell me where how to construct, an instrument for sketch- above name. It is mentioned by Sir Francis bbles from the Brunnen."—G.

Vheels.—Why are cart and carriage wheels conical? The lower spokes are, of course, ndicular to the ground; but what does it er the others (i.e., those above the boss, or endicular or not?—LEICESTER.

ngine.—Which would be the most econ- all steam engine, or a gas engine—to drive a namo to light a house, 12 rooms at most? ower would be required?—LEICESTER.

team Ports.—Why are the two steam inder generally made the same width? The ly more than uncovers one port, I think. If le the same width, why not make them so s more than uncovered?—LEICESTER.

asting.—In casting a jacketed cylinder is ll one, or are the cylinder and jacket cast If both ways, which is best for a cylinder n.? Are the ends generally jacketed?—

o Mr. John Grey.—Will you kindly tell epare uricate of potash in crystals containing les of water? Would you also be good enough takes place when potassic cyanide (KCy) added to a solution of ammonia, and give I am told there is a change occurs; but I am d out what it is from my textbooks.—A. C.

hooting Stars.—I have often watched s, and seen them go in almost every direction downward tendency; but I cannot recollect ne move with an upward direction. Is this t are accepted as "stars" are simply meteoric n the earth's atmosphere and governed by —COSMOS.

Getting Clock Depths.—Would r some other correspondent, please say how I working distances of wheels and pinions in h I am making? I do not wish to go to epthing tool. I also wish to use a different at described in Vol. XXXI., No. 791.—NOMEN.

atin Wall Papers.—Will some of "Ours' m me how to make the composition used for of satin papers? I cannot get the hard and rance. Are whites of eggs used as a size for —AMERICUS.

Fire Gilding.—Can any reader give name l composition of one or more organic salts of soluble in volatile compounds, such as tur- spirits, or oil of lavender, and that could be d at a cost not greatly exceeding that of gold OTTERY TECH.

Heating of Shafts.—Can any of our me the reason of shafting getting hot? I have vith a wire down the centre. I always keep rith best Galipoli oil; but in spite of all some- e such trouble every now and then through They seem as though they don't lubricate; ies they will run for days without attention. aft bearing is the worst; I have to keep con- g by hand, or else it would never do. Have I kind? Still I see them adopted in flour mills. only 20 H.-P. Any information on the above greatly oblige—LUBRICATOR.

Ghost in Telescope.—TO MR. SADLER, ."—Would either of these gentlemen kindly vrong? I see to the *s.f.* a star, or the planet lse image of the star or planet; in the latter int, but so as to see the ring. The o.g. is, I adjustment by a flare on one side of a star. Is se of the false image *s.f.*? It is the same with ; and when they are turned round in tube, ame position in field. I cannot get a sharp ght to do if all were in correct adjustment.—

Photographer's Law.—Is there any law photographers taking photographic views of ber buildings for trade purposes, or can owners rohibit such views being taken for trade pur- persons who get photographs taken for their use prevent the photographer from afterwards umber of copies he pleases from the negative rposes?—J. MCGRATH.

Gas Stove.—I have a cabinet Turkish bath, as a vapour bath by putting a kettle of water pheric gas stove under the seat. Will someone m me how to get rid of the unpleasant smell les the room after the water has been boiling e? Would it do to stop up the hole admitting pe of stove?—DERFLA.

Gasoline.—I should feel obliged if one of could tell me how to fill a Wolf's bottle with our only?—CYCLIST.

Heights and Boiling Points.—I shall some of "Ours" would give me some informa- [illegible] which I have read, they speak of at the end of the da [illegible] they ve travelled [illegible] boiling at [illegible] kind of thermom

for 100ft. of height or descent? Also, to refer to a table of heights and boiling points, in what book can it be seen in a plain form. I want to ascertain the difference between London and Fleet, in Hampshire. Also, what other instrument would show the difference of height at the end of journey by rail?—J. W. E.

[58224.]—**Letter Punches.**—Could any reader give me information as to the engraving of the steel punches for the matrices of type? I want to know whether it is possible for me to engrave any, and how to set about it, the tools required, &c.?—WAHBEM.

[58225.]—**Dynamo.**—TO MR. BOTTONE.—I have made a dynamo with a set of Mr. Jones's castings. Size of F.M., where wire is wound, 3¾ by 4 by ¾, wound with 6lb. No. 16 wire; armature, laminated, 3¼ by 1, wound with ½lb. No. 20. What c.-p. ought I to get from such a machine? Also tell me which will be the best kind of lamps for it, incandescent or Swan.—M. B.

[58226.]—**Colouring Brass Fishing Reels.**—How are the brass fishing reels coloured a dark green, or black, and lacquered, so as to leave the polish like those sold in London?—B. W.

[58227.]—**Lathe Query.**—TO MR. J. H. EVANS.—Will you kindly tell me how to refit the mandrel of my 5in. centre lathe by Buck? It runs in coned steel collar, and though tight at back is sloppy in front, and so causes vibration of the work.—B. W.

[58228.]—**Feed Pump.**—Will any friend give the dia. of plunger of feed pump for my engine? Dia. of cylinder, 2¼in.; stroke, 5in.; total length of cylinder, 6¼in.; thickness of piston, 1in.; length of steam ways, 5in. each by ⅜in. by ⅜in.; travel of valve, ⅞in.; steam pressure, 40lb. per sq. in., no lap; thickness of piston rod, ⅜in. If plunger be connected to cross head, it will have 5in. stroke; if to valve rod, ⅞in. stroke. State dia. of plunger in both cases.—J. F. C.

[58229.]—**Mending Saucepans.**—Will some kind reader inform me how to mend or fill up cracks in saucepans, to keep them from running when soups or puddings are boiled?—READER.

[58230.]—**Bicycle Cranks.**—Would some kind reader lend me a tool, or tell me where to borrow one, for taking cranks off? I am told it is a piece of solid iron, or steel, with a slot to go underneath the crank, and a screw at top; this is forced down on the spindle, gradually drawing it off.—READER.

[58231.]—**Artificial Memory.**—Can anyone give me some information as to the method taught by the late Prof. Pick? He does not seem to have published anything, though he laid his pupils under no obligation of secrecy. As this method seems to have been a very successful one, it would probably be useful to others, besides myself, if we could get a description of it.—S. C. C.

[58232.]—**Air Filtration.**—I have read, somewhere, that if air is passed through charcoal it would be obtained with a greater proportion of oxygen—that is, the charcoal acts as a filter, and tends to stop back some of the nitrogen in the air. Can any of your readers tell me whether this is the case, and, if so, whether it has been practically applied?—J. M.

[58233.]—**Safety Blowpipe, or Jet.**—Can any of "ours" tell me if there is in the market, or whether such a thing is wanted, as a small and cheap apparatus for preventing the running back of the light, and so save the gas bag, or bellows, from bursting? I will send particulars of one to any who advertise.—G. B.

[58234.]—**Horse-Power of Engine.**—Will one of our readers kindly inform me what would be the horse power of an engine; the cylinder 5¼in. stroke by 3¼in. bore, the boiler working up to 30lb. pressure? Also, what is the formula by which he finds the horse-power?—T. S.

[58235.]—**Stuffed Birds.**—I have a case of birds, and one, a white pheasant, has got very dirty. If any of our readers can tell me how to clean it, I should be very much obliged.—J. K.

[58236.]—**Electrical.**—Could any reader inform me if it is possible to draw back an ordinary Bramah door latch at a distance of 25ft. by electrical means, and, if so, what battery power it would require? also the form and size of electro-magnet.—J. J. C.

[58237.]—**Load on Girder.**—In the experiments made by Mr. Hodgkinson on girders, it was found that a girder, as in Fig. 1, on being loaded with a heavy weight at the centre, broke as shown by the dotted lines, a piece coming clean out (Fig. 2), part of which A B was a parabolic curve. This was proved to be theoretically the proper shape of the fracture; and I want to know if some reader will say how this was proved to be so?—STUDENT.

FIG. 1.

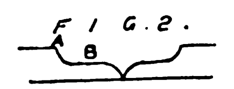
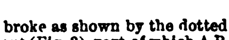


FIG. 2.



Every Workman connected with the Building Trades requiring a Situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 332, Strand, London, W.C.

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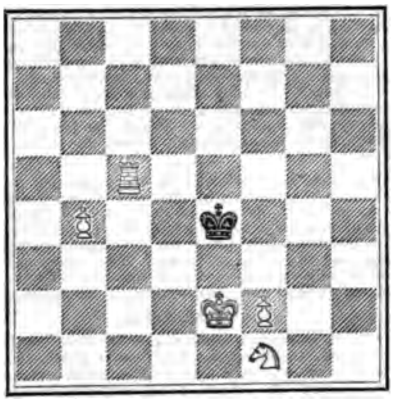
arge for Advertisements for Situations is One Shilling for four Words, and Sixpence for every Eight Words after.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLXVIII.—BY H. F. L. MEYER.

Black.



White. [5 + 1

White to play and mate in three moves.

IN 967 White mates in two moves.

SOLUTION TO 966.

White.	*Black.*
1. B-K 6	1. P takes B (disc. ch.)
2. Q-B 7	2. Anything (*a*)
3. Q, B, or Kt mates.	
2. Kt-B 8 (ch) &c.	(*a*) 1. R-K 5 (*b*)
2. Q-Q 5 (ch) &c.	(*b*) 1. Kt takes B (best)

WE have not received one correct solution of this fine problem.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 965, by A. Bolus and A. A. E. Lecluse.

H. BALSON AND W. T. P.—Thanks for games.

A. BOLUS.—Always diagram your problems and send solutions. Let us have that to the problem you have sent; if it corresponds to the one we have made out, it is worth publishing. We are not surprised that 966 gave you so much trouble; it is quite sound.

G. ROE.—Your problem is without point, obvious, and has, at least, two other solutions. Always diagram position. With regard to 966: if 1. Kt-Q B 4, Kt takes Kt; if 1. Kt-K 4 (ch), K-K 4; if 1. P takes B, R takes P, so your three "solutions" are all wrong.

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Indexes for Vols. I., VI., VII., VIII., and IX., 2d. each. Post free 2½d. each. Indexes to Vol. XL., and to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

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Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

Holloway's Ointment and Pills—Unvarying success attends the treatment of abscesses, erysipelas, piles, and inflammation, by these well-known remedies. These diseases, apparently local, are essentially blood diseases, and the Pills purify the blood and regulate the secretions, whilst the Ointment checks the local inflammation and throbbing, and alleviates the agonising pain.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

BACK NUMBERS.

WE receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

Bookbinding: No. 613.
Electric machines: Nos. 1,009, 1,025.
Electro-magnets: Nos. 772.
Lacquers: No. 866.
Pattern Making: Nos. 938, 941, 943, 945, 948, 950, 952, 954, 955, 956, 958, 959, 962, 963, 969, 974, 978, 986, 989, 993, 995, 998, 1,000, 1,001, 1,003, 1,004, 1,008, 1,009, 1,010.
Silver-plating: No. 1,009, 1,010.
Varnishes: Nos. 478, 619, 675, 723, 775.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 2, and unacknowledged elsewhere:—

LEROY AND CO.—Lewins and Co.—J. and H. Grace.—W. Coleman.—Major Dumbleton.—W. P. Ryan.—G. Weston.—T. Taafe.—Soft.—A. Jones.—Peinture.—Young Brewer.—Country Smith.—Johnny Nash.—Experimentalist.—Jason.—W. Wright.—An Anxious Enquirer.—Piston-rod.—F. W. E.—H. Bond.—Rev. J. Pearson.—Sydney Evershed.—Homoios.—J. N. D.—Hugh.—T.—H. A.—S. Bottone.—G. B.—T. G. Elger.—C. R. Woodside.—G. Townshend.—Bobadil.—Havelock.—H. Bellars.—Dr. Royston Pigott.

J. A. O. (See the numerous replies which have recently appeared.)—PANURGE. (The only information of the kind, so far as we know, is contained in the articles on pp. 514, 538, 562, 611, Vol. XXXI., and pp. 30, 54, 80, Vol. XXX. These were published in book form by Bell and Son, York-street, Covent-garden—"The Indiarubber and Guttapercha Industries." There is also a work by Hancock on the "Caoutchouc Manufacture," published by Longmans in 1857. 2. Do not understand the reference to whiskey.)—G. A. (Try Stanford, Charing-cross, W.C., for maps of any part.)—H. A. (It is evidently a case for a physician to examine. No one else can give useful advice.)—HENRY TOWNSEND. (It is purely a matter for private arrangement.)—BOOKWORM. (The bichromate or Bunsen; but much depends on the kind of work and the time it is required.)—SUFFERER. (See indices for remedies for indigestion. A medical man should be consulted.)—B. COLUMBIAN. (Such a question finds an appropriate place in the Wanted Column.)—A STUDENT. (The rules are given in the textbooks and in the pocket-books. You want a dynamometer, and the simplest is known as the Prony brake. The simple formula is: multiply the length of the lever in feet by the weight at its end, and the number of revolutions of the shaft per minute. The actual horse-power is found by multiplying that product by ·0001904. A good dynamometer is illustrated on p. 278, No. 844; p. 607, No. 832; p. 536, No. 750.)—PUZZLE. (See the indices of the last three or four volumes, and recent back numbers. You will find several machines of the kind illustrated and described.)—H. B. G. (For Repoussé work see p. 119, Vol. XXXVI., and p. 148 present volume.)—A GLASGOW SUBSCRIBER. (See Replies last week, and the indices of back volumes.)—MARLOW. (The penalty for placing the word "patent" on any article when a patent has not been granted is a "fine not exceeding £5" for every offence, on "summary conviction.")—LEGH S. POWELL. (You were answered on p. 212, middle col., to signature P. There is much information on the subject in back volumes; but nothing, we think, about "fluoride of ammonia." The etching of glass is a very simple matter, and such peculiar fluorides are not required.)—COPYRIGHT. (If they are not "copyright" here, they can be copied, of course. They can be made "copyright" by simultaneous publication, not otherwise.)—Z. Y. X. (The intensity coil is of no use in producing an incandescent light to take the place of gas; and such a light cannot be produced from a battery at about the same cost as gas.)—THOMAS HAMPSON. (If you cannot see back numbers, make your choice of a book from the list issued by Mr. Calvert, Great Jackson-street, Manchester.)—MECHANIC. (See "Hints," No. 4. The query is unsuitable.)—C. P. (Prout's elastic glue is generally used. 2. Recipes for crumpets and muffins on pp. 372, 414, Vol. XXXVIII.)—WORKING DENTIST. (The best thing you can do is to adopt the ordinary form of lathe treadle—that is, hinged at the back, so that the thrust is given by the leg.)—FERRUM. (Not of sufficient interest for insertion. Perhaps he was away on a holiday, or attends at the office only at wide intervals.)—IGNORAMUS. (Better use magnesium wire or ribbon in a suitable lamp, which you will find illustrated in No. 922, p. 277.)—J. S. L. (We do not know. Try Mr. Blackwell, Chapel-street, Liverpool.)—A. G. HEATHCOTE. (For storage batteries see the indices; but especially No. 1,016, p. 28. 2. We cannot determine which process of silvering glass will suit you; but there is scarcely one of the back volumes which does not contain several.)—F. THORP. (Why not submit your idea to a maker of reflecting telescopes?)—HORSESHOE. (There is no doubt that the patent will be granted to the person who made the application; but if you say the invention has been in use six months, the sooner it is fully protected the better. The stamps now cost £1 on application, and £3 when the complete specification is filed.)—H. G. (Your query is incomprehensible; but so far as we understand it, we should think you would find the required information in any cookery book.)—BORAX. (Glacialine is said to be composed of boracic acid 18, borax 9, sugar 9, and glycerine 6 parts. A difference of opinion exists as to the effects of boracic acid taken frequently into the human economy, for the pro's and con's. of which see sundry papers in back numbers.)—LEVER. (The difference is that in the old pressure brake the brake pistons are in direct communication with the reservoir of compressed air; in the automatic there is a reservoir under each coach, which discharges its air into the brake cylinders when any leakage occurs, whether intentional or accidental. The pressure system is used on the District line.)—SUFFERER. (As you say you can "see as good as anybody" except when reading, it is probable that a pair of spectacles will remedy what you call "weak eyes.")—E. S. J. (For methods of ascertaining whether wall-papers contain arsenic, See pp. 87, 153, 175, 219, last volume.—A NOVICE. (Surely you are joking when you ask for the insertion of a query how to make a Wimshurst electrical machine! If not, please look in the number published on Oct. 16 last. Your second query about electric bell and battery has been answered many times; and as to the third, if you will say whether you want to know about Telegraphy, Railway Signalling, or "Electricity in General," we will endeavour to oblige you.)—W. C. BLACKBURN. (It depends on the construction of the boiler, and the means employed to generate the steam. A charcoal fire would be best, we suppose, though for all you tell us we do not know where it is to be placed; but you can easily try.)—A CONSTANT READER. (Answered many times, and very recently, too. 2. From any music dealer, we suppose. 3. Refer, to the indices, and select the electro-motor which suits you best. Have a look at pp. 257, 274, 315, Vol. XL., to commence with.)—PHONE. (We have frequently mentioned that No. 594, which contains the description of the English Mechanic telephone, is out of print. For a general description of a modification see p. 186, No. for Oct. 30 last, and the indices. 2. For a variety of alarms of the kind see back numbers.)—H. B. C. (We know nothing about it, and do not advise in such matters. Surely, if you have joined it, you know what interest they allow.)—H. SHAFTO. (For illustrations of a pantagraph and how to make it see Nos. 683, 684.)—X. Y. Z. (An elaborate article on the camphor barometer or storm glass appeared in No. 1,059, p. 405. Directions for making have been given many times.)—C. D. R. (Please send.)

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Every additional eight words	0	6

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The address is included as part of the advertisement, and charged for.

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The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Horse-power **Vertical Engine**, pump, centrifugal governors, brass, superheater, made for exhibition, highly finished. No rubbish. Will exchange for useful back-gear Lathe, or any useful tools.—59, Monkton-street, Leeds.

Harmonium, 5 octaves, requires keyboard and case to complete. Exchange. Also 3 Organs and Materials.—Address, 12, Moxley, Wednesbury.

Gas Engine.—I have a one-man-power Dorrington's Gas Engine, new, fitted complete with gas bag, igniting jet, &c., cost £8 10s. Will exchange to value of £6, having no use for it.—F. BYRON, Nenagh.

Phonograph, new, with 30lb. tinfoil sheets, for exchange or sale, cost £17 10s. Would exchange for good double-barrel Gun.—S. C., 101, Adelaide-road, London, N.W.

I have got a few New and Second-hand Singer's Medium Sewing Machines. Exchange or offers.—STAFFORD, 17, Bradshaw street, Shudehill, Manchester. Repairer of all kinds.

Wanted, second-hand **Violoncello** in playing condition. Offers.—W. BRIGGS, Market-terrace, Wooler, Northumberland.

Plates.—House of Commons Lobby, 1869; Paris, 1867; Edinburgh: perfect. What offers? Magic Lantern and Slides preferred.—R. TURNER, Cleveland Villa, James-street, Oxford.

Laminated Armature, Weston
by 4 on spindle, wound. Exchange for
bound Vols. of "Engineer," "Engineering," "
or offers.—A. J. S., 188, Mare-street, Hackney, E.

Duplex **Canoe**, new, very buoyant,
children or ladies; paddle, sail, &c., complete.
or anything suitable for Florida to value of £6.
PERCIVAL, Hermitage, Woking.

Two three-burner **Glass Chandelie**
for gas or oil, cost £8. Exchange for amateur's
Cornwallis-crescent, Clifton, Bristol.

Beautiful Black **Retriever Dog** (sm
a lady. Wanted, pair Curtains, or bevelled Plate
Head, without pulley would do.—RALPH CA
terrace, Upper Holloway.

Offers wanted.—"**Cassell's Concise**
new, cost 14s. "Cassell's Technical Educator,"
cost 11s.—G. LOND, 6, Newcomen-road, Wellingb

Lathe-Head and Rest, 7in. cen
maker, suit wood turner. What offers? No ca
road, Reigate.

Medical Coil, new, very powerful, w
plete, cost 70s., price 25s., or exchange for Gal
thing useful.—PERCY HUDDLESTON, Montague

Whole-plate Mahogany Bellows **Came**
slide, two inner frames and good tripod:
August last, worth £4. What offers?—GEORGE
Addison-gardens, Kensington, W.

Four magnificent **Model Ironclad**
cases to scale, like those at Inventions Exh
splendid, inspection allowed; part exchange.—1
Bolton.

Boiler, Vertical, quarter-horse, doub
internal fire-box, ten tubes, water gauge, safety
working pressure, 60lb. Exchange to value of
Newington Green-road, London, N.

Perambulator, well made, infant f
repair, in exchange for Stocks, Taps, and Dies. W
¼in. by eighths.—BUCHANAN, Worple-road, Epso

First-class **Lantern Transparenci**
graphs, in exchange for Photographic Apparat
scopes, Microscopic Accessories and Slides, or oth
—Apply, PIGGOTT, Chemist, Huddersfield.

A Bargain.—4½in. centre **Lathe**, qu
cutting, slide-rest, and carriage complete, o
Offers.—FRIAR, 3, Victoria-street, Luton.

6in. turned **Brass Flywheel**, pair o
high, also a Breast Drill, good condition.—CAR
place, West Kensington, S.W.

Lathe.—Wanted, Lathe, about 4ft.
rest, in exchange for well made 20 candle power
part nickel plated.—Address, LOWE, 11, Wills-
Birmingham.

Prize Medal School **Microscope**, Field
cost 12s. 6d., sell it for 9s. 6d., including 10 cove
balsam, asphalte, objects, labels, &c.; cost 7s. alon
Brandon, Coventry.

"**Aristotle's Works**," coloured
mounted Mythological Photos. What offers?
St. Leonard's-road, Windsor.

Dynamo, 880 c.-p., nearly ready for wi
for 1 horse-power Steam Engine, back-geared
HATCH, Alderley Edge.

52in. Bicycle for exchange, in g
used. Wanted, Fret Machine and tools, or strin
19, St. Thomas-street, South Oldham.

Model Locomotive wanted. Will g
£22 Musical Box, and cash for good model.—1
Bolton.

Wanted, good **Microscope**. Will
Valve. Send particulars.—185, St. George's-road.

Wanted, **Model Rowing Boat** (no
exchange Silver Watch, lever, ¾-plate, quite new,
face.—185, St. George's-road, Bolton.

Second-hand **Harmonium**, in good
Offers.—Address, Rev. D. J. DAVIES, North Bend

Some good **Soudan War Slides**, C
Gas Bags, Tubing, and Jets. The whole or separ
JONES, 98, Packington-street.

120 **Slides**, some cost 2s. and 3s. e
Harmonium, price £4.—C. W. SEARLE, Sunningh

Carpenter's Tool Chest and seve
odd tools. Exchange.—SAUNDERS, Dickleburgh

Microscope Slides wanted, good;
Locket, value £4; ½-hoop Diamond and Pearl Ri
9, Ball's Pond-road, N.

What offers for double-barrel **Air Pu**
X., 9, Ball's Pond-road, N.

Printing Press, Incandescent Lamps
tro Motor for sale or exchange; Lathe and Lath
SPENCER, 5, Chetwode-road, Upper Tooting, S.W.

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The English Mechanic
AND WORLD OF SCIENCE AND ART
FRIDAY, DECEMBER 11, 1885.

MICROSCOPICAL ADVANCES — ANCIENT AND MODERN.—II.

By G. W. ROYSTON-PIGOTT, M.A., M.D. Cantab.; F.R.S., F.R.A.S., F.C.P.S., Formerly Fell. of St. Pet. Col. Cambridge.

Advancing Angular Aperture.

THE DEFINITION OF LINES, POINTS, AND SPHERULES.— Some of the most rucial proofs of advancing power and defiition of modern microscopes are found in he examination of thin lines, points, and efracting particles. If gold leaf, or even old-beater's skin, be folded, and the folded dge be carefully flattened, a black line is leveloped at the line of flexure. So does the odura and most insect scales. Thus, in the ase of a flattened sac, such as they mostly re, the edge of the membrane between he terminal spikelets, though only the -150,000ths of an inch, with the best glasses ppears jet black (gnat scale). Its thickness lenotes that of the single membrane forming he flattend sac of the scale.

On optical principles it can be shown that he thickness of this line gives a very near alue to the thickness of the single envelopng membrane. Many instances of this have een observed. Ofttimes a scale is folded ack and pressed down. There is a sharp lack boundary line at the line of flexure. The true definition of this is extremely rucial, and was formerly utterly baffling.

In 1845 a friend and myself used to adnire the "splendid definition" of a Ross ' one quarter." Round every scale where he membrane was duplicated as a compressed ac we descried a bright border. The edge vas not distinct and black, but thickened. We were thoroughly satisfied with the superb qualities of our objective.

So late as 1870 I was shown through a "very fine" Ross "one quarter" (presented to the Royal Microscopical Society)—*a red fibre*. I pronounced it vegetable. It was a crack in a silica film. No focussing or manipulation evolved any other appearance han than that of a brilliant cylindrical fibre. This was startling. My discomfiture was omplete. Why should this crack appear ound and red? Here was a perplexity.

About 1878 I received an oil immersion No. 15) from Zeiss, of Jena. Imagine my elight in turning the red vegetable filament to two excessively thin bright lines! Zeiss eclined to construct for me an oil lens with adjustable screw collar. I think this was mistake, as Powell and Lealand make them ccessfully on this plan. Now for the line. cannot imagine anything more beautiful an the brilliant grey lines of light displayed the two razor-like edges of these cracks. hey were cracks developed by the crystalation of silica (colloid) dissolved in ycerine. Nobert's celebrated lines can only exhibited and enumerated by the use of ry oblique illumination. The grooves, oughed by a diamond in the glass of unown shape or section, introduce peculiar tical effects. The cracks in silica films pear to avoid these intensified difficulties. ther bright lines or black lines can be disvered of intense tenuity. To these points can more properly allude at another stage the inquiry.

To at once enter upon a most difficult int. In many cases a scale appears doubled er; what is the character of the line of xure? Is it an even, straight black line, is it serrated or villous? Other inresting kinds of attenuated black line are en in the Rotifers. An exceedingly fine ⅔in. objective, bearing 200 diameters superbly, shows the outlines wonderfully fine, and jet black. The reason of this is no light can optically pass vertically through the edge of the bounding membrane. The thickness of this edging displays a measure of the thickness of the envelope. In all cases the absolute precision of this line, like the finest Indian-ink drawing, denotes the rare quality and value of the glasses.[*] The appearance of these lines changes very much with increased angular aperture.

Some examples may now be adduced. Messrs. Beck having constructed for insertion above objectives, by my direction, an iris diaphragm, many interesting observations were made. The iris contracts to an exceedingly minute aperture about the 1-100th part of an inch, or expands at will to ¾. It screws into the microscope's nose, and an objective is then screwed into it.

There are certain forms in nature which are far more clearly defined with low than with high-angled objectives. Yet the advance of power and resolution has run parallel with microscopical history.[†] After all, Lowenhoek's globules and minute lenses showed some objects exceedingly well, notwithstanding their very low angular aperture. Rising, then, from this, as power was increased, the light faded; but by increased aperture it again re-illuminated the object, and admitted rays of such great obliquity that deep shadows became visible which were utterly invisible before. Condensers kept pace. Powell and Lealand's condenser, dry, gives a nearly horizontal obliquity (87°), and produces shadows sufficiently deep and thick to render ridges (probably formed of closely-packed beading) sharply visible, though only 1-200 000th of an inch thick.

The definition of a fine line, curved, straight, or notched, fifty years ago was hopeless with any high power. A hair from the plumule of a gnat appeared thick and blurred with margins of light: so appeared the edges of all insect scales with any compound microscope of the day. With such instruments we heard of nothing but *lined* objects as tests. Diatoms were lined and cross-lined; so were seales: no beads or spherules could be descried. To finish this part we may advert to the appearance of a distant rod of glass, held up to a bright sky. The angular aperture of the eye may be half a degree. Two intensely black margins will be seen in the rod. So a thread of spun glass under a low-angled objective shows the same. But here is an important phenomenon: as the angular aperture of the instrument is increased, these black margins diminish sensibly. It can be shown that in this case there is decussation of the waves of light in planes above the thread, producing darkness, and at this point (if the glass be good enough) an exceedingly black line, parallel with the axis of the glass thread, will be discovered, and sometimes two lines. A solid glass, or refracting cylinder, produces these effects. But a tubular cylinder fails to show them.

REFRACTING SPHERULES OR MOLECULES.— These have been found exceedingly abundant as microscopical power rose to transcendency. In Quekett's time they succeeded by means of central stops, shutting out central light, in converting their lined diatoms, in which they so firmly believed, into very small black dots. These dots were never explained, and remained an enigma. The question arises—Were they true? In these articles reference must be frequently made to the behaviour of such interesting objects. The reader who wishes to carry out some of these experiments should be provided with spun glass, and fine glass rods of different sizes, and a spirit-lamp.

If a small glass globule be held at arm's length against the sky, the unassisted sight will discern a thick black ring, ornamented with a small central dot of light. With a pocket-lens an image of window-bars will be next discerned. If, now, the globule be illuminated by transmitted light under a microscope, as the aperture of the condenser is increased the central light enlarges, the black annulus thins itself, until, with a very large aperture and a very small globule, under transmitted light, it vanishes altogether. The law obtains that the black annulus varies its breadth, up to a certain point, inversely with the angular aperture. It also varies with the refractive index of the globule, so that its breadth is compounded of both. These principles apply to all refracting spherulets. But besides the black margin they are capable of forming a focal image above their surfaces. The ocelli of beetles' eyes show admirably the image of a distant object, such as a church clock, or a portrait 10in. away. A diatom also containing spherules may show an image of a given body. The measurement of this image and its distance from the diatom afford a means of finding the refractive index of the silex forming the spherule, as well as its focal length.

Diatoms with large spherules give fine black dots as images of a black disc. Supposing that a high-class 1-10th be in action; if a drawing-pencil be moved below a condenser of fine correction and moderate aperture, its image is seen also to move in the same direction. Perhaps practice with a "beetle's eye" will facilitate the success of the experiment.

In the case of globules inclosed in jewel cavities, the black margins are so extended as to leave only a minute central point of light. If the refractive index of the globules is less than the medium's refraction, the resultant lens has a negative focus—*i.e.*, it lies below. *Vice versâ*, when it is greater, the contrary effect is produced. Thus, if water (index 1·336) be mixed with oil of olives (1·470), a globule, with a moderately thick, black annulus, will be seen having a positive—*i.e.*, an upper focus. Arranging some of these according to their refractive indices, it will follow:—

Liquids.	μ Index of Refraction.
1. Water	1·336.
2. Oil of olives	1·470.
3. Linseed oil	1·482.
4. Canada balsam	1·532.
5. Essential oil of bitter almonds	1·603.
6. Oil of cassia	1·635.

The focus of the spherule F (Fig. A), when either of the oils above noted is mixed with water, will be nearer to the surface A B C as the index of the oil increases; and the black annulus, A E D or B E D, will necessarily broaden for the same angular aperture (50°) (Fig. B.)

The resulting refractive index for a globule of oil of cassia refracting in water is—

$$\mu = \frac{\mu'}{\mu''} = \frac{1{\cdot}635}{1{\cdot}336} = 1,224.$$

The refraction of oil of cassia into water is then less than from water into air.

The distance of the focus for parallel rays will be measured from the centre of the globule of diameter $2\,r$—

$$O F = \frac{\mu}{2 . \mu - 1} . r = \frac{1{\cdot}223}{2 . (1{\cdot}224 - 1)}\, r$$

$$= \frac{1{\cdot}224}{2 \times {\cdot}224} = \frac{1{\cdot}224}{{\cdot}448}\, r = 2{\cdot}73\, r. \quad \text{If } r = 1 = 2{\cdot}73,$$

or the focus F is nearly 1¾ the radius outside.

In the case of plate-glass, its globule refracts parallel rays to a focus just half a radius, or one-fourth of the diameter of the globule outside it. Should a globule of oil

---

[*] With this two-thirds glass the cilia of the wheels of a rotifer were seen hooked at the fine extremity, at the instant when their vibration was slackening, by reducing the objective apertures.

[†] In forty years the writer has accumulated a great variety of glasses of every variety of aperture, including an extensive set of Prichard's single and doublet lenses.

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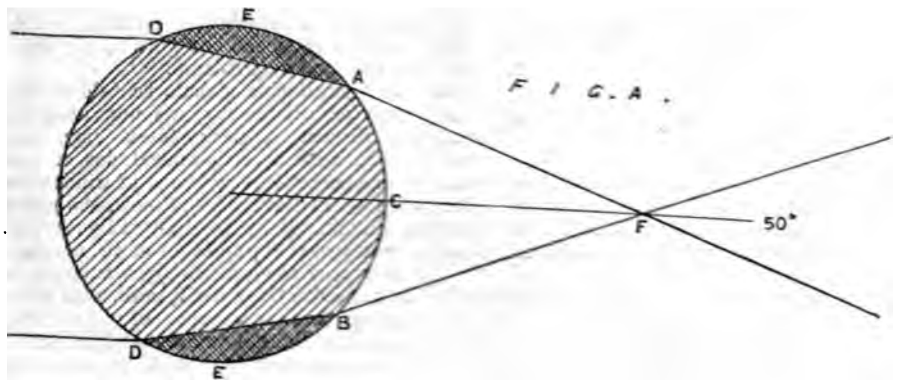


FIG. A.

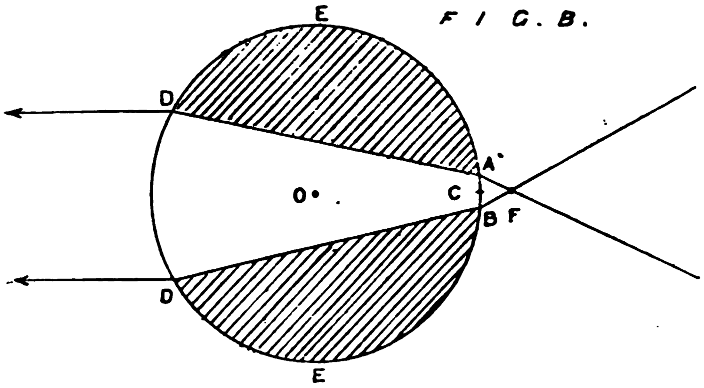


FIG. B.

of cassia refract out of Canada balsam of sufficient extent above its index—

$$\mu = \frac{1{\cdot}685\,.\,r}{1{\cdot}603} = 1{\cdot}020\,.\,r$$

Hence—

$$OF = \frac{1{\cdot}02\,.\,r}{2\,.\,(1{\cdot}02 - 1)} = \frac{1{\cdot}020\,.\,r}{0{\cdot}04} = 25{\cdot}5 \times r$$

If $r = 1$, O F, the disc of focus from centre of globule would be 25·4 radii, or 12·7 diameters: or the black annulus would be greatly attenuated.

If sufficient phosphorus can be dissolved in olive oil to bring the index up to 2·00, the index of phosphorus being 2·26, the focus would be, in air, exactly on the outside of the sphere.

According, therefore, to the difference in the refractions of a body and a fluid in which it is immersed, the black shadows are proportionately deepened. Conversely refracting particles, if spherical, are rendered more nearly invisible as their index approaches that of the medium. An article giving these results was published by the writer in the *Quarterly Journal Microscopical Science* about 1870. Since that time the advantage of mounting diatoms in fluids of high refracting powers has been fully recognised.

Black shadows are also more strongly pronounced, as the illuminating pencil has less angular aperture. Too great an angle drowns the object in excess of light: with the finest glasses the outlines of transparent objects thicken and blacken by lowering the condenser, a smaller cone of light then striking the object. Parallel rays, of course, have no angular aperture. The finest definition was attained with the old glasses by bringing a wax taper as near as possible below the stage—i.e., by means of a cone of light of very small range. It was with a glass of very small aperture and sunlight that jet-black beads were discovered as composing the markings on the podura, which become more and more difficult as glasses are used with increasing aperture. Intensity of black outline (except in the cases of ridges whose very oblique shadows can only be caught by oblique illumination) requires moderate observing aperture, and a greatly reduced illuminating cone of light.

The intensity of the blackness of the tips *of very fine hairs, or of* exceedingly fine filaments, are modern features of microscopical definition, residuary aberration being reduced almost to a minimum, showing the advance in modern glasses.

Many instances occur to illustrate these points. The very broad rings marking the battledore scales in "Pritchard" denote the smallness of the objective aperture; or this combined with a small pencil of light. These rings attenuate as the angle is increased. The same happens as already described with all transparent spherules, cylinders, and to some extent with tubules if refractive. The folded edge of any fine membrane is an exception to this in modern glasses from optical causes.

From all this it follows that the darkness of spherular refracting bodies depends principally on three conditions: the refractions between the spherule and the medium; the angular aperture of the objective, as well as that of the illuminating pencil; and it may be added, the obliquity, if any, of the illuminating pencil and the compound effects and projected shadows and eidola of subjacent bodies.

The peculiar effects of a taper advanced below or close as possible to an object have been quite neglected; the advent of the electric light is most welcome to the microscopist.

ELECTRICAL INSTRUMENT-MAKING FOR AMATEURS.—VI.*

By S. R. Bottone.

§ 15. VOLTA'S ELECTROPHORUS.—This is essentially the amateur's electrical machine. It is at once the simplest to construct, the most efficient in action, and its theory is most interesting as giving the key to the continuous-action electrophori of the present day. I allude to the Holtz, to the Bertsch, to the Carré, and to the Wimshurst machine.

§ 16. To make an electrophorus will be needed a sheet of zinc, from which are cut two discs, one being about 2ft. in diameter, the other about 4in. less. The zinc should not be more than [illegible]in., nor less than [illegible]in. in thickness. The outer edge of both the discs must be turned up by careful hammering with a mallet, and a round, soft, iron rod, a ¼in. thick, must be run
round the edge of each disc, and
with the upturned edge of the
operation requires a considerabl
care and patience to effect it :
absolutely essential to the effic
machine that the edges should
round, without any sharp angles :
can only be attained by using a
shape something like a stout penci
a semi-circular concavity at its lowe
(See Fig. 6 A). By turning the edg

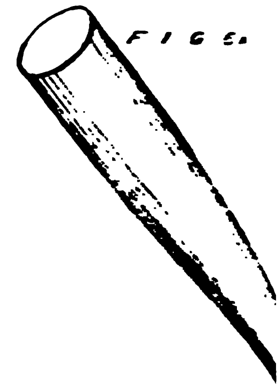
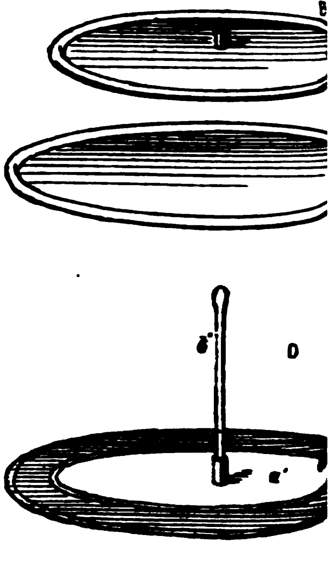


FIG. 6.

over the rod by the aid of this
hammer, a smooth border can ea
duced. Should, however, the amate
difficulty in performing this operati
be advisable for him to have reco
nearest tinman, who will execute th
sleight of hand for a few pence. E
the two discs should present the
shown at Fig. 6, B and C. It will be
from the centre of the smaller dis
short piece of tube. This is made
length of ½in. brass or zinc tubing
in length, which is soldered centr
smaller disc. It is into this tube
sulating handle is to be inserted
amateur may vary somewhat the d
his tube to suit that of his han
should not greatly exceed ½in. in di

FIG. 6.



be less than ¼in. Near one edge of the
disc should be soldered a short length
brass wire—say, about 3in. in length
into the form of a rounded L, and
its extremity a brass ball about 1in. in d
(Such balls may be obtained from
mongers at about sixpence each.) If n
procurable, it may be replaced by a
bullet cast on to the end of the wire
6, B). A handle of some insulating
must now be provided. In shop
struments glass handles are generally
these are not nearly so efficient
though very much more beautiful
chemists ebonite stirring-rods, ab
and somewhat over a ½in. thick,
tained for twopence or thre

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; will serve our purpose admirably; and ıd end should be cemented into the tube by the aid of a little guttapercha t's elastic glue, applied hot to the end rod, and the extremity of the tube ' pinched round it to insure its not ; out. The larger disc must now be ith some insulation composition. Of ıere are several; the best is perhaps · but it is expensive, being about 6s. 6d. l; however, it can be obtained in very eets, and this, of course, lessens the . If ebonite is used, a disc should that will just fit into the larger zinc ıd be fastened down to it nicely and y by means of Prout's elastic glue, y equal pressure with a warm (not too n. Another very good material is *gun-* Gun-paper, or *papyroxyline*, is paper ıas been immersed for a few seconds in a e of nitric and sulphuric acids, and then in an abundance of water. A disc of yroxyline, cut to reach quite to the bead arger zinc disc, may be cemented to the c by means of any spirit varnish (say, *zrd*), and when *quite dry*, the surface nished with the same, to prevent the absorbing moisture, which it would se be apt to do. If papyroxyline is should be made from stout millboard ast $\frac{1}{16}$in. thick, and ⅛th will be better ıis material is practically indestructible, s not deteriorate, as does the ebonite, xidation of the surface, or as the usual composition, by splitting up from the

ast and most usual composition for the isc is a mixture of Venice turpentine, ıd shellac. To make it of even con-, it is necessary to proceed as follows:—

ke best shellac .... 3 parts.
llow beeswax .... 2 parts.
nice turpentine............... 1 part.

he shellac in an earthen pipkin, and ; over a gentle fire. Watch until melted. nelted add the beeswax. When well pour in the Venice turpentine. Again l when mixed, pour into the large zinc ıich must have previously been warmed y the same temperature and placed on tly level table. Should any difficulty rienced in getting the mixture to flow over the disc, it may be assisted by over with a tolerably hot iron Should xture be preferred to the ebonite, or yline disc, then care must be taken to ufficiency to fill the zinc disc up level e wire beading, because if the coating ous mixture be left too thin, it will all ay on being beaten during excitation. shows the electrophorus in its finished ıd in position ready for use.

t in action, it is only necessary to re- e covering disc *a'*, by its handle *b'*, and e the resinous cake (ebonite or gun- y beating it with about half a yard of ry flannel, or better still, a cat's skin. the cover be placed on the centre of the *upper disc touched with the finger*, and idly raised to a height of 6 or 8in. by f the insulating handle *b'*, care being t to let any part of the clothes or body e disc, a fine 2in. spark may be drawn knob by approaching the *knuckle* or brass ball to it rapidly. Sparks may ıed almost indefinitely by again lower- discs, touching, and again raising. I recommend every student to make an horus, and not to rest satisfied until he y mastered the theory of its action. e understands this, he will have got eply into the theory of *induction*, and be prepared to grasp the theory of the rst machine—a machine which will play a very important part in future ons of electricity to the arts.

MOULDING.—III.*

By "Sand Rat."

next describe how to mould a large , such as is used in a chemical works. ustom to make them in loam in most ut we will suppose we are working in where the stove is so small that we rive a large loam mould, so we must in green sand. In the flour it will require great caution, as there is a large body of metal to contend with, and as I have spoken in my first numbers about venting, I must still warn you to vent both outside and inside very well. The outside must be vented into the coke-bed; the inside must be vented through the top part, down to the face of the inside of core. A pan this size ought to have three gates about ¾in. by 5in., and run as shown. The grid may be either made with bars, same as a box, and cast holes in for to lift by; they would require to be deep bars in the centre and shallow at the sides, as shown on Fig. 1, at E, or it may be made as the one shown, with prods about 1in. thick and 5in. broad, with a strong grid not less than 2½in. thick, and it ought to have about eight handles, 1in. thick and 4in. long, to lift the core by. It ought to have eight studs fixed on the core iron, and packed to the box bars as shown at Fig. 1, and letter I, so that when it is bolted to the top part, it will not rise out of its place, or slip off when it is being turned over. The feet can be made in cores, and laid in the mould when the outside is being strickled. By screwing a wing on as shown at E, in Fig. 3, a good bed may be made either for the cores to rest on, or for feet patterns to be laid on. In making a pan this way, we shall require a cenrte and spindle. I would recommend a spindle not less than 3in. diameter. As the pan is about 36in. deep, we must first dig a large hole about 18in. deeper than the mould; next, bed the centre (D) level, leaving a space under for all loose sand to drop into. Next lay some small bushes round the spindle, to keep out the coke and sand, then lay the coke bed about 5in. or 6in. thick, cover with straw thinly, then ram some black sand on. Next, set the board A to wing and spindle, to strickle the inside with, leaving the thickness until the core and top part is removed. Next, take off the board A, and screw on the board B, which gives the thickness and flange; also the board for inside will be 3=8½ and board for outside 3=10½, and spindle 3in., making 8ft. diameter. It will require a vent pipe to bring off the air as shown. I have also shown vents into bed from the face of mould (usual size about ⅜in.) It can be staked at the corners as shown at H H., and lifted at J J, box handles. B is box; F F is bolts into the grid-handles; A is pan; E is grid; G is gates; C spindle. (Fig. 2) A grid; B handles; C where the studs rest on. (Fig. 3) A inside board; B outside board; C spindle; Fig. 4 is studs I I. Put plenty of weight and two risers on; by doing so, it will take a great amount of strain off the mould, and will not require so much weight as with one riser; or, if weights are scarce, the mould may be bolted down by putting large plates under the coke bed, and long bolts with binders across the top part. I purpose showing bolting down tackle later on. Keep the centre and spindle well oiled.

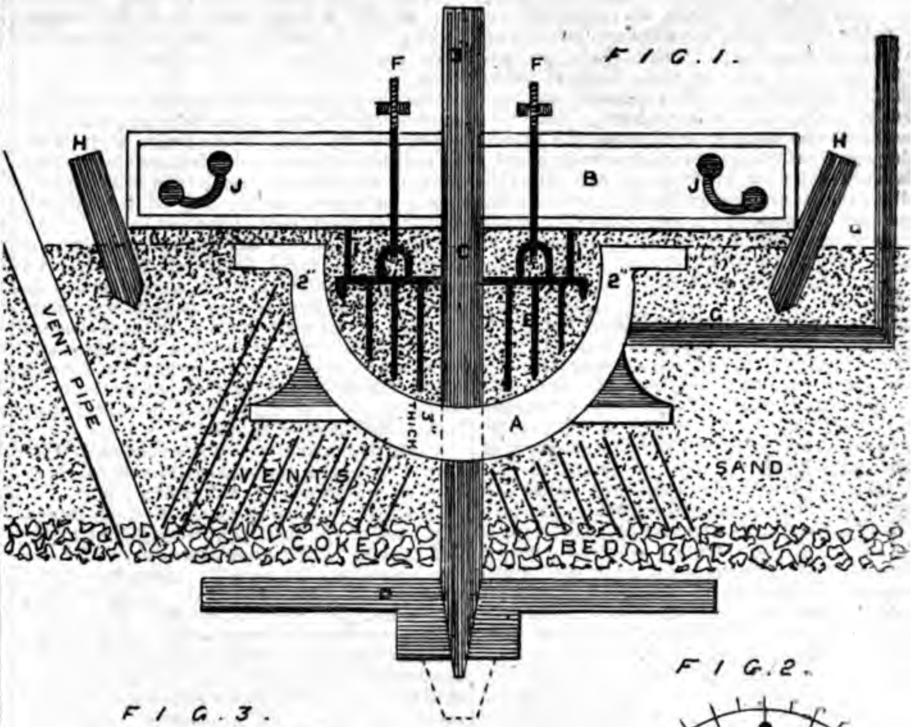

FIG. 1.

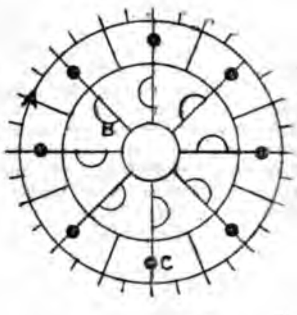

FIG. 2.

FIG. 3.

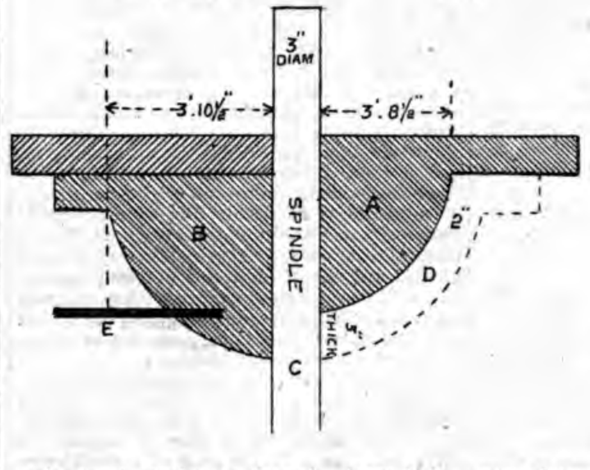

FIG. 4.

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MINING NOTES.

By J. H. Collins, F.G.S.

Prospecting.

IN searching for minerals in untried countries or districts, the prospector is usually guided instinctively in the first instance by the general contour of the country, particularly of its hills and valleys, the plains especially being known, from almost universal experience, to be very unpromising ground. Practically, for instance, the unlearned Cornishman has looked for a surface contour more or less resembling that of Cornwall, and then has more closely examined the earth thrown out of rabbit-burrows and fox-earths, small landslips, newly-ploughed fields, wells, &c.; especially on the flanks of the hills, the sides and bottoms of water-courses, springs of water, *shodes*, *gozzans*, *water-stains*—all are, in their turn, valuable outward indications of concealed mineral wealth. On the other hand, the tin streamers, who discovered most of the placer gold deposits of California and Australia, closely examined all such river sands and alluvial valley deposits as came under their notice by the processes of *panning* or *vanning*. The gem-seeker often works in a similar manner, except that, as minute particles of gems are of little or no value, he does not trouble to examine the finer sands.

Shodes are stones containing ore, often more or less water-worn from attrition in the beds of streams, which are recognised by the miner as being similar to those he has seen in connection with known mineral veins or lodes, or which, if of unfamiliar appearance, are still noteworthy on account of their high specific gravity or other obvious characters. He argues that such stones can only be brought by natural agencies down-hill, and therefore goes upwards to the higher grounds, or in the direction of the source of the stream, searching as he goes, until such shodes no longer appear. At or near the point of disappearance, he often searches for the lode by "costeaning," "hushing," or other convenient means.

Gozzan is the name given by Cornish miners to the ferruginous matter, often accompanied by cellular quartz, which is frequently found in large quantities at the outcrop or "back" of a lode. The existence of gozzan more especially indicates lodes or irregular deposits of pyrites (whether of iron or copper), lead, or silver: tin lodes are frequently without gozzan. This substance sometimes extends to depths of 60, 80, or even 100 fathoms. It appears to be due to the oxidation and partial removal by solution — from atmospheric influences in general — of particles of pyrites, blende, or fluor-spar, mostly associated with more or less silicious matter. Gozzan is known to French miners as "chapeau de fer," to Germans as "Eisenhüt."

Springs of water frequently indicate the existence, and, to some extent, the position of a lode in a mineral region or district — the lodes being the subterranean water-channels. Even in seasons when no water is visible at the surface, a slight depression of the ground, or a superior greenness of the herbage, often indicates the position of a spring. Of course, springs occur under quite similar circumstances in districts destitute of mineral wealth.

Stains of various kinds often occur in connection with springs, more especially in mineral districts. Stains or deposits of *red*, *yellow*, or *brown* material may indicate deposits of pyrites — or may come from the gozzans of other lodes; *green* or *blue* stains almost certainly indicate copper, very rarely the far more valuable nickel; *greyish*, *bluish*, or *slate-coloured* tints sometimes indicate lead; *bright yellow* or *greenish-yellow* sometimes indicate uranium, but rarely, as this substance is extremely scarce; *pink* or *peach-colour* is also very rare, but would usually indicate cobalt; *black* deposits are often formed by a minute proportion of manganese in the water —where the deposit is copious it may indicate deposits of value. Generally in such cases traces at least of cobalt will not be wanting in the deposit. It may be noted here that the water from lodes containing copper often has a strong copper taste; and that from iron pyrites often tastes like old-fashioned ink. A very perfect cleavage in schistoze or slaty rocks, or a very perfect porphyritic structure in eruptive rocks would not be looked upon in general as favourable signs. On the other hand, an intermingling of eruptive with stratified rocks—both classes showing signs of decomposition, would in general be regarded as favourable indications if they occurred in otherwise suitable situations.

Costeaning is not always a convenient process to the prospector, as it requires in general a considerable amount of labour. The process consists in sinking several shallow pits through the surface soil and subsoil in a line at right-angles to the presumed "strike" or "bearing" of the lode, and then driving or channelling from one to the other, so as to "cut" the lode if it exists. I have heard it called "cross-tinning" in Cornwall, where the process has often been adopted in the discovery of tin-lodes.

"*Hushing*" can only be carried out in hilly countries, and where a considerable quantity of water, flowing from a relatively high level, is available. It consists in the forcible washing away of the soil or subsoil in a hill-side by a stream of water, the outcrop of the mineral veins, if existent, being thus laid bare.

Panning is merely washing natural sands or gravels, or powdered fragments of rocks, in a pan with a quantity of water, a peculiar motion being given to the water so as to make it carry off the lighter fragments, and to leave those of greater specific gravity behind for subsequent more careful examination. Very often a rough spoon of horn is used for this purpose; even a common saucer or plate may be useful if no better implement be at hand.

Vanning is the same process—usually conducted with more care and skill—using a short-handled hollow shovel instead of a pan.

So skilful are many of the Cornish miners in the art of vanning, that, starting with only two ounces of finely-ground ore, they will bring the "produce" of metallic substance—tin, or whatever it may be—several times running within a single grain in weight. It would be useless to attempt to describe the process, careful practice, under the personal guidance of a skilled hand, is indispensable to one who aims at being a skilful vanner; although any one possessed of a saucer or pan—a little material of several kinds differing in specific gravity—some water, and a modicum of common sense, can, with due practice, learn enough of panning to be of real use to him in his prospecting tours. With a geological hammer, a prospecting pan or horn spoon, a compass, and a small set of blowpipe apparatus, a prospector may be regarded as well provided, little more being required than a fair amount of skill in using these implements, and some slight knowledge of mineralogy, to enable him to make great discoveries in hitherto untried districts. Where mineral districts are pretty well known, a much greater amount of skill and of close observation will be required, together with much good luck, and often a free and laborious use of the pick and shovel, and sometimes, too, of explosive agents and blasting tools.

Prospecting for Coal.—In an unknown or imperfectly-known district seams of coal may sometimes be discovered by a careful examination of the beds of rivers, sides of ravines, sea cliffs, &c., just as in the case of metalliferous minerals. Sometimes the "basset-edge," or outcrop of the coal-seam itself, may be thus discovered. More often, however, only black shales or sandstones containing impressions of fossil ferns, or limestones with shells (especially such as are figured from the carboniferous system in geological works) will be found, the coal itself having decayed and disappeared from the actual outcrop. Occasionally the situation of a coal-seam may be indicated by the outflow of a spring of water depositing much oxide of iron (iron stain), the result of the oxidation of iron pyrites or "brasses" existing in the joints of the coal; but this appearance, which also accompanies many ore veins, may frequently occur without the existence of anything of value. In some instances a darker shade of the ground after ploughing has led to the discovery of a valuable bed of coal; but this sign can only be of value in a known coal-bearing district.

Even when coal has been found, it will rarely be of value if it contains more than 10 or 12 per cent. of ash, or if it occurs in seams of less than one foot in thickness, or if it be far from a railway or port, or from places where it can be used in quantity. Under very exceptional circumstances, a seam of good coal of less than a foot in thickness might be valuable, if so situated as to be easily and cheaply mined—far from other fuel sources, near where fuel is required for the treatment of valuable ores and the like. Much misconception prevails upon this subject. The writer knows one recent instance, in which, quite in good faith, a property containing two thin seams of carbonaceous shale, not more than ½in. thick, was offered for sale for £30,000 because of its nearness to valuable deposits of copper ore. Of course, it was absolutely worthless, although good coal would have been worth, in that situation, at least £2 per ton.

PHOTOGRAPHIC PRINTING SURFACES.

DURING recent years many inventors have been engaged in endeavouring to discover a method of producing a printing surface direct by means of photography, and amongst them the late Mr. W. B. Woodbury was the most successful. The manager of the autotype works at Ealing Dene, Mr. J. R. Sawyer, has recently obtained a patent for a process by means of which electrotypes, suitable for printing in ordinary presses, may be obtained direct from photographic pictures in pigmented sensitised gelatine. On p. 47, last volume, we gave brief descriptions of three processes for producing block-printing surfaces from photographs: but as Mr. Sawyer's process covers the whole ground and discloses the principles on which improvement in details may be expected, we describe it at some length. The photographic picture is taken in pigmented gelatine, made sensitive to the action of light by means of bichromate of potash, or presumably by any other suitable salt containing chromic acid. The film of gelatine is backed by a polished copper plate, and when the picture is developed the plate is placed in a depositing vat, and an electrotype is taken of the gelatine photograph, the copper being deposited until it becomes as thick as an ordinary engraver's plate. In this case the gelatine picture is formed of masses of gelatine and pigment, which vary in thickness according to the degrees of light and shade in the original photograph, and it follows that when a copper cast is taken from it by the galvanoplastic method, the elevations in the deposited plate will correspond to the high-lights, while the depressions will represent the shadows and half-tones of the picture. A copper plate thus obtained resembles, to a certain extent, the finished work produced by the burin or the etching needle, with this difference, that while it is possible to ink up the plate just as if it were an ordinary engraved copper-plate, it is impossible to clean the surface in order to take the impression without wiping much of the ink entirely out of the plate. This result is due to the absence of a tooth or grain, and a consequent lack of ink-holding power. In practice, another difficulty is found in the fact that unless the gelatine picture is perfectly covered with a good electrical conductor, which insures a thin deposit of copper at once, the film is attacked by the solution in the vat, and the electrotype is spoilt. Mr. Sawyer believes he has completely overcome these difficulties by introducing into the gelatine a substance which aids in the production of a perfect conducting surface, and also at the same time imparts the necessary grain to the electrotype. This substance is amorphous graphite, which can be purchased as levigated plumbago, and is sifted through sieves having 120 holes to the inch for the finest grain, 80 holes for medium, and 40 holes for the coarsest grain—that is, for large pictures, such as full-size copies of oil paintings, &c. This powder of the size required, is mixed with a jellified gelatine prepared by dissolving 40 parts in 100 parts of water, with six parts of loaf-sugar and a drop or so of carbolic acid. About an ounce of graphite powder is required for each pound of the prepared gelatine, and the admixture is effected in a paint mill. Paper of suitable kind, such as ordinary printing paper, is coated with the prepared gelatine by floating it or gradually unrolling it on the surface of the mixture kept melted by immersing the vessel containing it in a trough of hot water. The paper thus coated is dried, and is ready at any time for the sensitising process, which is effected by immersing it in a four per cent. solution of bichromate of pot[illegible] This operation must be carried out in the d[illegible] and the paper be kept as other sensitised [illegible] The printing and other processes are mu[illegible] same as in carbon printing, and when th[illegible] tine film is firmly attached to the copp[illegible] by means of the squeegee, it will be a[illegible] development and pickling in an alum [illegible] the surface is covered with a grain [illegible] amount with the varying grades

—the smallest quantity being observable in the lightest shades. A soft brush, which is occasionally touched on a block of plumbago, is now applied to the surface of the gelatine picture, and in a short time it is rendered perfectly conductive with a fine black polish. It is then ready for the electrotyping bath, and is prepared in the usual manner, with shellac coating where a deposit is not required. The deposition of a sufficient coat occupies some time; but the subsequent operations of printing are the same as with ordinary engraved plates.

MOSSES.

AT a meeting of the Herts Natural History Society held last week in Watford, a paper by Mr. E. M. Holmes, F.L.S., was read, from which we make the following extracts:—There are few words used with greater latitude by the general public than the word moss. In common acceptation the term is applied to anything which grows on rocks or trees, and which has a mossy habit. Irish moss, Iceland moss, cup moss, and the golden moss of cottage roofs are familiar examples of this. The first named is a seaweed, the second and third are lichens, and the fourth is a flowering plant. Being of little practical use to mankind, and too small to be easily distinguished by the naked eye, it was not until the microscope became a familiar instrument in the hands of botanists that mosses were at all studied. Little or no attention was paid to them until the end of the 17th century, when our countryman Ray travelled throughout the length and breadth of the land and collected all the different kinds that he was able to distinguish. Even in the middle of the 18th century so little were the distinctive feature of the true mosses understood, that Dillenius, a professor at Oxford, classed lichens and confervæ under the same head. Even the great Linnæus included among them the club mosses and liverworts. But although rapid progress has been made in our knowledge of mosses during the last 50 years, so much so that whereas in 1827 only 290 British species were known, and now there are about 700, yet the general public still retain the same hazy nozions concerning mosses that prevailed more than 100 years ago. A few species are not at all particular as to the neighbourhood in which they dwell, but are thoroughly cosmopolitan, being found in all quarters of the globe. All species, however, love a certain amount of moisture, although the quantity necessary to the well-being of each varies considerably. Trees, rocks, caves, old walls, thatched roofs, anthills, ditch banks, dried-up pools, and even rivers have each species peculiar to them, which will flourish in no other situation. Some prefer granite, others limestone or sandstone rocks. A few exhibit a decided preference for a particular kind of tree, such as the ash, poplar, or chestnut. A certain number, including some of the loveliest species, are exceedingly low in their tastes, and are found in bogs, and there only, or the dung of particular animals, such as foxes, &c. But the neighbourhood of waterfalls, damp, shady dells in woods, and crevices of limestone rocks, near streams, ravines, or clefts, or the precipitous sides of mountains are the spots where the bryologist expects to reap the richest harvest and to find the rarer and more aristocratic species. Geological formations and the consequent variation in the amount of moisture, as well as climate, appear to influence considerably the distribution of species. The moss flora of the chalk districts, which are usually very dry, is quite distinct from that of the greensand and weald, many of the species found abundantly in the one being entirely absent in the other. So much is this the case that it is possible to tell by the presence of certain species the character of the soil on which they grew, even without being acquainted with the locality. Other influences also occasionally modify the distribution of mosses. The best time of the year to find mosses in perfection is during the winter months, most of the species being dried up and consequently in a dormant state during the summer. Those who have the opportunity of a visit to the mountains during the summer months will find many rare species in perfection in July and August. This is owing to the longer winter in mountainous districts and to the perennial moisture arising from the numerous bogs and springs and constant mist. In Lapland the women make a cosy little nest for their babies by lining the cradle with dried bog moss and the soft down of the reindeer, and as the materials are abundant the babies usually have a fresh nest every day. The influence of the bog moss in altering the face of the country in boggy districts can scarcely be estimated. Rising above the surface of pools it affords a foothold for seeds of various kinds, which produce a vegetation on its surface, and thus peat is formed, [illegible] supports plants of a larger [illegible] few years moss has a [illegible] application. It [illegible] been found in the cinchona plantations in India that if alternate strips of bark are carefully peeled off the tree and the bare places covered with moss new bark will be formed which contains a larger amount of quinine than the original strips, and that thus treated the cinchona trees will yield bark which for a certain number of years increases in value annually. Although in the economy of nature mosses appear to be intended simply to collect dust and form soil for larger plants, we are scarcely entitled to look upon them with contempt. If the Creator has seen fit to endow them with such marvellous beauty of structure, and such infinite variety of form, shall we say that they are not equally worthy of our attention? The study of these plants must lead to patience, skill in manipulation, and keenness of sight. Further researches into the life history of these minute plants will probably solve many points that are at present obscure. It appears probable, indeed, that some forms at present classed among the fresh-water algæ may be only persistent forms of the protonema of mosses, and which under different circumstances would produce mosses of various kinds.

SCIENTIFIC SYSTEMATIC METHOD IN ORDINARY MECHANICAL OCCUPATIONS.—I.

By PROF. COLEMAN SELLERS.

THE following is the substance of a lecture delivered last month before the Franklin Institute by Prof. Coleman Sellers, as an introductory to his course on mechanics. In commencing, Prof. Sellers said:—

I propose this evening to say a few words to you on the part that systematic, scientific method plays in the most ordinary mechanical operations, and to point out the need of orderly method in the advancement of all the arts. I had occasion the other day to watch the operation of a mechanical shoemaker at work in the Novelties Exhibition. Boots and shoes were being sewed on this machine, the stitches made with brass wire; brass staples were selected, automatically, of the proper length, and were inserted in place. My attention had been critically drawn to this machine in acting as judge in the class to which it belonged; not very far away were books, which, in binding, were sewed with wire staples, and between the two were many devices to enable hand-sewing with wire staples to be done with ease. My mind naturally grouped these objects and processes, and even flew back over many, many years to days of childhood, when I had learned one of my first lessons in mechanics from my father, who held me in his arms, so small was I, as he showed me the then great wonder of fine steel wire bent in a machine into staples and driven through thick leather in rapid succession, to form the fine teeth of the cards used in carding wool and cotton fibre. I was not at, say, four years old, too young to remember the lesson when it was facts that were given me to think over. He took good care to point out that the fine wire forming the staple was driven through the leather with unerring precision, and without any holes having been pierced for it by more rigid needles. The card clothing machines at Cardington were driven by water-power, but this mechanical shoemaker at the Novelties was driven by a steam-engine of the highest type. That steam-engine had its lesson to teach; a life, too, could span much of the period of transition from the first crude machines that grew out of Oliver Evans' notion of a high-pressure engine to the work of Corliss and others of to-day. It had made but little advance, even as early as I can remember, as compared to the results of to-day, and its slow growth had been after the manner of the survival of the fittest. Its history is cumbered with a vast amount of negative information, by years of mistakes, the results of empirical methods as against the systematic mode of more modern research. As the steam-engine grew towards its present state of perfection, in spite of the many drawbacks, the theory of thermo-dynamics took shape. The practical mechanic, who prides himself on the grand fact that he has drawn all his information, as it were, through the handle of the hammer he has worked with, has a holy horror of all that savours of science, and, what is more, he holds in contempt the scientific engineer. It was one of these practical men who presented a contrivance of his to a railroad company for trial; some of the directors thought it would be well to investigate, and the trial was made. The inventor afterwards said that the failure was due to the scientific experts who conducted the trial. He suspected they had put some thermo-dynamics, or some other scientific stuff, into the boiler, on purpose to prevent his device from operating. Now, thermo-dynamics is the name given to the science that takes into consideration the co-relation between heat and work. [illegible] designers of the great engines of to-day have [illegible]dvantage of a pretty thorough knowledge of the laws that have been found to govern the conversion of heat into motion and of motion into heat. Could a knowledge of thermo-dynamics have preceded the steam-engine, there is no telling how much further we would have been now in our motive-power department of the world's industries.

We are living in an age when the Baconian inductive system of research is relied on; the rapid progress of modern times is due to the results of the inductive system. In old times, the philosophers contrived theories to account for known facts. Lord Bacon was the one who clearly pointed out the need of obtaining many facts and finding the laws that govern matter through and by the study of the facts, but going beyond the range of the facts that we can obtain for the purpose of investigation.

The old philosopher stood on a hill and saw the land spread out before him as a mighty plane, and, as he watched the movements of the heavenly bodies, he saw them rise in the east and sink below the horizon in the west. Upon this visible fact he concluded, with the more modern coloured preacher in Virginia, that "the sun do move," because he saw it move; and so, from this visible fact, he proceeded to build up a theory of astronomy, and hunted for other facts to sustain his theory.

A more modern inductive philosopher under the same conditions, perhaps, notices that objects floating on the surface of the sea sink out of sight at the horizon, and as these bodies are moving, hence infers that the surface of the world is round, and, gathering many more facts, he then draws conclusions from his observation that enable him to look further ahead and foretell, as it were, greater discoveries. The wonderful progress of modern times is due wholly to the method that has been pursued of grouping facts in proper order, working out laws that govern matter, and proving that the laws are correct by finding no exception to them. An established law is what explains all phenomena bearing on it, and when no known fact offers any contradiction to it. We have before us, it is true, a vast field of experimental research, but we are in the position to guide our work systematically by the lights we now have. The day for empiricism in mechanics has gone by, and I wish to show you this with a few simple illustrations. I have here a ball attached to the end of a piece of string; the string seems strong enough to carry the ball—at least, it does not break under the strain. I whirl the ball in a circle, and past experience leads me to infer that if I whirl it rapidly enough the string will break under a strain, due to the centrifugal force incident to the rotation. This fact is so well known to all of you that it is not needful for me to prove it by trial. We hear of fly-wheels and grindstones breaking when revolved too rapidly. If, for any reason, I should desire to keep up the rotation of the ball at the end of the string with safety, I must know the force exerted on the string during rotation, and I must know the ultimate strength of the strain. I have only to know the weight of the ball and its velocity in feet per second during rotation, and calculation will give me the strain on string more accurately than I could obtain it by experiment. Now, on the other hand, no amount of calculation will tell me if this particular string is strong enough to bear the strain with safety. To find out the ultimate or breaking strength of the strain, I must load it with an increasing weight until rupture takes place, and the information thus obtained can be used with some degree of certainty with the balance of the twine on the ball from which this was taken, or can be used to predicate the strength of another string of similar size and construction. This homely illustration will convey to your minds what I want to make clear—namely, just where we can rely on calculation, and where experiment must be resorted to continually.

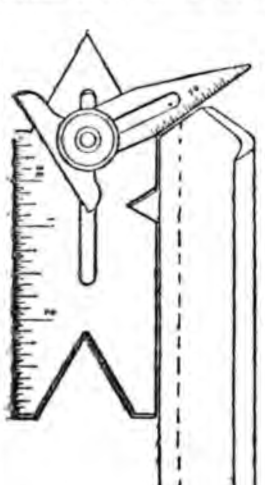
(*To be continued.*)

ALIMENTATION AND PHYSIOLOGICAL DIET.

IN commencing his course of lectures for the winter session, Prof. Germain Sée, of Paris, selected the subject of "Alimentation," with special reference to diet in health and disease—the latter branch being termed "alimentary therapeutics," in many diseases of more importance than drugs. Defining an aliment as a substance containing the elements capable of repairing the waste of the tissues of the body, as well as the renewal of the force and heat which are incessantly expended in the performance of the various functions of the organism, Prof. Sée said this led to the consideration of what he termed physiological diet, which consists of from 125 to 130grm. of nitrogenous matter, obtainable from 250 to 300grm. of muscle or of albuminates, from 84 to 100grm. of fat, which is the combustible principle of the economy, plus 250grm. of carbo-hydrates furnished by 300 to 400grm. of farinaceous substances or of sugar, without counting water, which favours the organic changes, as well as the mineral elements, which enter into the composition of all the liquids and tissues of the body. Prof. Sée considers that although green vegetables contain nothing nutritive, yet they have their utility, and must not be discarded, being a necessary element in the daily rations. Gelatine is another substance that has been greatly misrepresented because the *rôle* it plays in the process of nutrition has not been properly understood. Magendie, and other physiologists of his time, after having experimented with it for ten years, came to the conclusion that gelatine was of no utility whatever in the economy —that is to say, as food. Other physiologists have since proved that gelatine, gelatinous bouillons, peptones, &c., contribute to the maintenance of the forces of the organism, in economising the albuminoid principles, without its being itself transformed into fat. In developing the subject, Prof. Sée explained that gelatine may be looked upon as a substance that prevents or rather retards the process of denutrition, and on that account applied to it the term of "substance d'épergne," or, as Gubler termed it, "anti-derpidateur." It is, therefore, a useful addition to our diet, not only in health, but in disease; particularly in fevers. Where the process of denutrition goes on at a rapid pace, gelatine, in the form of beef-tea or other concentrated broths, is invaluable. Any deviation from the above principles, whether in quality or in quantity, must more or less affect the normal functions of the different organs and thus produce disease, and Prof. Sée parenthetically stated that the Germans were large eaters and the English great consumers of meat, which may account for the greater prevalence of gouty affections among them. Prof. Sée attaches the greatest importance to diet in a therapeutical as well as a hygienic point of view. In the treatment of disease it is sometimes even more important than pharmaceutical preparations, as for instance, in typhoid fever, where a proper selection of food is everything, while drugs serve only a secondary purpose.

ANGLE AND TWIST DRILL GAUGE.

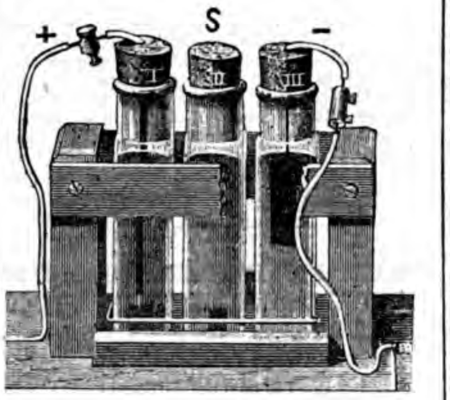
A USEFUL little angle and twist drill gauge which can be also employed with advantage in centring, depthing, and screw cutting, is shown in the illustration below as set for use as a gauge in



testing the angles of the point of twist drills. When grinding the drill throw the tongue of the auxiliary gauge back, and set to the angle of one of the lips of the drill. Notice which line of the graduation coincides with the front of the lip; then bring round the other lip, when the difference, if any, will be seen. This tool is made by J. Wyke and Co., East Boston, Mass.

THE WIRT CONSTANT BATTERY.

A MODIFIED form of the Daniell cell, known as the Wirt, is being introduced in the United States, and as it possesses features which may render it of special value we annex an illustration. The battery consists of three square bottles, 1¼in. square by 4½in. high, with a neck ⅞in. in diameter by 1in. long; these are securely clamped together at the top and bottom, as shown in the engraving. In the upper part of the adjoining sides of bottles I and II is drilled a small hole ⅛in. diameter, and in the lower part of the adjoining sides of bottles II and III are similar holes, all arranged to correspond with each other. A soft rubber washer separates the bottles at the holes, making a water-tight joint, and also acting as a support to hold in place a thin film of goldbeater's skin, through which the liquids must pass by the process of endosmose and exosmose, from one bottle to the other. All the bottles are filled with a dilute solution of sulphate of zinc. Within bottle I is placed a piece of sulphate of copper about the size of a pea, which changes the solution to a blue colour; the copper electrode at the bottom is connected by an insulated wire, which passes through the cork. At the bottom of bottle II is a small piece of zinc which collects any deposit of sulphate, should any pass through from bottle I. The zinc electrode is suspended from bottle III. This arrangement, the inventor states, gives a very constant battery which cannot polarise, as each electrode is completely isolated, and the separation of the bottles with the goldbeater's skin also prevents an easy mixture of the solutions.



HOW TO RECOGNISE GOOD WOOD.

THERE are certain appearances characteristic of good wood, to whatever class it belongs. In the same species of wood, that will, in general, be the strongest and most durable which has grown the slowest, as shown by the narrowness of the annular rings. The cellular tissue as seen in the medullary rays (when visible) should be hard and compact. The vascular or fibrous tissue should adhere firmly together, and should show no woolliness at a freshly cut surface; nor should it clog the teeth of the saw with loose fibres. If the wood is coloured, darkness of colour is in general a sign of strength and durability. The freshly cut surface should be firm and shining, and should have somewhat of a translucent appearance. In a wood of a given species, the heaviest specimens are generally the stronger and more lasting. Among the resinous woods, those having the least resin in their pores, and among the non-resinous woods, those having the least sap or gum in them, are generally the best. Timber should be free from such blemishes as "clefts," or cracks radiating from the centre; "cupshakes," or cracks which partially separate one layer from another; "upsets," where the fibres have been crippled by compression; "wind galls," or wounds in a layer of wood which have been covered and concealed by the growth of subsequent layers over them, hollow, spongy places in the centre, indicating the commencement of decay. It may be added that the microscope is of great value in testing the qualities of wood; its evidence is, indeed, decisive on this point. Samples and micro-photographs of bridge timbers which have proved faulty, but which a preliminary examination with the microscope would have thrown out, have been exhibited. The timber was from a railway bridge wrecked in 1879. Annular rings appeared about three times as far apart as they would be in good wood of a similar kind. The medullary rays were few in number and short in length, while in good wood they are of considerable length and so numerous that tangential sections present the appearance of a series of tubes seen endwise on a number of parallel chains. After once seeing and comparing samples of good wood, it is easy to recognise the difference with a pocket magnifying glass. The trunks and limbs of exogenous trees, as is well known, are built up of concentric rings or layers of woody fibres, which are held together by radial plates, acting like treenails in a boat's side. The rings, representing successive years' growth, are composed of tubes, the interstices of which are filled with cellulose. The slower the growth of the tree, the thinner these yearly rings, and the denser and harder the wood, other things being equal. Not only is the closeness of the texture an indication of
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Lumber Journal.

USEFUL AND SCIENTIFI

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covery of banks, or shoaler soundings
the accuracy of the depth indicate
checked by an up and down cast of
line. There are frequent cases on
ported discrepancies of soundings ove
and of banks, given on the strength
machine, which have been disproved w
with lead and line.

Alloys of Cobalt and Copper
copper with cobalt are readily obtain
the two metals together under a flux
and wood charcoal, or by melting co
alloy of copper and cobalt which is
process of copper smelting. The a
M. Guillemin for this purpose had the
Co, 48·28; Ni, 1·0; Cu, 50·26; Fe, 0·4
alloys investigated contained from 1 t
of cobalt. They have a red colour, an
fracture, resembling that of pure c
have remarkable ductility, malle
tenacity, and can be worked and roll
but they cannot be tempered. They
a tensile strain of from 25 to 36 kilos
millimètre, with an elongation of 28 t
An alloy containing 5 per cent. of
forging and rolling, broke under a
kilos. per square millimètre, with an
10 per cent. This particular alloy,
Chemical Society says, is as malleable
reliable to oxidation as copper, and
and tenacious as iron.

SOME remarks on the subject of
recent experiments on the velocity of
view to testing the truth of the kine
gases, were recently read before the Pa
of Sciences by M. Faye. The author
the results of these experiments tha
hypothesis will have to be reconsi
absolutely rejected. The limit which
the velocity of gases under
temperature and pressure
ginary.

SCIENTIFIC SOCIETIES.

LIVERPOOL MICROSCOPICAL SOCIETY.

THE ordinary monthly meeting was held at the Royal Institution on Friday evening, 4th of December, the president, Charles Botterill, Esq., F.R.M.S., in the chair.

Several donations were announced, and the thanks of the society voted to the donors.

Mr. Thomas J. Davies was elected a member of the society.

A paper on "Some of the More Interesting Forms of Life Obtained During the Summer Dredging Expeditions" was read by Professor Herdman, D.Sc., &c., of the Liverpool University College.

The lecturer commenced by alluding briefly to the formation and work of the Liverpool Marine Biology Committee, the main object of which is to investigate thoroughly the Fauna and Flora of the estuary of the Mersey and the neighbouring seas, and to draw up reports upon the various groups of animals and plants. He then, after acknowledging the assistance which some of the members of the Microscopical Society had rendered to the committee in the work, proceeded to discuss some of the more interesting and important forms of life which had been collected during the summer dredging expeditions. Amongst Cœlenterata some points in the structure and the life-histories of the following forms were illustrated and explained:—Hydractinia echinata, Syncoryne eximia, Garveia nutans, Eudendrium ramosum, Tubularia indivisa, Alcyonium digitatum, and Adamsia palliata. The curious Polyzoon, Pedicellina cernua, was then discussed, and after that a series of Tubicolous Annelides, showing various modifications of structure. Special attention was directed to Sabellaria alveolata, which forms large encrusting masses on the rocks at Hilbre Island. Various tubibranch and nudibranch molluscs, including Aplysia, Pleurotranchus. The rare Goniodoris castanea, Eolis, and Dendronotus were then described.

The lecture ended with an account of the blood vessels in the tunic of three genera of Ascidium found at Hilbre Island—viz., Clavelina, Ciona, and Ascidia. The process by which these vessels had become evolved so as to form an organ of respiration in the last-mentioned genus was briefly sketched.

A cordial vote of thanks was given to Professor Herdman on the motion of Mr. W. H. Weightman, seconded by the Rev. Frank Ballard, M.A., and in reply, Professor Herdman said that his chief object in reading this paper was to encourage and promote the study of marine biology.

A conversazione followed, at which a number of subjects illustrative of the paper were exhibited.

The Preparation of Carmine.—Carmine is prepared by comparatively simple processes, yet the beauty of the product depends upon various circumstances which are not generally known, and some of which are even a secret. The temperature of the air, light, the condition of moisture in the air, and other climatic variations, are known to affect the product. According to the celebrated method of Madame Cenette, fine carmine is obtained as follows:—Shake one kilo of best cochineal, in powder, with 75 kilos of boiling distilled water, boil for two hours, then add 25 grammes of pure nitrate of potassium, and after three minutes 30 grammes of acid oxalate (binoxalate) of potassium, boil ten minutes longer, then allow to stand at rest during four hours, and tranfer the liqnid, after settling, into large glass dishes, where it remains for three weeks. At the expiration of this time the mould is removed, the liquid is drawn off as much as possible with a pipette, and the deposited carmine is dried in the shade. According to another process, the cochineal decoction is mixed with soda or potash, afterwards with alum, and the separation of carmine effected by addition of albumen or isinglass. Carmine containing albumen is difficult to reduce to powder, being always somewhat granular, and is chiefly used only by confectioners, as painters' colour, and for red ink, while that prepared with isinglass is quite friable and applicable for rouge and other delicate purposes. "Burnt carmine" is obtained by cautiously heating ordinary carmine in small quantities at a time. It is a dark purple to violet powder, and is distinguished by its remarkable permanence.

ESSRS. KRUPP AND CO. are at present ufacturing for the Italian Government four for a shore battery which will be larger than n the world. Each will weigh 120 tons, charge of 600lb. of gunpowder will be e firing of the projectile of ton. ge is five miles. T f e tested at Mep

SCIENTIFIC NEWS.

THE Dun Echt Circular, No. 100, contains a communication from Prof. Krueger, of Kiel, announcing the discovery of a new comet at Paris on Dec. 1, G.M.T. 9h. 25m. 3s.; R.A., 0h. 39m. 8·5s.; N. Dec., 21° 2' 25". Daily motion in R.A. – 37'; in Dec. – 3'. This new comet is probably that referred to in advices from Paris, which announce its discovery by M. Fabry, of the observatory there, and state that it has a nucleus like a star of the 12th mag. It is in Andromeda, near the square of Pegasus.

Dun Echt Circular No. 101 contains an announcement, received by Harvard College Observatory from Dr. Lewis Swift, director of the Warner Observatory, of the discovery of a comet by Mr. Barnard, presumably at Nashville, Tennessee, on Dec. 3, G.M.T. 15h. 7·2m.; R.A., 4h. 21·9m.; N. Dec., 4° 45'. Daily motion 35' towards the *n.p.*

Signor P. Tacchini, the successor of Padre Secchi, at the Observatory of the Collegio Romano, has published a confirmation of Forel's statement that the sun's corona is, in a clear sky, discernible on high mountains in a surprisingly distinct manner. He himself observed the phenomenon from the summit of Etna at the beginning of July. At Rome, Naples, Messina, and Catania the sun appeared surrounded by a broad white crown; but from the top of Etna, 3,300 mètres above the level of the sea, in a very clear sky, it presented the appearance of a white ring surrounded by a splendid copper-red corona. Near the horizon, the sun's appearance changed into an ill-defined arch of great span. He was able to observe all these phenomena at leisure on two different days. At sunrise and sunset he saw clearly the beautiful red light of the arch. But he is of opinion that those appearances are not so strong and brilliant this year as in 1833 and 1884.

The seventh volume of the *Annalen* of Leyden Observatory contains an elaborate determination by Prof. Bakhuyzen of the rotation period of Mars, which he concludes is 24h. 37m. 22·66s. ± ·0132s. Prof. Bakhuyzen says that changes on the surface of the planet have certainly occurred since the observations of Schröter and the elder Herschel which tend to show that portions of Mars are covered by matter in a fluid condition.

Notes of observations of the meteor-shower of the 27th ult. continue to be received. Mr. A. R. Brooks, observing at Lordship-lane, S.E., counted as many as 468 "meteors" between 8.51 and 9.44, and noted that when one appeared in a certain direction, it was almost without exception followed by three or more in close proximity to its track.

The death is announced of Miss F. Helen Prideaux, M.B., from diphtheria, contracted in the execution of her duties as house-surgeon at the Paddington Hospital for Children. Miss Prideaux was one of the most distinguished of the women who have graduated in medicine at the University of London, having matriculated in the honours division in 1878, passed the preliminary scientific examination in the first division (second-class honours in chemistry) the following year, and in 1881 at the intermediate M.B. examination obtained the first place in honours in anatomy, with the Gold Medal and Scholarship. In 1884, in the final M.B. examination, Miss Prideaux gained a place in the honours list in each subject, and also passed the B.Sc. examination. It is proposed to found an Helen Prideaux Memorial, to take the form of a scholarship or prize, and Lady H. M. Stanley of Alderley, and Mrs. Garrett Anderson are respectively treasurer and hon. sec. of the fund.

The Rev. William Henry Pinnock, vicar of Pinner, died last week in his 73rd year. The deceased was a voluminous writer, chiefly on ecclesiastical laws and usages, but was perhaps most widely known as the editor of those catechisms of the Arts and Sciences which formed the elementary textbooks of the last generation.

The death is also announced of Dr. Tribe, whose name has been for many years coupled with that of Dr. Gladstone in several important researches.

Prof. Giuseppe Ponzi, the distinguished n physiologist, comparative anatomist, zoologist, and geologist, died at Rome on the 29th ult. in his 81st year. Ponzi devoted many years to an exhaustive exploration of the country around Rome, and ultimately produced his celebrated geological chart of the basin of Rome. For many years, too, he was president of the Pontifical Academy of the Lincei, but after Rome became the capital of a United Italy, he founded the Royal Academy of the Lincei, and was elected its first president, a post he retained until failing health compelled him to resign.

Capt. Mangin, the inventor of the system of optical telegraphy introduced into the French army, died the other day, aged 45.

There is now in the Eastern Aviary of the Royal Zoological Gardens a magnificent black-eyebrowed albatross (Diomedea melanophrys), believed to be the only albatross that has reached these shores alive. It is said to be "doing well," and hopes are expressed that some day the Gardens may possess a specimen of the great wandering albatross (Diomedea exulans).

Mr. Eric S. Bruce has received an order to supply his balloon apparatus to the Government.

At an annual dinner of a benevolent society in Belfast last week, the president of the Belfast Chamber of Commerce, Mr. R. M'Gaw, stated that arrangements had been made for the introduction of new French patent machinery, which will supersede the present methods of flax-scutching, and give an increased product of perhaps 40 per cent. Every part of the fibre is said to be taken out in the form of good rough flax.

At a meeting of the Society of Engineers, held last Monday, Mr. P. S. Justice read a paper on the "Dephosphorisation of Iron in the Puddling Furnace," in which he combated the statement that good iron cannot be made from phosphoretic pig in the puddling furnace. In the face of the acknowledged success of the Bessemer, Siemens, Thomas-Gilchrist, and other systems of making mild steel, it has been said that "the days of puddling are gone," but Mr. Justice contends that this is not the case, and that the process discovered by Mr. Beasley, of Handsworth, and fully tested by two years' working on a considerable scale, meets the difficulty by a special treatment of the "fettling" of the puddling furnace, whereby the phosphorus is eliminated during the ordinary process of puddling.

The hatching of fish ova is being prosecuted energetically at the establishment of the National Fish Culture Association, South Kensington, the species chiefly chosen being Salmo fario and S. levenensis. The United States Government have promised large consignments of ova of various species of Salmonidæ, especially of the white fish (Coregonus).

At the meeting of the San Francisco Microscopical Society on Nov. 11th, Dr. J. H. Stallard discoursed on "Lung Structure in Health and Disease," and illustrated his remarks by some fine specimen slides, showing the effects of London smoke and 'Frisco dust on the human lung, the deposit of carbon in the coal miner's lung, fat embolism, tuberculous, and other morbid lung tissue. Dr. Edward Gray, of Benecia, who was present as a visitor, exhibited the curious seeds of Orthocarpus purpurescens, a California plant belonging to the natural order Scrophulariaceæ. The seeds are exceedingly minute, and each is inclosed in a beautiful latticed receptacle, which is very effectively displayed with dark-field illumination, and shows considerable double refractive power when viewed under the micro-polariscope.

The Cantor lecture next Monday, by Mr. J. Mayall, jun., will be on "Objectives, Oculars, and Accessory Apparatus." The exhibition of microscopes will remain open during the period of the delivery of Mr. Mayall's course (to Dec. 21), and admission can be obtained by means of the tickets supplied to members of the Society of Arts.

A Baltimore correspondent kindly sends us the following cutting:—"The New York Central 'flyer' on Thursday, Nov. 12, made a remarkably fast run. It was made up of five cars. Leaving Buffalo two and a half hours late, it went down the nine-mile Byron grade in seven minutes, covered the distance to Rochester, 72 miles, in 70 minutes, and the 33 miles from Batavia to Rochester in 31 minutes, and after a stop of five minutes whirled along to Syracuse, where the time record showed that it had travelled 150 miles in 161 minutes."

We mentioned some time ago that Mrs. Elizabeth Thompson, of Stamford, Connecticut, had left a fund, the interest of which was to be used "for the advancement and prosecution of scientific research." The fund now amounts to 25,000 dollars, and as the income is now available, the trustees are prepared to receive applications for the first grant, which will be made in the early part of 1866. Applications should be sent to Dr. C. S. Minot, 25, Mount Vernon-street, Boston, Mass.

At Wilhelmshaven not long ago, several fatal cases of poisoning occurred from eating mussels gathered from the sides of two ships, and it was readily assumed that the deaths were due to copper. At the inquest it was proved that copper had nothing to do with the effects, and the German Government sent a commission, with Prof. Virchow as president, to ascertain the real cause. The investigation has led to the discovery that the distinctive poison of the mussel is an alkaloid, chemically identical, it is believed, with the deadly juice termed "curara." Another important fact is that the fatalities at Wilhelmshaven were caused by a particular variety of mussel closely resembling the common species, and therefore easily confounded with it. On close examination, however, the poisonous mussel can be distinguished from the common species both by its shell and its peculiar odour.

Railway Accidents. — Major-General Hutchinson, the inspector of the Board of Trade, in his report on the railway accident that occurred on the 28th of September last, at the Liverpool-street Station of the Great Eastern Railway, in which some of the carriages left the line, and 12 passengers were injured, states that the result of the inquiry shows that the accident would have been prevented if the points where it occurred had been interlocked with the arrival signal for the line on which the train was running in, and if that rule had been attended to which prescribes that unlocked facing points should be held when being run over by passenger trains. These points and others in the station, the inspector states, were too far from the signal cabin to be worked from it; but he is of opinion that there would be no great difficulty in bolting them by means of an interlocked lever in the cabin, and he expresses a hope that no unnecessary time will be lost in doing this. In reporting upon the accident which occurred to one of the Metropolitan District Company's empty carriage trains in the Thames Tunnel, on the East London Railway, on the 21st of September last, Major-General Hutchinson states that it was most unsatisfactory to learn, from the evidence of the South-Eastern Company's permanent-way inspector, that shortly after taking over charge of the East London line from the London, Brighton, and South Coast Railway, on the 1st of September, he found no less than 91 broken chairs on the down line, between the bottom of the tunnel and the Rotherhithe end of it, that is, in a distance of about 265 yards, in which distance there would be about 600 chairs. The inspector states that the negligence of the ganger in charge in not having detected this serious state of things was most reprehensible; for, although without removing the rails it might have been difficult, it was by no means impossible, to ascertain whether chairs were or were not broken.

The Steel Production of the United States.—From statistics just published we learn that the production of all descriptions of steel in the United States since 1874 has been as follows:—1874, 241,614 net tons; 1875, 436,575 tons; 1876, 597,174 tons; 1877, 637,972 tons; 1878, 819,814 tons; 1879, 1,047,586 tons; 1880, 1,397,015 tons; 1881, 1,778,912 tons; 1882, 1,945,095 tons; 1883, 1,881,359 tons; 1884, 1,736,985 tons. The principal steel manufacturing State of the Union is Pennsylvania, which, of the 1,736,985 tons of steel made last year, produced 1,157,376 tons.

THE principle of continuous motion used in the belt-saw for wood, has been applied to stone-cutting. Instead of a flat metal band, three steel wires twisted together and run at a very high speed, form the cutting surface. Water and sand are applied in the usual manner with the ordinary flat saws for stone. It is claimed that such saws advance in marble at from 10in. to 26in. per hour, according to the hardness of the stone. It is also used for quarrying purposes, in dividing up masses of stone projecting between recesses in the quarry.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

PHOTOGRAPH OF THE DEBILISSIMA, &c., OF ϵ LYRÆ.

[25082.]—I HAVE just seen a most marvellous photograph of the region round ϵ Lyræ, made by the Bros. Henry with the 13⅜in. telescope described in your issue of June 12, 1885. A map of a small portion of the region in question, laid down from micrometrical measures, will be found on page 40 of Vol. XXXIV. of the ENGLISH MECHANIC (Sept. 16, 1881). The engraver has represented the star E (10·1 in Σ's scale according to Dembowski, 9·5 mag. Dawes) as far too small on this diagram, and there is a flaw in the engraving, looking like a misshapen star, just above J; but the diagram is otherwise correct. On the paper enlargement from the negative by MM. Henry, taken August 12, 1885, the "Debilissima duplex" of Struve is most beautifully shown, the stars being as clearly defined and as round as a dot over an "i" in this letter. The southern "debilissima" is markedly larger than the northern. Not only this, but the far smaller stars, H, I, and J, are most distinctly shown without the slightest optical aid as minute little needle points! These three stars are drawn by the Rev. J. M. Perry in the ENGLISH MECHANIC for September 3rd, 1880. Probably the minuter stars, L and M, would appear on the original negative. The exposure was 120 minutes, and the stars are as round as possible.

Dec. 8. **H. Sadler.**

DUMPY 3in.

[25083.]—IN reading over the letter of Mr. Nelson, upon page 278, I was very forcibly reminded of an expression which a friend once used jokingly to me when I had been telling him something which rather tried his powers of belief. He said, "I will believe any statement which you make, Tom, however incredible it may appear." In the same way I believe Mr. Nelson when he says that he saw Rhea, Dione, and Tethys with a 3in. telescope of 27¾in. focus, "however incredible it may appear."

One naturally wonders, however, how it was that Titan was not visible also, seeing that he is much larger than the three named satellites, and is generally much better placed for observation. I have had a good deal of experience with telescopes, and I find that it is by no means easy to see the satellites which Mr. Nelson mentions, with a 3in. telescope of 56in. focus, so I must congratulate Mr. Nelson upon his excellent instrument and powers of vision, both of which seem to be very much above the average. The powers which Mr. Nelson mentions—namely, 46½ and 67½, also touch one upon a tender spot and excite one's admiration, if nothing else, as I do not remember ever to have seen such a power as a half-magnitude mentioned before. Perhaps Mr. Nelson would kindly inform us how he attained such extreme and unusual accuracy in the measurement of the eyepieces he employs. I am afraid that it is a case of "make believe very much," like "F.R.A.S." says of Mr. Holmes seeing Cassini's division and the crape ring with 2in. of aperture. **Ascalon.**

NEW COMET.

[25084.]—THE new comet was observed 1885, December 4th, at six p.m., Greenwich mean time. The approximate position, as read off the circles of the equatoreal was R.A. 0h. 32m. Dec. 21° North. —The bright stars 54 and 55 Piscium were in the same field, with a low power.

The comet is a faint nebulous body about 2' in diameter, with a very slightly condensed centre, but no stellar nucleus could be made out. The motion is rapid towards the S.W. (that is, towards the sun), and at 9 p.m. the comet had considerably moved from the earlier position.

At 9 p.m. the centre of the comet was close to a 10th magnitude star which appeared involved in the cometic matter, and looked larger and less distinct than when seen on the clear sky three hours previously. **C. Grover,**

Assistant to C. E. Peek, M.A., F.R.A.S.
Rousdon Observatory, Lyme Regis, Dorset.

THE METEORS OF NOVEMBER 27.

[25085.]—IN December, 1872, you printed a letter from me, dated "Jonzac, Charente-Inférieure," giving my observations of the meteors of November 27th. I have now seen a similar display on the 27th ult., from which it would appear that the period of this stream is 13 years. There were, however, differences between the two displays which it may be well to note.

In 1872 the display took place when the radiant was near the zenith, the result being that the meteors fell vertically all over the sky like a cascade of fire. This year the maximum was (probably) between 6 and 8 p.m.; but *certainly* not in the middle of the night, as in 1872. I first saw them at 6.30 (Paris time). There were many detached nimbi about. The meteors were chiefly in the E. and S.E., with paths inclined at about 45° to the horizon; but, of course, there were many others at different angles. The radiant point was singularly obvious one moment, when two meteors started simultaneously from it, one to E, the other to S. The point was in Andromeda, if I mistake not—not very far from the new star.

In 1872 the meteors were all small, but very numerous. This time there were many as bright as Venus; but the number of the whole was less.

At 7 the sky became overcast, and so remained till about ten. I then saw a few up to 11—enough to make a distinct meteor period; but not anything resembling the display at 7.

Numbers of people were out in the streets wondering. I heard a carpenter say it was a comet. It is probable he had stumbled somewhere on the discovered relation between comets and meteor streams: if he had not, it is a curious coincidence between an illiterate guess and the last word of science.

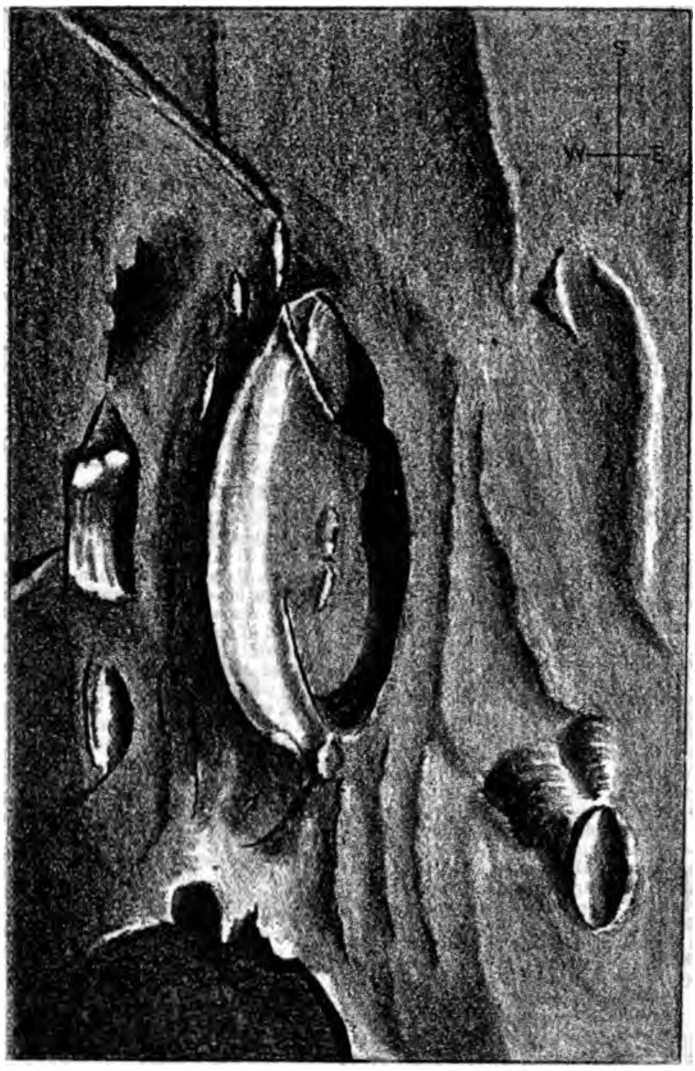
The curé, who is over 75, said he had never seen anything like it. He was snug in bed, no doubt, on the night of the 14th November, 1866, when the maximum display was so superb.

Pornic, Loire Inférieure. **A. P. S.**

SELENOGRAPHICAL—GEMINUS—TROUVELOT'S MURS ENIGMATIQUES—CATALOGUE OF LUNAR CLEFTS.

[25086.]—IN Schmidt's large map two clefts are shown in the interior of Geminus, one on the south-eastern side of the floor running parallel to the foot of the wall and terminating apparently at the base of the south-western wall, and another very similarly placed with respect to the north-western border. Neither of these objects appears to have been recognised by English selenographers, though from the quarto introduction to Schmidt's chart it seems they were recorded by him more than twenty years ago, viz., on 12th February, 186[illegible]. The accompanying drawing of the ring-plain and its surroundings, made between 9h. and 10h. on [illegible] September under favourable conditions of libration and definition, shows these clefts. At the time I was unaware of their existence in Schmidt's map. That on the southern side of the floor was distinctly traced from the shadow of a peak on the eastern wall across the interior and up the inner slope of the opposite border to the summit, which it clearly traverses terminating at a large but much foreshortened crater on the exterior glacis. In its course it is joined by what seems to be a short branch running from the southern wall. Though Schmidt draws this object as ending at the foot of the inner slope, he shows a short cleft, a probable extension of it, beyond Geminus on the south-west. Of this no traces were seen. The cleft-like valley running from the foreshortened crater towards the south-west (marked *zeta* in Neison's Map IV.) was a prominent feature. The cleft on the north-west quarter of the interior was also easily detected. At times of best definition I fancied that it extended much farther along the foot of the inner slope of the western wall than the drawing shows. With a power of 340 on 8½in. Calver it appeared to be very irregular [illegible] width, and was traced nearly to the summit of [illegible] north-east border.

It is to be hoped that lunar obser[illegible] attempt to verify the remarkable obse[illegible] recorded in *L'Astronomie* for June last [illegible] Trouvelot, of Meudon, relating to sp[illegible] noticed by him mostly in connection [illegible] In the case of the ring-plain Eudoxus, [illegible] a narrow line of light crossing the [illegible] tion of the formation from wall [illegible] bordered by shadow on both sides e[illegible] east wall, where the shadow was [illegible] the northern side. There is no r[illegible] the site of this luminous line, an[illegible] To what was it due? Any [illegible]



phenomenon based on the supposition of a ray of sunlight shining through a small fracture in the west wall of Eudoxus (the observation was made during morning illumination) is, as M. Trouvelot points out, negatived by the fact that the thread of light was more brilliant than the contiguous parts of the floor which were illuminated by the sun. Were this a solitary instance of the phenomenon, however, it might be disregarded; but M. Trouvelot describes in detail other cases where similar appearances were observed. Among these he mentions the south-eastern section of the prominent cleft which commences north of Burg, and that under the south-east wall of Aristarchus, shown in my drawing published in the ENGLISH MECHANIC, Vol. XXXVIII., page 448. In both these instances a delicate line of light was observed which resembled a narrow wall of rock rather than a cleft. I may here direct attention to the case of the curious cleft connecting Cardanus and Kraft. When this object is on the morning terminator, its western border, evidently a more or less lofty bank, stands out as a bright line of light, while its surroundings on either side (except the illuminated eastern slope of the cleft) are in deep shadow.

As observations of lunar clefts accumulate, it becomes more and more probable that the idea of the intermittent visibility of many of these features rom some at present unknown cause is based on act, and cannot be explained away by appealing to ferences in atmospheric or other conditions. e re-discovery of many of Gruithuisen's clefts, supposed to be merely inventions of his lively ination, and the unexpected appearance, as easy objects, of clefts in places which have ently been searched in vain for a trace of are circumstances difficult of explanation on the hypothesis of actual change either in fts themselves or in a medium which over- s them.

am preparing for publication a catalogue r clefts, which will include the more recent ies of Schmidt and other selenographers, feel under great obligations to observers l kindly furnish me with any notes or relating to these objects.

Thos. Gwyn Elg

9th November

THE WIMSHURST INFLUENCE MACHINE.

[25087.]—I WAS much interested with the theory propounded by Mr. A. J. Walker, and communicated by Mr. J. Wimshurst in letter No. 25054. With all due deference to these gentlemen, I beg to submit a theory based on a different principle of statical induction. I will first describe an experiment which will illustrate the principle to which I have referred.

I took a metal disc about 9in. in diameter, and having carefully insulated it, gave it a charge of + electricity. Next I suspended a small metal ball by a silk thread in order to insulate it; bringing this in contact with the centre of disc, it took a charge of + electricity at the same potential as the disc. On now bringing the ball in contact with the knob of an electroscope, it shared with it its charge of + electricity. The ball was next brought within ½in. of the surface of the disc, and touched with the finger in order that it might take a charge of – electricity inductively. On bringing the ball again in contact with the knob of the electroscope, I invariably found that this second charge of – electricity was much greater than the charge obtained by direct contact.

We thus see that the potential of the charge communicated by induction will depend upon the relative sizes of the charged surface and the surface-receiving charge. If the surface-receiving charge inductively be small as compared with the surface acting upon it, it will receive a charge of the opposite kind of electricity at a higher potential than the charged surface. If the surface-receiving charge be larger than the one acting upon it, the potential will be lower than the charged surface. In both cases the charge received inductively will be smaller in actual quantity than the charge producing it: but it is potential (that is quantity per unit of surface) that we are dealing with.

Let us now apply this principle to the influence machine. We may leave the action of the prime conductors out of consideration because, as Mr. Wimshurst has frequently pointed out, the machine will become charged when they are removed.

Assuming that a small difference of potential exists among the various sectors, and that by working the machine this has become distributed over the various parts of the machine, how can this small charge be increased so as to produce self-excitation and continuous working?

Let us fix our attention upon the sectors in contact with the brushes at H and C respectively. (The letters refer to the diagram published with letter No. 25054.) In consequence of being connected together with the metallic rod D B they will be in a most favourable position for receiving opposite charges of electricity. The sector on the back plate at H will not only be acted upon inductively by the sector at A on the front plate immediately opposite it, but also by the two adjacent sectors on either side of the one at A; thus three sectors on the front plate at A will concentrate their inductive effect upon the one sector on the back plate at H, and will consequently impart to it a charge of – electricity at a higher potential than the + charge on the sectors at A. This action takes place successively with each sector as it comes in contact with the brush at H.

The charge of – electricity on the sectors at the point Z will act in a precisely similar manner on the sector at C, in contact with the brush, imparting to it a charge of + electricity at a higher potential than that possessed by the sectors at Z.

The working of the machine will bring the sectors which have received an increased charge of – electricity at H (as above described) into the position at W, where they will now act the part of inductors to the sectors on the front plate at S. The three adjacent sectors on the back plate at W concentrating their inductive effect upon the one sector in contact with the brush at S, will impart to it a charge of + electricity at a higher potential than the charge of – electricity possessed by themselves. Precisely similar reasoning will apply to the sector receiving a charge of – electricity at T. But the sectors receiving charge at S on the front plate are carried by the working of the machine to the position at A, thus completing the cycle of operations.

We thus see that there is a tendency for each sector to take an augmented charge of electricity when in momentary contact with the metallic brushes, in consequence of three sectors on the opposite plate concentrating their inductive effect upon it at the same time, which action is equivalent to a larger surface acting inductively on a smaller surface.

This increase of charge goes on until the limits of insulation are reached.

If the above theory be correct, it will be seen that the self-excitation and continuous action of the machine are independent of any action which takes place at the prime conductors K K and L L.

The charges of + E. possessed by both plates at K K render them capable of being freely imparted to the prime conductor at this point, and similarly the charges of – electricity possessed by both plates at L L render them capable of being freely imparted to the prime conductor at this point.

Old Smings.

THEORY OF THE WIMSHURST INFLUENCE MACHINE.

[25088.]—MR. WIMSHURST has added to the debt of gratitude many of us owe him, by kindly communicating the theory of this machine as furnished to him by Mr. A. J. Walter, LL.B., and his having procured the opinion of this gentleman proves his desire to fully elucidate the matter. Thus, I do not think he will consider me captious if I direct his attention to some little facts not quite consistent with the theory of Mr. Walter. This theory is "that assuming an insulated sector, carrying a charge of + E., to come opposite another sector in contact with a brush, the + E. is repelled from the sector in contact, and – E. is held bound." So far this seems indisputable; but where does the repelled + E. go to? Mr. Walter thinks to the brush at the opposite end of the neutralising rod. Why go there in particular? The plates being neutral, at first have no attraction for it. The rod is not insulated, and the repelled + E. may turn in through the spindle and be lost in the frame, or may go along the rod of the other plate to a brush where it is not wanted, and where it would certainly set up an adverse excitement. Does our experience of high-tension electricity lead us to think it so obliging? No. Besides, what if there be no connection between the brushes at all—will the machine work? Yes; even if the brushes do not touch sectors on opposite parts of the plates at the same time. All that is wanted is "that the brushes afford free passage to electricity to come and go as it will." This, Mr. Wimshurst's arrangement does effectively. It is symmetrical in appearance, easy of adjustment, and hard to beat; but it is not a necessity.

Of course, in making these statements I may be supposed to have the proof before me and I have. Living in the West of Ireland, it would be useless to offer it for inspection; but I can describe the machine for others to construct similar ones, and to contradict me if I am wrong.

The machine has 24in. discs of common window glass. There is no spindle through them; they are not bored; they are set on independent axles on separate standards, they work in deep slots cut in the standards and have driving pulleys external to the standards, so that a driving band can be slipped off and a plate taken out in a moment. This allows the standing plate to have its E. fully examined. The brushes are attached by stout wire to the mahogany frame, but have no metallic contact with each other; they do not touch opposite sectors at same time. The machine in this condition is before me, and is in full working order. I think the theory is not far to seek, and requires no knowledge that is not 40 years old. In giving it I must state much of what is already known; but I think I shall state nothing that is not easily comprehended and easily proved.

On removing the conductors and turning the handle a few times, a drag is felt. The plates seem to encounter some resistance, invisible but there. Several hands being held near the plates, the drag is reduced, and sparks fly freely from certain parts of the plates, while other parts of the plates seem devoid of electricity, thus the plates would appear to be divided electrically into four segments marked by the four brushes. The top and bottom segments seem to have no electricity while the right and left segments have plenty. Reverse the handle, the machine works again; but this time the segments are reversed, the top and bottom segments giving sparks, the lateral segments giving none. Remove the back plate and examine the front plate with the knuckle: it gives a small spark from every sector not in contact with, or quite near to, a brush. Examine with charged electroscope, the plate seems electrically divided *not* into four segments, but into two semicircles marked by the two brushes of the plate. The left shows, say, − E., the right + E. (This is not always the order.) On replacing the removed plate and again working the machine, we now remove the front plate and examine the back one. The shape of this plate is the same as the front plate exactly. The right and left semicircles hold the same electricity as the right and left semicircles of the front plate. Whence come the dormant segments! It is clear that the semicircles must overlap, as the brush rods cross and the electricity is bound in this overlap, as Mr. Wimshurst states, and as we can prove by a proof plane and electroscope.

Thus, no matter how we turn the handle, there are two segments in which electricity is free, and two segments in which it is bound. From which segments does the electricity arise? To find this out we apply forked conductors to the free segments. The machine works still, but the handle drag is less while the conductors discharge. We then remove the conductors and apply them to the bound segments, the machine at once ceases to act. What do we gather from this? That the electricity is developed by the bound segments which are thus the charging segments, and its potential is raised or lowered by the amount of electricity in the free or discharging segments. Now, what determines the position of these charging segments? The position of the brushes; one rule is ever followed: the charging segment for each plate has that plate's brush at the entrance, and the opposite plate's brush at the exit. Mark this well. Now assuming a sector charged with + E. to be coming out of the charging segment, it must pass a sector of the opposite plate, which sector is in contact with brush; the sector in contact being free to dispose of its electricity while the charged sector is insulated, the result must be that the + E. of the sector in contact will be dispelled through the brush, and − E be held bound. The sector in contact with brush must be about to enter the charging segment, and when it does so it becomes in turn insulated and retains its charge of − E. It passes on and effects a transient influence on such insulated sectors as it meets, until at its exit from the charging segment it in turn passes a sector in contact with a brush. This it in turns makes + and soon all the sectors of the charging segment become excited, and as they leave that segment they come charged into the discharging segments; but as only one plate leaves that charging segment at either side, only one plate at either side can be charged by it. We must have the other charging segment excited to produce a general effect. Now, how is the other charging segment excited? Mr. Walter's theory would explain, but the basis of that theory is taken away. It is clear that a sector cannot enter a charging segment without contact with a brush, and therefore cannot carry its charge beyond that brush; besides, the charge it would carry would be the wrong one, for, say the back plate comes down with — E., it is found to be + after passing the brush into the charging segment. How does this come about? Remember, no sector can get into a charging segment without being discharged. Let us examine the plates carefully with charged electroscope, stopping the machine and slowly setting it agoing. It will be found that if the machine be not self-exciting (its normal condition in my climate) and that we start the back plate at the top with a + charge, no sooner do the charge sectors come down near the brush of the lower charging segment, than the front plate, before neutral, shows + at its exit from that segment. Does not this clearly show that the + E. of the down-coming back plate drives back the + E. of the up-coming front plate? and thus raises the + of the front plate at its exit from the charging segment. But here a brush is found on the opposite plate. Let the driven back + E. but induce the sector in contact with that brush, and the next moment the induced sector passes into the charging segment insulated and the fort is taken. One half revolution of a plate can do this.

Now the question arises, Has glass the capacity to have its electricity hunted to and fro over its surface without parting it to the air. It has, if smooth; but it does it slowly, and apparently with effort. Proof: Take two Leyden jar condensers; charge them to saturation for some time; take them in hand, and bring the outside foils together; then touch together the two brass balls connected with the inside. The jars discharge. Hold them together for a moment so that they may discharge thoroughly; then place them on the table or finder for half a minute. Try the same course with them again: they have recharged themselves, and will do so again and again if there is much glass uncovered. The explanation is easy. The foil-covered glass could not carry all the E. sent to it. It spread over the uncovered glass, and when the foil-covered glass is emptied the E. which was turned out comes back to the empty house; but remember it comes back slowly. This fact is material.

Now we have got all the sectors charged to the same potential as the initial charge, less waste—no more, and if the action stopped here this beautiful machine would never have been heard of; but the potential rises with surprising rapidity. How is this accounted for? A plate comes out of a charging segment carrying its feebly charged sectors, and in one revolution there is a blaze at the brush. It would take the aggregate electricities of all the sectors to make that blaze. Just so; that's what happens. The aggregate electricity is all driven together. The sectors no longer play a first part; they become valets, and help the plates to doff and don electrical garments at each brush, for the electricity is driven along glass and sector by the force of the hand which revolves the plates past each other in defiance of the similar electricities which don't wish to so pass. Any plate leaving a charging segment meets another plate coming in; both plates are similarly charged; what must happen? Each electricity drives back the other, and the potential of each rises, for the supply is ever coming on from behind. This only makes the resistance greater, for each charging segment is turning out a plate charged up to its own potential, and that potential rises as the electricity is driven back on it. What is the upshot? The glass plates drag a certain amount of E. past each other to the rakes, where they only too gladly turn into side channels; or if the charging segment be too small—that is, if the brushes be too close—the E. is driven back as far as the brush and escapes, when the potential falls in proportion to the escape, or if any aid, like a ring of moisture, assists the E. to run along the plate faster than the plate travels, why the potential falls lower every moment, and the machine is reduced to its first puny induction efforts, which soon die out from leakage. All this may be tested by anyone making a machine without glass, or some such sluggish conductor, between the sectors. These may be placed on strips of glass set like spokes of a wheel. This machine will soon show how idle it was to ever suppose a little sector, with surface equal to a thimble, could by itself carry round one-third of the plate a static charge of electricity which would be anything but the merest moiety of what streams from it as it discharges the glass around it. "How is this?" says some electrician. "If sectors are mere collectors at this stage, and that rakes discharge them for one segment, why won't rakes discharge them for the other segment, and why need brushes?" Exactly so, sir; when the machine is in full excitement the brushes may be removed and rakes substituted. With these the machine works briskly. I only use the pointed wire carrying the brushes for this experiment. I can stop the machine to take off the brushes, and its potential will not fall too low to start the machine again. Of course, if the excitement is allowed to cool down to the puny sectorial induction stage, a rake distant half an inch cannot neutralise a sector with the very feeblest little charge.

Mr. Wimshurst remarks that the tension seems higher near the brush, as the sparks are greater there. This is owing to the discharged sector offering a place to the high tension E., which is near it, and which leaps along the glass to the opened passage. The same thing can be seen if you cover your jars inside an inch or two higher than outside. This naked inch or two shows the E. at every discharge leaping along its surface, because it can't go through the glass fast enough.

Mr. Wimshurst says, that with very many sectors the machine is more self-exciting. I have not tried this; but I accept this statement as indisputable, and I can understand that when sectors are needed to spread or collect a feeble charge over the glass, the more sectors to help, the quicker the work; but I shall be much surprised if the Leyden jars can show as high tension when the sectors are close enough to allow the glass to be dragged round, while the repelling electricities won't pass each other, but leap the spaces between the sectors like phosphorescent squirrels in their revolving cages. That much light in the dark would ensue, and little work with the jars I would suppose to be the result. I have not tried it.

In the foregoing I have spoken of glass as the material of the discs or plates, because glass was the material I used in my experiments: but I have noticed exactly the same properties in ebonite when experimenting some years ago with the Carré machine.

Roscommon, Dec. 1st. **F. Taaffe.**

FUSING POINT OF ALUMINIUM.

[25089.]—IF a scrap of thin sheet aluminium be heated alongside a similar piece of silver foil on charcoal B.B., the former will instantaneously begin to "droop," and then (without fusing) be slowly oxidised into alumina; whilst the latter, after becoming red hot, will occupy a perceptible interval of time before fusion into a ball. From this result it might be alleged that the fusing point of Al was almost infinitely lower than that of Ag; but if the operator takes a ½lb. of each metal, and very strongly heats a corner only of each fragment, supported on a slab of iron, such as a smith's anvil, he will find the silver corner begin to "run" long before the aluminium one; if, indeed, the latter can be thus "reduced" at all by anything short of an oxyhydrogen blowpipe. If the first experiment is to be taken as a proof of the fusing point of aluminium, it must be admitted that this is lower than that of lead, or even of antimony; if the second is considered a fairer test, it cannot but be observed that the capability of aluminium to withstand fusion is in direct ratio to its power of heat conductivity, both being above those of silver. This appears to be also true with regard to some other metals than aluminium; as follows*:—

	Mean Conductivity °C.		Fusing Point °C
	Calvert and Johnson.	Wiedemann and Franz.	Ice = 0.
Ag	1000·	1000·	1022·8 (Daniel
Sn	422·	145·	232·7 (Person
Na	365·	—	103· (Regnau
Pb	287·	85·	326·2 (Person
Bi	61·	18·	266·8 (Person

N.B. The extraordinary discrepancy between the conductivity results of the English and the German operators (amounting in the case of tin to 277° C.) may be here observed.

I do not consider the "surprise" of, and the novelty of information to, the writer of letter 25076, ENGLISH MECHANIC, No. 1,080, p. 282, to subjects of scientific discussion in your paper, and therefore, make no remark regarding them: but Sir Henry Roscoe's statement as to the comparative fusing points of Al and Ag was probably merely copied from some authenticated table published before the superiority in heat conduction of Al to Ag was established.

At all events, in that author's beautiful work on Chemistry, the following (now known to be) erroneous statement is made:—"Most metallic oxides dissolve in fused boron trioxide at a red heat; many of them imparting to the mass characteristic colours." This comes of republishing statements from books before testing their value by practice.

W. A. Ross.

NEW PEDAL ACTIONS FOR HAR-MONIUMS.

[25090.]—IN Vol. XLI., of the ENGL[illegible] MECHANIC, I described a new pedal actio[illegible] American organs. As that arrangement w[illegible] suitable for harmoniums, I thought it might [illegible] interesting and useful if I described [illegible] pedal action suitable for harmoniums. I [illegible] send sketch: D D shows pedals, which [illegible] actuate [illegible] pallets P; S is the stem, and C th[illegible] touch-spring, as it is usually call[illegible]ed; E [illegible] action rail, W the wind-chest, and [illegible] which the indiarubber tubing by [illegible] conducted to the reeds. [illegible]

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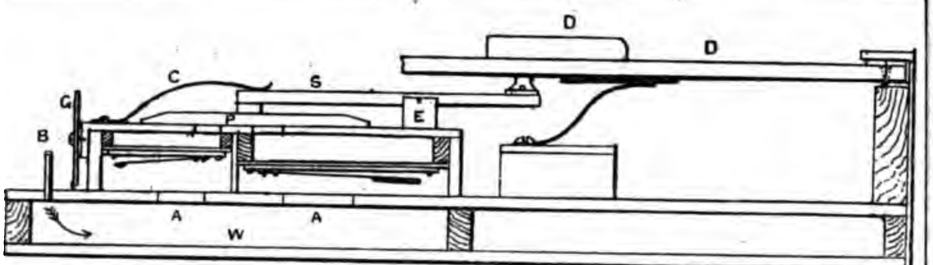
* *Phil. Transactions* [illegible] Miller's "Chemical Ph[illegible]



windway to reeds (two sets respectively) of 16ft. and 8ft. pitch. The soundboard, which is shown in sketch, should be hinged at the front, so as to swing back to gain access to vibrators for the purpose of regulating and tuning.

The wind enters in direction shown by the arrow; G shows one of the back-hooks by which the soundboard is held down at the back. It is scarcely necessary to say that the pallets should be covered over by a suitable air-chamber, so as to subdue some of the harshness which would predominate if the pallets were exposed. On top of the soundboard chamber a shutter may be hinged so that, by this means, a soft and loud effect may be obtained.

The other portions, shown in sketch, will be easily understood. **G. Fryer.**

SINGLE-PORTED SLIDE-VALVE.

[25091.]—

Y = half-travel = S + L = not less than P
S = opening to steam = Y − L
E = opening to exhaust = at least P
  = M − Y − b = W − Y + b
P = width of cylinder-port
L = lap
A = P + L
M = E + Y + b = W + 2b
W = E + Y − b = M − 2b

FIG. 1.

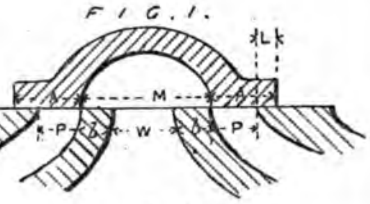
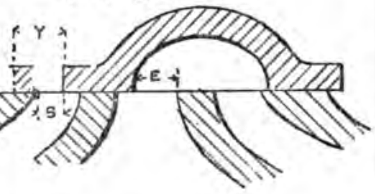


FIG. 2.



The area in square inches of the cylinder-port, P, must be at least $C \times \frac{v}{6{,}000}$

where C = area, in square inches, of the piston
V = velocity of the piston in feet per minute.

S may be about ⅔rds of P.

For values of L see my reply to query 57511 on page 126 of this volume.

There is a slight misprint, which I have pointed out, on page 145. **Glatton.**

GASOLINE GAS, AND THE OTTO GAS-ENGINE.

[25092.]—I SEND you an account of an Otto gas-engine which has been worked for three years with gasoline gas, at a cost of about £6 per year. Some three years since I bought of Messrs. [illegible]rossley, of Manchester, a one-horse Otto gas-engine. I also purchased of Mr. F. W. Clark, of [illegible]ndon, one of his patent gasoline gas apparatus, [illegible] condition that if it would not drive the engine [illegible]as to be returned.

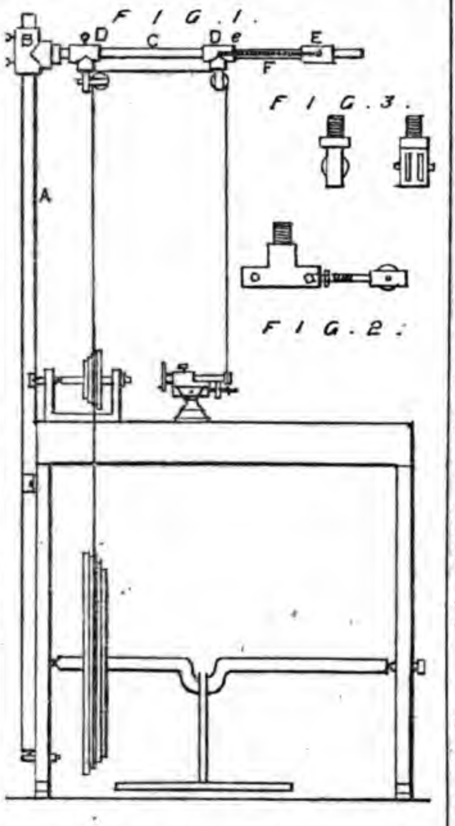
[illegible]he engine did not at first work quite satisfactorily, but I felt convinced that it could be [illegible] to do so. I concluded to keep the gas apparatus, and I then began to experiment with the engine, and for upwards of two years it has [illegible] to my entire satisfaction. In summer time [illegible] light the gas apparatus, and have the engine [illegible] ten minutes, and in one minute can stop [illegible]paratus, leaving both perfectly [illegible] in very [illegible] your gas, and you will have no further trouble. I have two copper boxes (through which the gas passes to cylinder and slide lights) fixed on the top of the retort, and the waste heat from making the gas is sufficient for this purpose. I also heat the water in the jacket of cylinder to about 100 deg. by having a Fletcher's gas bath-heating apparatus between cold water supply tank and cylinder, so that I can shut off the cold water when necessary. If any of your readers will do the same, they will have no difficulty in working the Otto gas-engine with gasoline gas.

William Wright.

Fiskerton Manor, near Newark.

A CHEAP OVERHEAD.

[25093.]—FOR the benefit of amateurs and others I send you a rough drawing of a cheap overhead which I made about three years ago, and found it answered my purpose very well, remains now as good as ever, and works beautifully steady. The materials cost me but a few shillings. The overhead consists of a galvanised gas-pipe upright, Fig. 1, A, about 7ft. long and 1¼in. diameter, and another smaller pipe about 3ft. long and ¾in. diameter; for the bar (Fig. 1, C) screwed into a piece of iron 1in. deep, turned and cut screw outside to fit the T-tube, Fig. 1, B, of which the screwed hole I had bored throughout smooth so as to slide up and down the vertical pipe Fig. 1, A, and is fastened with two screws at back, any height to tighten the gut line. The horizontal bar, Fig. 1, C, has two smaller T-tubes. Fig. 1, D D, made like that, Fig. 1, B, to slide forward and backward. The first one is held fast by a screw at top to keep the gut upright, and the other to move loosely, and held by two indiarubber door springs, Fig. 1, F, (shaded) by two screws through their eyes into it at both sides; the other two eyes of the elastic at Fig. 1, D *e* are fastened on a short tube, Fig. 1, E, which must be made tight on the bar Fig. 1, C, by two more screws through them. If the T-tube, Fig. 1, B, is found too thin to hold the screws, two stout, squared rings may be put on at top and bottom tapped for them. Fig. 2, A, represents a piece of iron forged and filed flat, 1in. wide and ⅜in. thick, with a screw at top for Fig. 1, D, and two holes about 2in. apart to hold a pair of iron pieces, each of which (as shown Fig. 2, B) holds a brass pulley in a slot about 1¼in. diameter, and $\frac{3}{16}$ or ¼in. thick; is fastened with a nut; the end being round, can be sloped at any degree to facilitate running of the gut line. Fig. 3 is another piece of the same metal turned and screwed for Fig. 1, D *e*, with a pair of brass pulleys of the same sizes as the others, in a double slot. The first is the side, and the other the face. **William Simmons.**



[25094.]—OUR correspondent, "Tuebor," in letter 25035, page 260, recommends *rubbing* bands with rosin. My plan is to dissolve the rosin in methylated spirit, and soak the bands in it; and I find it answers very well. **Volt.**

OVERHEAD GEAR.

[25095.]—IT would have been better had I stated in my description of overhead that the grip of the driver pulley is sufficient for all purposes, being simply a question of the weight on the suspension pulley and the strength of the endless cord. For light work running direct over the bench I use a 1lb. weight, over the jib 2lb. The suspension pulley weighs 2oz. The groove in the top bar was milled with this apparatus; in fact, curious as it may appear, more can be done in that line than by any form of overhead I ever saw. Were it necessary, the cord could be passed completely round the driver by taking the spindle out of its centres for the purpose. I have done this as an experiment, but found it unnecessary in practice, unless you wanted to drive a circular saw; then, perhaps, you would have to adopt the expedient.

The principle of the fast and loose pulley is not my invention, as it is adopted by one of the first lathe makers in the kingdom for driving, milling, and other cutters. It might be advantageous to have these pulleys 9in. or 12in. in diameter, very light; but I have not tried it.

As an ornamental turner, I know of no reason why the overhead should be where the London makers usually place it—i.e., up above: I think they are wrong; but most lathe builders, and the London ones in particular, are very conservative in their plans. It pays the best, perhaps, and for that reason most improvements emanate from amateurs. Be it remembered there exists a large class who are skilled mechanics, having served apprenticeship as such, and who practise turning *con amore*.

Mr. Evans, I am sure, would not hesitate to make an overhead after my pattern should he be asked to do so. When I described it to him recently, he said, "Ah, we all think our own coals the blackest"; but, for all that, Mr. Evans is not slow in taking up an improvement, and I should like to see his opinion. "Faber" suggests that my universal cutter must be very tall—it stands 2in. above centres, thus allowing a bare 4in. of material swung between poppets, without impeding the cord. As for additional friction, it is well-nigh impossible for any form to run with less. The remarks of "O. J. L." are appreciative. He is right: the endless cord is the thing.

Can any of the lathe contributors tell us how to fly-cut spirals in the lathe without change-wheels or spiral chuck? It can be done, and in such a simple and correct manner as to be really ludicrous, when one considers the elaborate apparatus usually made for that purpose. By a misprint my first letter was signed "Trebor." It should have been— **Tuebor.**

LATHE MATTERS.

[25096.]—TO-DAY'S ENGLISH MECHANIC is a good one; just the sort of number to delight the hearts of amateurs. The lathe is again to the fore, and all the details brought forward for discussion are of interest. Mr. Ashton's counting apparatus, described by Mr. Evans, will, if adopted, remove one serious obstacle to the use of the division plate, and will save the eyes a vast deal of very trying and sadly injurious work. The worst of all such contrivances is that they cannot be very cheaply made; but, then, customers of Mr. Evans and his rival are not likely to mind the outlay. I am also glad to see engravings of Mr. Brown's new rest, as my own drawings were merely by way of introducing the stranger—a new member, who is pleading for a seat on somebody's lathe bed, and is pretty sure of election. But I do not let go of my long-sustained opinion, that all combination tools are defective—necessarily so, indeed, and that they never can efficiently supply the place of two machines, each exactly suited for its intended purpose. The suggestion about the wear of the main screw is a case in point; but so far as a combination rest may be desirable, I certainly consider this a very good design. Our many critics will point out its defects if they exist, and I can answer for the maker as a man ready to adopt any improvements that may be suggested. Will some one kindly say if there is any drawback to a scroll chuck with four jaws instead of three, so that by removing two it could be used as a two jaw chuck for holding square work, for which one pair of such jaws could be specially shaped? The present chuck will not hold any square work. The drill holding jaws of a four jaw would have the gripping angles filed to 45 degrees each, and would thus meet quite closely, just as the three jaws are filed to 60 degrees. There are many cases in which such jaws would be convenient, and, strange to say, a two jaw chuck in Churchill's catalogue is more costly than one with three jaws. **O. J. L.**

SMALL APERTURES.

[25097.]—AS Mr. Calver declines replying, will you allow me to ask "F.R.A.S.," Mr. Sadler, or any other reader to kindly look at letter 25012, and give such information as they can in reply?

Re the question of magnifying stars, Mr. Calver (25075) says, "Small apertures show the spurious discs larger than large apertures." In the same paragraph he says, "The image of a star remains practically the same, no matter the telescope or power used." Will he kindly reconcile these statements, or explain wherein the image of a star in a telescope differs from the spurious disc?

Allow me to inform Mr. Franks (25074) that *everyone of the expressions he calls personalities and exhibition of feeling are his own, verbatim.*

I thank Mr. Sadler for his information *re* β 82. On a second look I found thick atmosphere had caused me to misjudge the distance, and that it was at least twice my first estimate. Mr. Sadler has been always very kind in his communications.

It would benefit a considerable number of eminent contributors if they would go through some elementary work on optics and a few practical experiments. It might prevent our being so often told that the nature of telescopic definition is different when bodies having sensible size are looked at, and when stellar points only are observed. I have repeated a number of times that all vision with unaided eye, microscope, or telescope is of exactly the same kind, and subject to exactly the same rules and considerations. We have not two kinds of sight, but one kind only. I shall be told that everyone knows this; but it is theoretically only, and, practically, we are told often, as by Mr. Calver this week, that sensible surface alters the conditions. It would be of much value if you, Mr. Editor, would reproduce an article by the Rev. Mr. Webb, which appeared in the "E. M." of June 10, 1870. I quote one or two sentences, but the article is well worth reprinting as a whole; Mr. Webb had real and exact knowledge underlying his statements, and not the mere confused, dim appreciation of scientific truth possessed by many who think themselves authorities, and are thought so by others: "The natural outlines and boundaries of heavenly bodies become sensibly mathematical lines. But the mathematical line may be considered as composed of an infinite number of mathematical points, and its telescopic representation will therefore be equivalent to an infinite number of spurious discs, each with its attendant series of rings." "The surface itself, mathematically represented by an infinite number of points, will produce a luminous image composed of an infinite number of overlapping spurious discs." "Every line being referable to an infinite number of points, and every surface to an infinite number of lines, we have at length a clue which will guide us through all the details of telescopic definition." "As long as the power employed is insufficient to give a sensible magnitude to the radius of the disc, so long the sharpness of outline continues apparently perfect; but under the same conditions of magnifying, which render the spurious disc large enough to affect the eye with the idea of size, we shall find the hard definition of outlines begin to fail." "We may, however, remark that the sharpness of planetary definition always is in proportion to the size of the telescope, the diameter of the spurious discs on which it depends varying inversely with the aperture." Mr. Webb clearly saw the oneness of vision under all circumstances, and that it was not, as Mr. Calver imagines, subject to various laws of definition according to the object looked at. Every circumstance connected with this matter will be found considered in the article referred to by Mr. Webb, and any correspondent who remarks on this matter will do well to read it before doing so, as he will thus avoid attributing to me opinions I do not hold, or saying I have not considered some matters which I omit on account of space, but which Mr. Webb describes fully. My opinions on the matter are identical with Mr. Webb's, with a very slight modification of one or two expressions. **Edwin Holmes.**

MR. BROMLEY'S SINGLE EXPRESS ENGINES ON G. E. R.

[25098.]—FINE engines as the late Mr. Bromley's 7ft. 6in. "singles" undoubtedly are, they are not capable of performing the feat attributed to one of them by a correspondent (letter 24713, p. 14) of taking 19 vehicles from Liverpool-street to Colchester (51¾ miles) in 50 minutes, including the ascent of the Brentwood Bank of 1 in 93, and 15 miles of constant rise. It is simply an impossibility, and some mistake must have crept into the reckoning. I have found 70 minutes very good work for such a load over such a road. Your correspondent is wrong at the outset in stating the "schedule time" as 65 minutes. The time allowed is 71 minutes, and that is little enough in the circumstances. I have records, however, of some admirable work being done by these engines, and may, perhaps, send some on another occasion. It does no good to place on record manifest impossibilities, and, therefore, I deem it well to correct this obvious error.

Wellington, N.Z. **C. Rous-Marten.**

LONDON AND N. W. COMPOUND LOCOMOTIVES.

[25099.]—IN reference to Mr. Seaton's letter, No. 25078, respecting above, it would be interesting no doubt to your readers if Mr. Seaton would give us further particulars and dimensions of these new goods engines.

Great Northern Engines: Perhaps some correspondent can inform us what trains the new 7ft. 6in. singles are intended to run. Are they built to replace the old 7ft. engines? They are surely not intended to supersede the 8-footers—a hard task indeed.

I trust you will be able to find space for this letter in your columns. **W. C.**

GREAT NORTHERN 7ft. 6in. ENGINES.

[25100.]—SEVERAL questions having been asked about these engines, I send all the dimensions that I know of No. 232, which was turned out on August 1st:—

Diameter of cylinders, 18½in.; stroke, 26in.; diameter of driving wheels (single), 7ft. 7½in.; diameter of leading and trailing wheels, 4ft. 1½in.; wheel base, centre of leading to centre of driving wheels, 9ft. 9in.; wheel base, centre of driving to centre of trailing wheels, 8ft. 1in.; boiler (all steel), blows off at 150lb.; boiler, length of barrel, 10ft. 6in.; total heating surface, 967·8 sq. ft.; framing, 1¼in. steel; weight on driving wheels, 17 tons. Total weight of engine (full), 39 tons 15 cwt. Outside bearings to leading and trailing wheels, inside bearings to driving wheels.

Two of these engines are at work, and I am informed that two more are ordered with larger boilers. **G.**

COMPOUND LOCOMOTIVES.

[25101.]—I OBSERVE, from letter 24713 (p. 14), that the Great Eastern compound engines designed by Mr. Worsdell are now coming in for their share of depreciation—I think undeserved. I made several trips with the first of the series (No. 230) during my inspection of the English railways in the early part of this year, sometimes behind her, and sometimes on the footplate, and the result was, to my mind, very favourable. I have no means of testing the records of her coal consumption; but her work was certainly excellent. Fast and heavy trains were run, in every case, to time, and over heavy gradients. One run with the 4.25 p.m. Colchester train, which stops at Brentwood, I thought particularly good. There were 12 vehicles, and the evening was foggy and frosty, the rails very greasy. No. 230 drew this train from passing Stratford to stopping at Brentwood, up-hill all the way, and including the ascent of the steep Brentwood bank of 1 in 93, in 19 minutes, the 5¾ miles of severe gradients from Romford being done in 8¼ minutes, including slackening and stopping. The start from Brentwood on the sharp ascent was made with perfect ease, and after passing the summit, the next 10 miles of slight descent was run in 9½ minutes, of which the last six miles, before steam was shut off, were covered in 5 min. 5 sec., or at a rate of over 70 miles an hour. The running down hill was remarkably free, quite as much so as that of any of the "single" or "coupled" engines on the line, and also very steady. It may be pointed out that Mr. Worsdell claims, by the use of fluted side-rods (which combine equal weight with larger sectional area), to have averted the danger of coupling-rods breaking, while dispensing with the complication of the third cylinder. I am glad to hear that more of these fine engines are at work.

Wellington, N.Z. **C. Rous-Marten.**

[25102.]—I CANNOT say I agree with Mr. Thompson with regard to steam tenders being the best method of compounding a goods engine. The cost of the steam tenders as made by Mr. Sturrock must have been very great; but of course extra power was obtained on account of the two extra cylinders.

No doubt a very good compound engine *could* be made in this way, but that it would save sufficient coal to pay interest at 5 per cent. on the extra outlay, and cover the extra repairs and oil, is, I think, extremely doubtful. Mr. Webb said at the Institute of Civil Engineers in March last, that he was then preparing the patterns for the goods engine I sent a sketch of last week, so I presume one will be out ere long. The compound system does not seem to be making much headway, except on the L. and N. W. The G. W. have, I understand, abandoned the idea altogether. I hope to send dimensions and particulars of the G. N. 7ft. 6in. engines next week. **G. D. Seaton.**

ALTERNATE RESEMBLANCE OF CHILDREN TO THE MALE AND FEMALE PARENT.

[25103.]—MORE than twenty years ago I observed a curious fact in relation to a large family with which I was well acquainted—namely, that the eldest child resembled closely in appearance, manner, and disposition the maternal parent; the second eldest bore the same close resemblance mentally and physically, to the father; the third again resembled the mother, and so on, the children bearing alternately a close resemblance to the male and female parent.

It struck me that this law (if I might so call it) might possibly have a wider application than the limits of this particular family, and ever since that time I have taken every opportunity of testing its truth.

Though every case did not bear out the observation so strikingly as the first one observed, yet, on the whole, the results of my observations have always tended to confirm my original view.

I am anxious to have the opinions of any of your learned correspondents on the subject.

Francis Heron.

HOT-AIR ENGINES.—LATHE OVERHEAD.—TRUING-UP SCREW-THREADS.

[25104.]—SEVERAL correspondents seem to be taking an interest in the hot-air motor, and its having no smell of gas about it seems an advantage over the gas-engine as a workshop motor. May I appeal to your readers to give us a working drawing of a one or two-man motor that will not burn out in a year or so? I see castings are advertised in the "E.M." for Nov. 27th.

Will someone explain to us the overhead motion employed by Messers. Cooke and Sons? I have a photograph of it, and it appears very like the one described by "Tuebor" without the upper part. Perhaps the two guide-pulleys on "Tuebor's" jib may, in Cooke's arrangement, be suspended from the ceiling.

"S." asks whether a screw-thread might not be trued-up by means of a small cone-pointed lap revolving like a drill, and charged with abrasive. I think I may say that plan is all right in theory, but that the tiny cone-lap would become quickly deformed and used up. Will "S." look at Reichel's plan, explained on p. 33? I hoped some of our readers would have told us we had some better plan in England; but it seems the Germans are ahead. **F. A. M.**

JORDAN'S SUNSHINE RECORDER.

[25105.]—I SEE a notice in the ENGLISH MECHANIC, of Nov. 27th, of Jordan's sunshine recorder.

I purchased one some weeks ago along with a supply of prepared charts. It appears to work fairly well; only in my experience, when the charts have been exposed in the cylinders and afterwards immersed in water, in place of the sun-mark being fixed, it vanishes away. Can you or any of your readers explain this? I wrote to the makers of the instrument. They answer that if the mark is run over with a pencil, the vanishing in the water is of no consequence. This is hardly satisfactory.

Edinburgh.

THE BLOWPIPE, &c.

[25106.]—AS Col. Ross, in his letter, No. [illegible], page 263, does not mention the previous points he disputed, I take for granted that he intends judgment to go by default, and allows that I have made out the originality of the sp. gr. balance blowpipe, &c., as described by me in "E. M." Col. Ross seems to think that I wrote disparagingly of aluminium plate. In this he is mistaken, as nothing could be further from my mind. I simply [illegible] few words of caution against using too [illegible] heat on bare Al plate. Had Col. Ross [illegible] note in his book stating that he only used [illegible] lamp when testing his Al plate in 1871, [illegible] not have been so misleading. Instead [illegible] makes it read as though his Al plates [illegible] hottest flame of a hot-gas lamp, which [illegible] his readers to make use of. I give [illegible] for the statement that the fusing [illegible] minium is between those of zinc [illegible] the latest edition of [illegible] find the melting [illegible] aluminium 700°

if "I am mistaken" there are others labouring under the same delusion. If Col. Ross can prove the above figures to be incorrect, he should do so, and place it on record in a scientific manner. In respect to the statement that there are hundreds of students daily using Al plate, "not one having burned holes in process of analysis," Colonel Ross might accept a little advice, and have proof positive before rushing such assertions as this and others of like character into print. Again, Colonel Ross repeats his allegation, "that it is impossible to produce the proper effects of oxidation and reduction by forcing the air inside a gas flame." This is, indeed, not a very scientific expression, in support of which he advances no proof.

On reading over the above, I determined to test my new blowpipe fully on the most delicate aluminium plate reactions, and compare the results alongside those obtained with a blowpipe having the blast-pipe on the outside of gas tube. Having obtained a blowpipe, with foot-bellows and air reservoir, also fitted with taps to both gas and air, I began my work of comparing results. To save needless repetition, I will call my new blowpipe No. 1, and the one with air-tube resting on nozzle of gas jet No. 2. I commenced trial on No. 2 first on a pellet of pure silver, reduced from precipitated chloride, perfectly clean, and free from flux. After long blowing, Al plate and carbon slip showed a very faint brownish fawn-coloured sublimate, bespattered all over with small metallic silver balls. This I scraped off the plate, and mixed with a little moist carbonate of soda, and reduced. I next took a pellet of pure precipitated gold, placed it on a fresh carbon slip, and for some time allowed a strong O flame to play upon it without the slightest effect. As my Al plate was getting rather hot, and not wishing it to come to grief, I placed a wet sponge near the back, and in a little while was rewarded by the appearance of a very faint reddish-purple colour near to carbon slip. The assay being in a high state of incandescence, the carbon slip was burnt through and the assay came in contact with the Al plate, making a hole of ⅛in. diameter clean through the ledge, the aluminium having alloyed with the gold, which was a rich purple all over. The sublimate was but a mere colouration on the plate, and could not be scraped off. I now cleaned the plate with the aid of a piece of stick and fine pumice powder and water, and prepared for trial my blowpipe No. 1 with the same kind of assays. Taking the silver as before, I had in a very short time a copious fawn-coloured and browning sublimate perfectly free from the small metallic balls which were present in sublimate from blowpipe No. 2. None of those metallic silver balls could be seen even under the microscope. I attribute this to the perfectly steady and uniform character of the flame produced by this blowpipe. I scraped off the sublimate, mixed it with moist carbonate of soda, and reduced it on ledge of plate. I then tried the gold in the same way as before, and was not long in getting a beautiful reddish-purple sublimate of gold so thick that I could scrape it together with my knife. I took up the sublimate in a phospho-boric acid bead, and in the oxidising flame the colour was purplish-violet, and in the reducing flame it became streaked of a dirty blue. The above experiments I repeated many times, getting the same result each time, so was perfectly satisfied that the results were correct in each case. I find in Ross's work, "Blowpipe Manual, 1883," that the sublimates of both gold and silver are stated to be "pink." It occurred to me that where a pink sublimate was obtained, it might be from contained lead in the assay: for instance, cupelled gold or silver always contains traces of lead, whereas the assays operated on by me were from precipitates in each case.

To test this point, I alloyed a pellet of gold with a trace of lead on trial; the lead was deposited first, and the gold sublimate on the top could be distinctly seen, of a decided pinkish tinge. I found that there was as much distinction between the sublimates of pure gold and silver as there are between those of tin and lead, and no one who had produced the two would mistake them in future. I could describe many other of my test operations, but I think this will be sufficient to disprove Col. Ross's assertion. I now claim for my form of blowpipe economy in the consumption of gas, perfect combustion, a more concentrated flame, a steadier and more uniform blast, and altogether superior results.

On these grounds I call upon Col. Ross either to withdraw or substantiate his statement, and further challenge him to produce equal results by simply blowing a column of air against a gas jet as in the ordinary way of using the blowpipe. I inclose my card, which may be found in the address column.

B. C. R.

P.S.—After my gold assay had burnt a hole in [illegible] of Al plate, I cut some carbon slips ⅛in. [illegible] from one of the compressed carbon [illegible] tical chemists. These I found [illegible] an ordinary [illegible] charcoal, and quite as efficient. Perhaps the makers of these could be prevailed upon to make compressed slips of the above size.—B. C. R.

A WATER BAROMETER.

[25107.]—ABOUT six years since I constructed a *water barometer* which has been acting very satisfactorily ever since, and which indicates very correctly the fluctuations of the atmospheric column. It is on the principle of the Sympiesometer, being corrected for changes of temperature before each observation. The readings are, therefore, far more reliable than in the arrangements of the glycerine barometers which have lately appeared in the MECHANIC.

The glass tube is 42in. in length, and ¾in. in diameter, the bore being ½in. in diameter. This tube is attached to a neat frame which hangs on the wall, and as some arrangement was necessary to obviate all appearance of clumsiness, I place both the air-vessels, as well as the cistern, on brackets in an adjoining cupboard, and connect the tube to each vessel by short pieces of flexible tubing passing through the party-wall. The tube has on its left side the fixed scale for temperature, and on the other the barometric scale on an endless paper band passing over a small pulley, one at the top, and the other at the bottom of the frame. Each tenth of an inch of a mercurial barometer reads an inch and half on the scale, and the degrees for temperature are an inch apart. This instrument has afforded me much pleasure, and its extreme sensitiveness and the large scale of degrees enable one to observe fluctuations which are not visible on the ordinary barometer. As the air-vessel is in connection with the *top* of the tube, and the cistern is placed at the *lower* end (being the reverse of the glycerine barometers lately described), the readings are not reversed, which I consider to be a great advantage.

Glycerine might be used in the above arrangement, but water is in every way equally efficacious; and, moreover, allows of the interesting phenomena of the constant oscillation of the column during a high wind, amounting occasionally to at least half an inch up and down.

I had no difficulty in making the cork closing the air-vessel perfectly air-tight at once, by roughing the glass and tube with a bit of emery-wheel, and casting a good body of cement of rosin, beeswax, and red ochre around it and over the cork.

G. F.

Cheap Sodium.—The manufacture of cheap sodium by an electrolytic process has been announced in France. An engineer of Lyon, M. Lossier, states that he will soon be in a position to sell sodium in large quantities at a price of about 25 centimes per kilo., not much over one penny a pound. There would be no necessity for such an extremely low figure to be reached to insure a very large demand for the material. The process of M. Lossier consists, it appears, in decomposing with an electric current, the chloride of sodium at a temperature of 900° C., and it appears incredible that by any such process the price named is not absurdly low. In France, indeed, sea salt, which costs about 2½ centimes the kilo., to obtain, is sold wholesale at 10 centimes the kilo., the duty being considerable. It appears that 3 kilos. of salt are required to produce one kilo. of chloride of sodium. It follows that at current prices the sodium not extracted from the combination is worth 30 centimes the kilo., to which must be added the cost of fuel for melting and heating the salt, the expense of producing the current, general expenses, profits, interest, and depreciation, which would be extremely high. The price of 25 centimes appears therefore to be far too low, even if the salt be valued at the prime cost of production. It may be remarked that marine salt is at once one of the cheapest and most abundant materials known in commerce. If we assume a moderate area and depth of that portion of the globe covered by the ocean, the quantity of salt that it contains is estimated at six times the volume of the Alps. Unlike coal the supply of which is being gradually but surely exhausted, marine salt is absolutely inexhaustible. It is therefore essentially a raw material of high value, for which many applications have yet to be discovered.—*Engineering.*

FOR many years the highest incorporated town in the United States was situated in the coal-mining regions in the western part of Maryland at an elevation of 1,400ft.; the recent settlements at the western part of the country have been in places which are probably of the highest altitudes for permanent dwellings. Leadville is situated 10,200ft. above the sea level; Hot Springs, 9,029ft.; Silverton, 9,224ft.; Marshal's Pass, 10,800ft. These are among a few of the highest towns. The United States Signal Service observers live at a station on the summit of Pike's Peak, 14,147ft. above the sea.

REPLIES TO QUERIES.

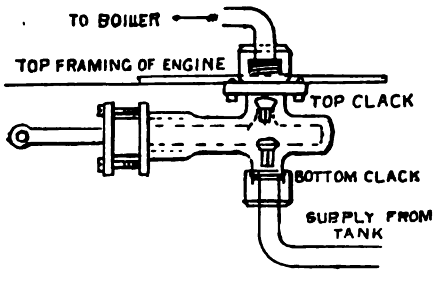
**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[56755.]—**Magnesia Firebricks.**—I fancy these are not identical with the American soapstone firebricks I inquired about last May, and which I have never been able to discover. Magnesia firebricks are manufactured by Messrs. Schneider, of Creusot, France. Perhaps these may be those "Cosmopolitan" inquires about. I also came across the specification of a patent for magnesian firebricks by Sydney G. Thomas, No. 4381, 1881.—MURANO.

[57360.]—**Chronometer Balance.**—"Wen" asserts that a chronometer removed from the Poles to the Equator would not be affected by gravity, or else, in other words, that the force exerted by gravity on the mass of a balance is the same at the Poles as at the Equator. Well, I can only think that "Wen" confounds the two terms, mass and weight—i.e., force of gravity. The mass would be, of course, unaffected; but for "Wen" to assert that the force of gravity exerted on the mass of a balance at the Poles and the Equator is the same, seems to me simply absurd; but as I do not consider the matter of sufficient general interest to occupy the valuable space of the "E. M.," I will only refute him on one or two points, and beg to refer him for further information to "Saunier's Treatise," where, under the heading of the "Theory of the Annular Balance," he will find the following: "Since the same laws govern the movement of a pendulum and balance, &c." Now, if this be so—and I don't know of a better authority—I think "Wen's" assertions are pretty effectually upset, especially that one where he says the effect would be to gain on time. In reference to this, I offer "Wen" a simpler case in point. I suppose "Wen" will admit that after a watch has been cleaned, that "a reduction of the friction on the endstones, &c.," is the main thing that has been effected by cleaning. Now, by analogy, according to "Wen," effect would be to gain, but it does not; it loses on time, as, if "Wen" has any practical knowledge of watchwork, he must well know. In common with "Leicester," I have always understood that gimbals were used in order to keep the chronometer horizontal, however much tilted by motion of the ship or any other external motions, rather than to avoid the direct effects of gravity.—FIRST CLASS HONOURS.

[57360.]—**Chronometer Balance.**—"First-class Honours," like "Leicester," has not discriminated between the phenomena of "weight" and those of mass, inertia, &c.: they have not a scientific comprehension of the meaning of the terms, nor of the properties of matter that they express or define. Strictly speaking, "the weight of a balance-wheel is of no importance in a watch"; it is the mass and diameter together, not the "weight and diameter together," that "regulate the speed at which the spring can move it." "Weight" is the centripetal force with which bodies attract one another, and the method commonly used to find the mass is to weigh the body. "First-class Honours" (why use such a high-sounding and many-lettered *nom de plume?*) quotes the law, "bodies attract one another with a force directly as their masses, &c.": hence the phenomenon of "weight." The properties of mass, inertia, &c., are inherent in the bodies themselves, and are quite independent of weight; also are constant properties, so much mass having so much inertia, or, if moving, so much momentum anywhere in space, whereas "weight" is a relative quantity, varying as regards two bodies "inversely as the square of the distance" apart; in remote regions of space a solitary mass would have comparatively no "weight," or attractive force, on any other body; but it would take, friction apart, just the same pressure or force to impart to it a given velocity in a given time as it would do on the horizontal at earth's surface, which is the truer method of ascertaining the "mass" of bodies. To say that the weights of the parts are varied by the up and down motion of the ship, is, to speak very incorrectly, excepting as the distances of the c.g.'s are varied. The pressures on the bearings are, of course, varied; as motion is imparted to the various masses they support in one direction or another, and these varying pressures, like the action of gravity, disturb the actions least on the horizontal. As the balance-wheel rotates, the pressure on its bearings is also varied by the ship's rolling and pitching, apart from "up and down motion"; also motion N. to S. or S. to N. causes minute variations of pressure, which differ in amount from those of motion E. or W., which again differ between themselves, the pressure being greater going to E. than W.; but, apart from friction, there is no influence on the chronometer, and they are beyond practical computation or effect. Our other unknown motions in space have also some effect.—Wen.

[57805.]—**Locomotive Model.**—By all means line your cylinders up to ¾ bore; but I think if your valves and pistons are all right and tight, your boiler ought to give plenty of steam. Your valves and ports will need no alteration if you get a piece of very stout triblet tube, which, of course, means a lot of metal to get warm; turn your tubes the right length of cylinder; then sweat them in with soft solder, and open ports into cylinder. I inclose sketch for simple pump, easily made, and worked off cross-head.—Ex-Fireman.



[57813.]—**Gramme Dynamo.**—I do not know whether it is a printer's error or not, Mr. Eaves, but your drawing is certainly wrong. If the current goes through the coils in the direction you have shown, the poles are opposite to what you make them.—P. C., Hornsey.

[57813.]—**Gramme Dynamo.**—Why cannot correspondents refrain from making unnecessary remarks—remarks often far from courteous? Surely Mr. Needham was acting rightly in suggesting that Mr. Eaves had made a mistake, when his figure was not in accordance with English textbooks? But with regard to the nomenclature of the poles—Is there not as much reason for calling the magnetic polarity of that part of a magnet which, when the magnet is suspended so as to move freely in a horizontal plane, lies towards the north, "north polarity," as there is for calling the magnetic polarity of that part of the earth which lies towards the north, "north polarity"? We must make a choice between the two nomenclatures—English writers (in general?) choose the first method; French writers the second.—Cloy.

[57830.] — **Emulsion of Spermaceti.** — "Maschera" asks for a method of making the above, and very pardonably mistakes the difference between solution and suspension in the fluid, whereupon, in No. 1,079, p. 265, "T. J." thinks it right to turn the query into ridicule with a silly and perfectly irrelevant reference to the impossibility of an approach of the moon to the earth. Years ago this emulsion was deemed a demulcent in cases of common cough, the dose being a tablespoonful. Here is the recipe, as found in Cooley: Take of spermaceti 1oz., powdered gum-arabic 90 grains, water 24 fluid ounces, simple syrup four fluid ounces; put the syrup and gum into a warm mortar, add the spermaceti and triturate with a warm pestle until united; then add the water (warm) gradually, and continue the agitation till the whole is quite cold.—F.R.C.S., Eng.

[57864.]—**Magneto-Electric Machine.**—To "P. C., Hornsey."—What is this correspondent driving at? Cavilling at a statement I made at page 190, he says at page 226, "It is of course impracticable to test the resistance of a dynamo while running"; and when I have shown him at page 246 how to do it, he coolly turns round at page 284, and says, "There are several better methods of testing the resistance while running." If he knew of these, why mislead others by saying, as he did at page 225, "It is of course impracticable to test the resistance of a dynamo while running?" S. Bottone.

[57904.]—**Compound Tandem.**—The dimensions will do; but it is really not worth while to compound so small an engine. Better have two 3in. cylinders driving on cranks at right angles.—E. G. M.

[57909.]—**Florentine Bronze.**—Not quite sure that I understand what is meant by "Florentine"; but querist should try a weak solution of hydrosulphuret of ammonia in water. Or sal-ammoniac one drachm, oxalic acid fifteen grains, vinegar one pint.—Nux. Dor.

[57913.]—**Photography by Arc Light.**—One arc is sufficient for photographic purposes, and the carbons need not be very large for that—5 to 8 millimètres diameter being ample. Reflectors are necessary, of course, to throw the light in a diffused state over the subject.—J. E. M.

[57912.]—**Potential of Induction Spark.**—On page 246 I notice a reply to above query. I missed the original query; but as "Vulcanite" remarks, "a ⅛in. spark for 2,000 volts" does seem to be only a guess. The most accurate results we have were obtained several years since by De la Rue and Müller by means of their 15,000 chloride of silver cells. Here are a few of their results:—

E.M.F. in volts.	Length of Spark in inches.
2,000	0·019
4,000	0·121
6,000	0·27
8,000	0·40
10,000	0·50
12,000	0·59
14,000	0·67

This gives the length when discharge takes place between two pointed wires. The potential per inch is nearly constant for sparks over ⅛in. long, and is about 20,000 volts per inch. If this law holds at high potentials, a lightning discharge half a mile long requires a difference of 800 million volts between the cloud and the earth. Of course it is just possible that the induction coil may give longer sparks per volt than the battery; but it does not seem likely.—Sydney Evershed.

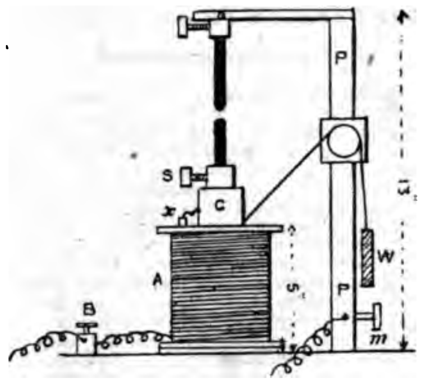
[57918.]—**Light Pony-Trap.**—The information required by this querist would involve a column or so of space, so I should advise him to read the articles on "Cart and Wheel-Making," which appeared some little time ago. See p. 514, Vol. XXXIII., and pp. 50, 152, Vol. XXXIV., for instance, where there are illustrations of such a trap as would suit.—J. P. M.

[57920.]—**Power for Lathe.**—One man-power is sufficient. Better have a gas-engine, as more economical, or a hot-air engine.—S. R.

[57925.]—**Leclanche Batteries.**—This querist should let us know where he finds any mention of the Victoria battery; or, what would be preferable, apply to the quarter from which he understands that it is a "modification of the Leclanché." A cell of that description is, I believe, made by Mawson and Swan; but there is no advantage whatever in using Leclanché cells for electric lighting—modified or not.—S. P. T.

[57941.]—**Fan.**—This querist should try his fan; but it is doubtful if it will give good results unless placed near the delivery nozzles or tuyeres.—S. R.

[57956.]—**Arc Lamps.**—Annexed is a sketch of an arc lamp, known as Archereau's, which may suit "Lear." It consists of a bobbin, A, of No. 12 s.c. wire, in one layer, or, at most, two, for weak currents, having a cylinder of soft iron, C, within it. The upper end of the cylinder carries the lower carbon, held by a set-screw S. One end of the coil is connected to the binder on the base-board; the other end is soldered to a thin copper spring pressing gently upon the soft iron cylinder, as at *x*. The connection to the upper carbon is made by the upright brass pillar, P, through the screw *m*. A weight, W, is supported by a cord which leads over a pulley in the pillar, and passes under the low end of the central cylinder in the coil, supporting it in position with a gentle pressure between the carbons. Connected to the dynamo at B and *m*, the coil magnetises C, which is attracted into the coil, and thus the carbons are separated. Should the separation be too far, the weight brings the points nearer again. W must be of such a weight as to counterbalance the action of the current on the cylinder, and will be best made adjustable. The tube of the coil may be ¾in. diameter, and the diameter of the sliding column may be ½in. A brass or iron socket should be fitted to the latter for the reception of carbons of different sizes. Urquhart's "Electric Light" is my authority for the sketch.—Bobadil.



[57961.]—**Small Dynamo.**—Many thanks to Mr. Bottone for his reply to my query. But I must inform him that I have not fastened one end of armature coil to the ironwork, as I wound both A. and F.M. coils under his instructions from his "Dynamo: How Made and Used"; but at time of winding I made a mistake, which is as follows: When winding A., instead of starting at left cheek and winding from me over to under, I started at left cheek under to over towards me; but to remedy this I fastened each end of coil to opposite halves of commutator or otherwise, contrary to your instructions. Will this affect the machine in any way? If so, please state. The insulation is in every way perfect; but I forgot to inform you that I have the machine coupled up as shunt, so will that account for the drag on A. when outer circuit is broken, and why does it run so light when I have one secondary cell in outer circuit? I shall esteem it a favour if you will try and put me right. The machine seems to do good work in respect to fusing iron wire. Will you inform me if there is any current to spare after lighting the six 10-c.p. lamps as stated, or does it take it all its time to do it at 3,000 revs. per minute?—J. S. P.

[58016.]—**Sea Anemones.**—They must be kept in an aquarium, or a bell-jar turned upside down. Put some well-washed gravel or shingle at the bottom, and on this arrange pieces of rockwork in a picturesque manner, leaving crevices for the anemones to creep into. The water must be made with Southall's "aquarium sea-salt," and adjusted to the right specific gravity with a "gravity bulb." It must not be placed in too light a place, and must have some seaweed as well as the anemones in it. This is absolutely essential to their well-being if you keep them in a deep jar. If you have no seaweed, you must keep them in a very shallow dish. They will eat quantities of small bits of raw beef or mutton put on to their tentacles when expanded. They won't open at first after being brought from the sea, so don't be alarmed. They are well worth the trouble of keeping, and the trouble is very slight. Change the water, or syringe it well (with a glass syringe), when it looks muddy. All rejected pieces of meat and the skins which they are continually casting must be removed as soon as seen. A very good book is "The Fresh and Salt-Water Aquarium," by the Rev. J. G. Wood. If you want fuller details, and will get the November number of the *Naturalist's World* (2d.), you will find in it an article by—R. A. R. Bennett, Walton Manor Lodge, Oxford.

[58031.]—**Two Telephones.**—I ought to have made the following correction last week, but had not time to do so:—In Fig. 1, the secondary of the induction coil and the receiver are connected in multiple; they ought to be "in series," as in Fig. 2. So that in Fig. 1 the wire which connects *s* to the left-hand binding-screw of the receiver ought not to be there; *s'* ought only to go line, and the wire from the top peg in S ought to go to the left-hand binding-screw of the receiver. I am sorry to have made this mistake.—Bunsen.

[58059.]—**Electrical Units.**—To "F. A. F."—You are quite right. I see that I have multiplied 100 by 86, instead of adding them as I should have done; therefore, in this case, in series would be better than in arc, as you state.—C. L.

[58065.]—**Backing Mill Stones.**—I had the misfortune to have a couple of ribs broken by reason of the defect in a mill-stone back, put on by a party somewhat on the lines indicated by "T.C." in last issue, and I give the querist a little cautionary advice. I have never used, nor seen used or worked, stones with other backs than plaster of Paris; but I have no doubt whatever that a cement back would do, and it would probably be heavier than plaster, and could be worked to shape more leisurely than plaster, which sets very quickly—so quickly, in fact, if good and fresh, that I have never succeeded in making a solid back when working it at the consistence of mortar. On the contrary, to make a solid job, I found it necessary to run it on in a semi-fluid condition, and had to be very sure to have all the appliances handy, and be very lively even then. Querist had better test his plaster on a small scale; this, to be sure of its quality and condition, as it absorbs moisture rapidly from the atmosphere and weakens; and, at the same time, see if he can get perfect and solid adhesion when putting it together at the consistence of mortar. Plaster, when set, is lighter than any cement I am acquainted with; but is capable of being turned off true. When set, I know of no cement that will permit this. The weight, in either case, will have to be given probably by stone or iron. If loose stone, then there should certainly be a band of ½in. by, say, 4in. iron, well riveted, driven on the mill stone to contain the back, and the heavier pieces of filling packed evenly and close up to it. If it be intended to turn the back, these will require another narrow band on top that can be removed, and, in any case, a tin, sheet-iron, or solid wood cone, tapered and soaped to aid withdrawal, to form the eye, everything harder than the plaster must be fully kept below the turning level. Bef- plaster is poured, the back and filling well damped. I take it for knows that the balance of and standing, has to be the ryne be pivoted.—

[58068.]—**Conversion of Photo. O.G. into Telescope.**—The front lens is $3\frac{1}{8}$in. diameter, and the focal length 24in. Will "H. A." or others kindly say if the curve is too deep for telescopic purposes?—B.Sc., Plymouth.

[58086.]—**Muscæ Volitantes.**—Thanks to "Medicus" for his reply. Can I confirm the diagnosis by entoptical or other tests, as I should be much relieved to know for certain that the muscæ are not due to internal mischief? The following are a few facts which I should have given before:—In 1883, had a sharp attack of conjunctivitis without apparent cause, followed by iritis, and treated at the R.L.O.H. with atropine. Surgeon's report showed slight myopia, vertical astigmatism, and numerous opacities in lens. Noticed muscæ soon after this, and they have steadily increased since.—X.

[58098.]—**Regenerative Gas Burners.**—The replies to this question in the last two issues of the "E.M." are in some particulars incorrect and misleading. Having had considerable experience of regenerative and most other kinds of gas burners, I may say that for economy of gas with an equivalent light, no other kind of burner comes near them; the best argand will not give half the light, while ordinary jets such as are generally in use will give but one-third to one-fourth of the light for similar quantities of gas consumed, while the heat of a regenerative burner (though concentrated in the lamp, and therefore felt on a near approach to it) is actually less than that given off by ordinary burners giving the same or less light. The ventilation of these burners, if desired, is more easily carried out than with any other kind, somewhat in the way carried out by "Hugo" for open lights in your last issue. It is quite a mistake, though a general one, that these burners give off more heat than ordinary gas flames; the latter, burning openly, give off proportionate heat, which is carried away by the currents of air and distributed throughout a room, and is not felt as concentrated at one point as in regenerative burners, while the latter have the great advantage that the products of combustion (CO_2) can be easily and entirely carried away from the room, in which case the radiant heat of the lamp will not warm a room to one-third the extent that open lights would. It is not correct to say that the regenerative burners are liable to smoke when turned down low. Just the reverse: they will smoke when turned too high just as an argand will; but when properly fixed, with a good regulator on the supply pipe, it is impossible to make them smoke. They have one peculiarity which does not apply to other burners (except partially): that when burning properly, giving the light which their size is suited for, turning on more gas will not improve the light; while if a richer gas is used, the total light will be the same as before, but the quantity of gas consumed will be proportionately less. The light of a regenerative burner is steadier and whiter than all other gas lights, so much so that the finest photographs can be taken by it direct in the camera. To light up ceilings with these burners, it is only necessary to use a rather flat opal glass shade, which will destroy all shadow above the lamps.—S. S.

[58102.]—**Electrical.**—There are two slight errors in my reply to this query. In line 14, for $\frac{1}{4}$ read $\frac{1}{Z}$. In line 16, for B read A.—F. B. ALLISON.

[58109.]—**Double and Treble Threads.**—To cut double and treble threads the wheels must be arranged so that the one on the mandrel can be divided into as many equal parts as the number of threads to be cut. Having cut the first thread in the usual way (with the exception of a finishing cut) mark one of the teeth of the wheel which gears with the one on the mandrel, and also mark the space of the wheel on the mandrel, No. 1. If the thread is a double one, count half the number of teeth on the mandrel-wheel, and mark that No. 2. Then let down the quadrant, and turn the mandrel round till the space marked No. 2 will gear with the tooth marked on the wheel on the stud: it will then be right for cutting the next thread. This plan will answer for three or more threads by having a wheel on the mandrel, which can be divided into as many equal parts as the number of threads to be cut.—W. WRIGHT.

[58111.]—**Dutch Grammar.**—There was a book by one Sewell published at Rotterdam some thirty years ago—a Dutch grammar. I am unaware whether it has been reprinted, or is now to be had. Perhaps some of the foreign booksellers, like Williams and Norgate or Rolandi, might help you; or, if you have a reading ticket for the British Museum, you might find there what you want.—DEVONSHIRE SQUIRE.

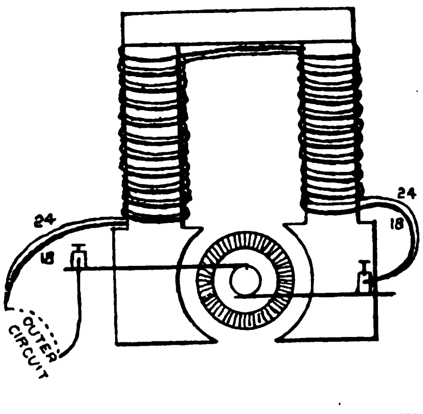
[illegible]—**Welding Iron.**—"Mechanic" should [illegible] to weld his plates with [illegible] the [illegible] or his must not use too much), at the same time to carefully watch his heats; he must also cut his plates clean on the edges to be welded, especially the one forming the bottom of his box, which ought to be hammered up square, so that the others will fit nicely to it; and also to keep any dirt from getting between the joints. For sand use some clean stonemason's refuse, well pulverised.—COUNTRY SMITH.

[58119.]—**Wheel.**—You must get two bars of convex iron, $2\frac{1}{8}$in. wide, by $\frac{3}{4}$in. thick in the middle, from which make your rim; drill fourteen spoke holes round each rim at equal distances, $\frac{3}{4}$in. diam., and countersink outside of each. Use $1\frac{1}{8}$in. oval iron for your spokes; shoulder one end of each, and rivet them cold into the rims, keeping them as true as possible. You may then have the hubs cast in, which should be of taper bore, 7in. through them, $1\frac{3}{8}$in. back, 1in. diam. at nose end. But, if you want your truck to do hard and constant work, I would advise you to get a pair of good wooden wheels well bound with iron.—COUNTRY SMITH.

[58147.]—**Lens.**—I would advise "C. J." to get the loan of a lens fitted with stops; he will then be able to readily understand the way in which to alter his lens. He may use tin discs to make the sheath for the stops if he thoroughly blackens with matt varnish. He will find the stops reduce the speed of lens in proportion to size—viz., the larger the stop the quicker the lens, and vice versâ. I shall be pleased to give him any other hints he may require.—JOHNNY NASH.

[58160.]—**To "Sigma."**—I am greatly indebted to you for your reply as above, and also for letter 25047. As regards the reaction of copper dissolving, Roscoe gives it in the same form, except that he uses the "anhydrous" formula SO_2 for the gas coming off, and adds that the acid employed must be "strong." I suppose I should have been correct if I had said that the copper dissolved spontaneously above a given temperature, if the acid were not dilute. I presume the heat assists the development of the sulphurous gas. The other replies seem completely to meet my inquiries, though I look forward with great pleasure to some opportunity ere long of consulting the work to which you refer me for details. Still, one would think that the chemical reaction of the deposited copper, combined with the counter E.M.F. of the copper plate, could not together exceed the theoretical combining force of Cu with SO_4, which Thompson places (as I now understand him) at 1·223, but which you apparently stated as ·506, though I am very doubtful if that was what you really meant. As regards the hydrogen film, I suppose you do not mean to dispute that it obstructs the current of resistance, as well as by actual antagonism.—A. E. B.

[58163.]—**Dynamo.**—There would be no practical advantage in adding any more No. 18—rather the contrary. You are not correct in your view of the mode in which the current passes in the shunt circuit. The current divides itself between the F. M. circuit and the outer circuit, in exact proportion to their relative conductivities. The annexed cut shows the proper way to connect up in parallel.—S. BOTTONE.



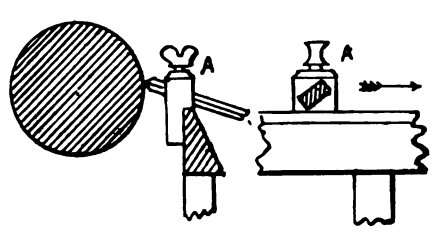
[58165.]—**Magneto-Electric Machine.**—To MR. BOTTONE.—Your commutator is wrongly constructed for this purpose, and probably the springs press against the cheeks at the wrong period of the revolution. See Ganot's "Physics," paragraphs 855, 856, for full details as to construction of this form of armature and commutator.—S. BOTTONE.

[58167.]—**Sanitary.**—There are in the market two forms of mechanical earth closet—Heaps and Moulds; I have both in use, and find both equally good. The least expensive form is a bucket under closet seat, and a box of dry earth with a scoop in close by so that some earth can be thrown in each time closet is used. The earth, if kept in a dry place, can be used three or four times over with advantage, as it then contains more ammonia. —MEDICINÆ DOCTOR.

[58167.]—**Sanitary.**—Will find that the best form of earth closet is "Morrell's Patent Ash-Sifting Earth Closet," which utilises house ashes for sanitary purposes by separating the fine dust from the cinders, and casting it (the former) near the soil, just as in the ordinary earth-closet, and saves the unconsumed fuel, in the form of cinders, for reburning. Ash-dust is really calcined earthy matter, and has advantages over ordinary mould for deodorising and absorbing purposes. Dr. Stockhardt, in his "Dictionary of Chemistry addressed to Farmers," strongly recommends the use of sifted ash-dust for manurial purposes, as well as for deodorising cesspools. Professor Watts, in his "Dictionary of Chemistry," gives analyses of various coal-ashes, from which a value for manurial purposes is shown, ranging from 9s. to 17s. per ton. An interesting experiment in the growth of plants in ordinary ashdust alone was recorded in the *Quarterly Review* some time since, but which is too long to repeat in this reply. The experiment was most successful. Morrell's system is very fairly described in some chapters on "Domestic Economy" which appeared in *Knowledge*, from January to March, 1885. An advertisement of the manufacturers of Morrell's patent apparatus appeared in the *Building News* of Dec. 5, giving a quotation from a letter of a surveyor to a suburban district. The apparatus is available for use with earth as well, if it is desired to supplement the ashes. Morrell's Sanitary Co., 4, St. Anne's-square, Manchester, are the makers.—D. CHARLES MORRELL, 112, The Grove, Ealing, W.

[58172.]—**Plating.**—To prevent the deposit of metal on any part of an article the part is painted with copal varnish, which must be dry before immersion in the bath; this is called "stopping off." Remove the copal afterwards with benzole.—BOBADIL.

[58174.]—**Washing-Machine Rollers.**—If the Editor thinks it worth while, the above sketch will show "H. B. M." how he can finish a wood roller as fine and as long as his T-rest is. The cramp A, if cast in gunmetal, will cost very little. Use a long chisel and handle; slant the chisel as shown. The cramp runs easily on the T.—G. B.



[58175.]—**Vallisneria Spiralis.**—My plan is a glass bell fixed upside down on a wood stand. Take the grass and plant it in some rotten sod and a little coarse gravel, then fill up carefully with water at about 60 degrees—say, once a week, pour some fresh water in, and let it overflow; it answers better than pouring off the old water, which would disturb the plant. I use a syringe to change mine; mine is growing in a small greenhouse; from two plants I have now at least fifty in about eighteen months. I have some growing well in a small glass vessel in my workshop window, but, of course, not as quick as in the greenhouse; it grows like weeds at about 60 degrees.—J. A. P.

[58175.]—**Vallisneria Spiralis.**—This is readily grown by placing a few roots in about 3in. of small well-washed stones and silver sand at the bottom of one of those tall glasses used by confectioners, and standing the jar in a south window. It grows very fast in summer, throwing off offsets; but, like other water plants, it gets shabby and partly dies down in winter, unless kept in a warm room. The fertilisation in this plant is very curious. The female flowers are on the top of long corkscrew-like stems, which contract and expand their coils so as to keep the flowers just floating. The male flowers are on short stems near the root; and the problem of meeting one another is solved in spring by the male flowers becoming detached and rising among the others. The plant is, I believe, Italian; but is common enough at aquaria shops. The inside fountains at the Crystal Palace contain large quantities.—B. HARCOURT.

[58177.]—**Casting Brass.**—The white powder dusted over the mould is three parts flour, one part slaked lime, put into a cotton stocking (machine knit stockings are best), then blown off by a pair of hand bellows; this prevents the sand from callousing; powdered charcoal is for metal castings. A good wrinkle to get the castings clear of sand and a nice skin is to empty while hot (no hotter than red hot, when nicely set). Have a large bosh, tank, or cask ready full of clean cold water, then with a pair of tongs take your casting and place it in your bosh; as soon as you get it below the surface draw it quickly forward, still keeping hold with tongs—you will hear a report and a splash, then lift out. If done properly, without fear of getting wet, you will find every particle of sand blown off both inside and out. I am speaking of castings from 1cwt. down to ¼lb., such as cocks and valves, &c. From 3in. down to ¼in., if done this way, you will find the cores clean blown out, which saves a lot of labour, besides making a much cleaner and better job. The lighter the casting the smaller the bosh; a beer barrel with one end taken out is the one I have.—BRASS MOULDER.

[58178.]—**Heath Land.**—Chalk would do no good, and might do harm. Clay or any loamy soil would do good, but would be very expensive. "London Man" had better keep to pines, rhododendrons, azaleas, &c., which will do well.—M.

[58178.]—**Chalk on Heath Land.**—As you have bought building plots, it is evident you do not intend to farm the land. Why, then, should you wish to put chalk or lime thereto? You have the very best possible soil for growing some of the finest of all shrubs, as rhododendrons, azaleas, andromedas, heaths, and such-like. What would we not give in these parts for a few acres of such land from whence to draw peat for our plants? Let me tell you that if you are going to plant rhododendrons, that the addition of chalk to the soil will simply destroy them. A little quicklime might be beneficial to ground intended for kitchen garden. —DEVONSHIRE SQUIRE.

[58180.]—**Lathe.**—What do you want to know? Angle of mandrel cones or centres? If latter 60°; if former, say, 15°.—T. C., Bristol.

[58185.]—**To "Fiddlers."**—I am afraid the only remedy is rest, and the removal of the cause. While in Germany, some years ago, I saw many fiddlers using a chin rest. I got one put on my fiddle, and can speak from experience of its benefit. If "Silas" gets one of these, it will relieve the neck of its tension, and thus reduce the swelling.—B.SC., Plymouth.

[58187.]—**The Wimshurst Machine.**—TO "ONE IN A FIX."—The plates should run as close together as practicable; nothing is needed between the glass and the wood boss. Rockhill's tricycle cement answers for attaching the plates to the boss. The tubes of the neutralising rods are made to fit into the holes at the top of the stancheons, the spindle fits into these tubes, hence the 10in. length for the spindle. Leyden jars are not open at the bottom end. The bottom circuit is made by a wire extending from the Leyden jars on the one side of the machine to the L. jars on the other side of the machine. I make the metal connection between the tubes and the insides of the Leyden jars by fixing a wooden button on the end of the tube and then coating the button with tinfoil; the stick of wood is only to carry the weight of the terminal.—J. W.

[58188.]—**Photographic Lens.**—"Fiangus" is right; the larger the lens (if good), the larger the stop, and more illumination and rapidity of working.—JOHNNY NASH.

[58188]—**Photographic Lens.**—You are quite right; a 2in. lens of 8in. focus is much more rapid than one of 1¼in. with the same focus. If they are both equally rectilinear, the 2in. is more valuable than the 1¼in.—B.SC., Plymouth.

[58188.]—**Photographic Lens.**—To grind a lens 2in. in diameter of the same focal length as another of 1in. in diameter, so that it shall perform as well, is a very difficult matter, since the larger the glass, the more liability to streaks, flaws, &c., as well as the increased area of curvature. If equally perfect as to definition, then a lens twice the diameter would admit four times the light, and would therefore act four times as quickly. The construction of the lens also may be entirely different, so as not to necessitate so small a stop. But if both lenses work the same as regards definition, with the same sized stop, then the surplus paid for the larger lens is sheer waste.—S. BOTTONE.

[58192.]—**Coils.**—TO MR. BOTTONE.—Such a case has never come under my notice. I have seen very fine covered wire, which, when soaked in paraffin wax, looked as though it were bare, so fine was the coating; but have never seen bare wire laid on. Still, if the individual coils of wire did not actually touch each other, and each layer were insulated from the one below, there is no doubt but what the coil would work.—S. BOTTONE.

[58193.]—**Brass Castings.**—Red brass for turning: Copper, 24lb.; zinc, 5lb.; lead, 8oz. Put in the lead last before pouring. Or, copper 32lb., zinc 10lb., lead 1lb. Red brass to turn freely: Copper, 160lb.; zinc, 50lb.; lead, 10lb.; antimony, 44oz. Best red brass for fine castings: Copper, 24lb.; zinc, 5lb.; bismuth, 1oz. Put in the bismuth last before pouring.—HEXHAM.

[58194.]—**The Wimshurst Machine.**—The only advantage in using thick glass is that it bears a little more rough usage—the thinner the glass the better the results for 24in. plates; use a little under the ⅛in. thickness. Most window-glass answers, but test a sample for high degree of insulation before you order. The holes in both discs are of the same diameter; I should use thin brass washers for attaching 24in. plates, but these washers should not be allowed to rub together; leave the brass tube slightly projecting. The tinfoil is put on just the same as for an ordinary Leyden jar.—J. W.

[58197.]—**Oil Waste.**—Bisulphide of carbon, I think, is the chemical used. You would want an experienced man to set the works out.—W. W. E.

[58197.]—**Oil Waste.**—Oil can be extracted from the above by means of carbon bisulphide, which dissolves all the oily matter, and can be itself separated from the grease by distillation, so as to be used again and again. As good a book as any, if you can read French, is "Le Fabricant et Epurateur d'Huiles," in the Encyclopédie Roret, which you can get from Dulau, Fleet-street, London.—S. BOTTONE.

[58198.]—**Celluloid Cement.**—Celluloid is soluble in a mixture of alcohol and ether, or in ether alone, and therefore forms its own cement.—NUN. DOR.

[58199.]—**Backing Plates.**—By backing plates is meant painting the back with an opaque varnish to prevent reflection from the back surface.—MAGISTER.

[58199.]—**Backing Plates**, photographically speaking, means smearing some dirty yellow or black mess at the back of the plate, to prevent the image being reflected back again on to the back of the sensitive surface, if the coating is very thin. This would produce halation.—S. BOTTONE.

[58199.]—**Backing Plates.**—To back plates to prevent halation, use a solution of bitumen in coal tar naphtha or Brunswick black. Coat stout paper with this solution, and when dry place it on the unsensitised or glossy side of plate before exposing. Its use is to prevent a kind of blurr or secondary image appearing on the negative.—JOHNNY NASH.

[58201.]—**Bellows Body.**—It would hardly be worth while to spoil a good sliding body camera to make a bellows body out of it; but if the lens is a good one, you might make very easily a bellows-body camera to take it and the dark frame. Full directions for making such a camera were given by our **Mr.** Lancaster, about two years ago, in the "E. M."—S. BOTTONE.

[58201.]—**Bellows Body.**—You can make the bellows yourself; but will find it hardly worth your while, as when you have converted your camera into a bellows one, it will most likely have the appearance of half-wood, half-bellows. However, if you get some black twill cotton and brown paper you can proceed thus: First cut your cloth the size required to make the bellows in one piece, after this lay it on a flat surface and glue two thicknesses of paper on it, then place another piece of cloth over all; when dry you must make chalk lines on cloth the same width apart as the height and breadth of camera, then fold the cloth so as to form a kind of long box. You will find making the folds rather troublesome; but practice with a sheet of paper first. I have one of my cameras with bellows made this way, and for myself I prefer it to leather.—JOHNNY NASH.

[58202.]—**Photo. Lens.**—From Dallmeyer's Catalogue you will find that if your 2in. is a "rapid rectilinear" it will cover a 12 by 10 plate. If a "wide-angle rectilinear" it will cover a 15 by 12; if a "wide-angle landscape" it will cover a 10 by 8. —B. SC., Plymouth.

[58202.]—**Photo. Lens.**—The solar focus is the distance at which the rays of the sun converge to form an image behind a lens. As the distance of the sun is so great as to render the rays virtually parallel, the solar focus is shorter than any other. The focal length of a lens is the distance at which an image is formed behind it, and is larger as the object is nearer. The usual diameter of a ¼in. plate lens is 1⅜in.; focal length, 4½in. If your Dallmeyer has a longer focus than this, it will cover more than ¼ plate; if not, no.—S. BOTTONE.

[58204.]—**Burning Bricks.**—The most economical kilns are the regenerative gas-fired kilns. The utmost economy is only to be obtained by having at least three kilns. If for a permanent job, it would decidedly pay to go to the extra expense of a regenerative kiln, even if there is only one. I shall be pleased to supply further information.—GAS FURNACE ENGINEER.

[58205.]—**Worm Wheel.**—To obtain the bevels on the worm wheel, it is necessary just to reverse the process. Take the pitch of the worm and its circumference both at point and root, mark corresponding diagonals on a board, measure off the width of the teeth on these diagonals, and these will then give the bevels on the roots and points of teeth, which can be scribed thereon with a strip of bent steel. But let me tell you as a pattern maker that you go the wrong way to work if you set about your worm wheel thus. The proper way is that described on p. 307 of Vol. XXXVII. The wheel to be parted in the centre, the bevel to be got at pitch line, the teeth marked in the joint and on the outer faces, then roughly worked with templet, and finished by trial of the worm itself round from time to time. It is possible by a very roundabout and unpractical process to make the teeth right at first by taking sundry sections of the worm at set distances from its axis and marking and cutting the worm wheel in corresponding sections: the reason of this being that the sections of a worm-wheel tooth are not exactly alike in any different sections, notwithstanding that the difference is scarcely perceptible in those of small pitches. If it is of use to you, I will tell you how to make perfect worm gearing with little trouble. Make your worm first, and get your wheel prepared according to the directions just given, and rough out the teeth with templet. Set the worm between centres in the lathe, and rig up the wheel in a horizontal position, so that its horizontal axis coincides with that of the worm. I place it on a vertical spindle set in the socket of the Tee rest, and "ease" the wheel teeth until red lead rubbed on the worm shows contact all round, as the worm being turned on its axis is allowed to carry the wheel round its axis.—J. H.

[58206.]—**Chain Sheave.**—"J. H.'s" method is correct, if you will read it over; or set it out thus —Scribe a circle any size, say 6in. diameter, and with dividers mark it off into 20 equal divisions, and draw lines to centre. Now, with dividers set to length of one link, you can find a distance from centre where the lines will be at requisite distance apart. Then scribe a circle (through this part) from centre, and work as "J. H." says. You will sure to have to pare the pattern a little, as is meant by "J. H."—T. C., Bristol.

[58206.]—**Chain Sheave.**—If the answer given in reference to the above "cannot be brought to practice" by you, that is not my fault. I gave you correct and safe information, by means of which I have made both sheave and sprocket wheels. Certainly, you must have polygons. Did I not, in my reply, tell you how to mark the tangent lines? Or do you mean that I was wrong in giving you arc divisions instead of chord divisions? Where the difference is inappreciable, as in this case, it is always easier to turn to a table of circumferences than to obtain the chords. If you want to obtain the circumscribing circle by taking chords, you can do so by multiplying 2in. (the length of your link centres) by 3·1962266, and the result will be the radius = 6·39in.; and this is against 6⅜" obtained by the arc measurement, as I gave you before. Is it worth while wasting time and valuable space over such an infinitesimal difference? Or if you have plenty of leisure, you can mark 20 radial lines at exact angles of 18° with each other, and your radius will be where the lines diverge to 2". You say it is not practical to ease them (the link recesses) if the chain does not fall in exactly in the first place. But I say it is the very thing which a practical pattern-maker who does not want to spoil his job would do. When you say, in your first query, that your chain either gains or loses, you show clearly that a first marking out is not absolutely reliable. And I gave you the only reliable method which a lengthy experience has shown me the value of. If the links of chains were all of exactly the same length, and if there were no differences in thickness, no lumps, no inaccuracies of workmanship in the pattern either, perhaps my method of striking out slightly full, and easing might be rightly deemed unpractical. But, taking things as they are, I have given you the best information which it is in my power to give. Beyond that, "guaranteeing a certain fit" must be contingent upon the amount of skill which you bring to bear upon your task.—J. H.

[58207.]—**Grinding-stone.**—Have you tried Carter's disintegrator? This is simply four steel arms revolving at 2,000 or 3,000 revs. a minute, and pulverises by percussion until the material is small enough to pass out of the screen used.—T. C., Bristol.

[58207.]—**Grinding and Pulverising Machinery.**—"A. J. S." should state what quantity he wishes to grind, lb., cwts., or tons; also if he requires the resulting powder in suspension in water, or perfectly dry. The process I tried to describe in "E. M.," p. 148, is the one employed when thousands of tons have to be ground to fine powder; for small quantities, more methods are made use of by the potter. cheapest way of accomplishing your object, I say, would be to send whatever mate require to be ground—to Sta for grinding would vary f pound, according to have neither m

e correcting you in one particular—
lid not say that flints were used "for
rcelain."—POTTERY TECH.

—**Wheels.**—If the cart gives a lurch to
it tends to drive the spokes outward if
this is resisted by tire. If not coned,
lurch would tend to draw spokes away
bes, which it could easily do.—T. C.,

—**Wheels.**—"Leicester" is hardly cor-
ing that "the lower spokes are, of course,
pendicular to the ground." Wheels are
ical," as "Leicester" calls it, so that the
y be perpendicular, or in the best posi-
ar the extra weight when the vehicles
ideways. Thus, if the road be rounded,
tly happens that the greater portion of
is supported by the lowest wheels, and
the approach to the perpendicular the
ume the greater the advantage gained.—
S.

—**Engine.**—Have a gas-engine. Sup-
comes on, and you have to get up steam
tting a light! And it would be as
l. Depends on how many lights you
ckon one H.P. for every five incandes-
andle-power lamps.—T. C., Bristol.

—**Steam Ports.**—Very seldom that a
e than uncovers the steam port. More
uld be waste of power. If no lap on
just covers *all* the ports when at mid-
. C., Bristol.

—**Steam Ports.**—I have sent a letter
portions of an ordinary D valve which
you. You will see that, in order that the
ch is exhausting, may only just be un-
e opening to steam must be = P – L; and
e half-travel, must be just equal to P.
d not be convenient, as it would be diffi-
a proper area for S with some degrees of
without making P awkwardly large, and
the clearance. The exhaust, too, would
en full for a moment, and back-pressure
increased.—GLATTON.

]—**Casting.**—Generally cast together;
arge castings there is a little risk of a
nd some makers use a liner. For a
10in. by 20in., cast together, and for such
fair, you had better lag the ends only.—
stol.

]—**Heating of Shafts.**—Your wires of
s are rather too tight. Take them out
flat on them until they feed enough, or fit
ires. I expect oil is rather thick some-
d does not flow fast enough. Have you
of the heavy mineral oils? They are
l effective.—T. C., Bristol.

]—**Photographer's Law.**—Most public
in England may be "taken" by the
her, and he has a copyright in the
Private buildings, of course, require
n; but, if taken, I believe there is no
revent the sale. Negatives of portraits
a photographer are his own copyright
pecial agreement was entered into at the
it a photographer who sells copies of
t without having obtained the sitter's
n, is actionable.—S. BOTTONE.

]—**Photographer's Law.**—(1) With
public buildings, there is nothing to hinder
g and selling photos. of them in this
In France and Germany permission is
the chief of police. (2) With regard to
buildings, you must get consent of the
efore selling the photos.; but if they are
will invariably get this. (3) If you mean
e purposes," selling or exposing to view,
tainly you cannot take any number of
u please from your negative of a photo-
ken for private use.—B. SC., Solicitor,
.

]—**Gas Stove.**—An atmospheric burner
it for the purpose; common luminous
hould be used. I have a cabinet bath
r ordinary jets inserted in a bit of compo-
They are rather too much, and the gas
turned down a little, so I daresay three
sufficient. Atmospheric burners always
isagreeable and very unhealthy smell in a
m, and should not be used without a
or good ventilation.—CITRUS.

.]—**Heights and Boiling Points.**—
a special thermometer made for this pur-
duated into either 0·20 or 0·10 of a degree,
called an hypsometer thermometer. It
not be placed in the boiling water, but
suspended in the steam; a kind of tele-
ssel is used for this purpose, heated by a
p, and is very portable. The difference
ater-boil point is approximately 2 deg. for
00ft. of height or depth. But the most
ist— heights is the aneroid
delicate —

use, and to show within a foot or so of the correct height. I can let "J. W. C." have further particulars if he wishes.—CYCLIST.

[58223.]—**Heights and Boiling Points.**—"J. W. E." had better rely upon an Ordnance Survey map for his information regarding the altitude of Fleet, for he certainly will not derive it from any experiment he may make with the thermometer. If the place named were several thousand feet above the sea level, he might have made a very rough guess in the manner he suggests; but as it requires an elevation of 1,080ft. to make a difference of 1° C. in the boiling point, he will see the utter uselessness of this method for obtaining accurate measures of small elevations. An aneroid barometer, graduated to show elevation, might answer "J. W. E.'s" purpose; but this would only give an approximate result.—MAGISTER.

[58223.]—**Heights and Boiling Points.**—The thermometer required for ascertaining heights must be most accurately graduated to the tenth part of a degree: the scale generally ranges between 180° and 214°; any ordinary, chemical, or other thermometer is utterly useless. It has its scale etched on stem, and is inclosed in a sort of telescopic case, the base of which acts as a boiler, making the whole instrument very portable. Each degree of the boiling point is equivalent to, roughly speaking, about 550ft., and one-tenth of a degree is equivalent to 55ft.; therefore, it shows the exactitude to which a thermometer must be graduated. At the summit of Mount Blanc, which is 15,650ft. above the level of the sea, the mercury of a barometer stands at 17in., and water boils at 185·8° Fahr., or 26·2° below the boiling point of water at the sea level. I see by Messrs. Negretti and Zambra's list, they supply a very portable form of instrument; but the price sets one against it. I advise you to get a good pocket aneroid barometer, which will cost you a little more than a mountain thermometer, but will give more accurate results. To find the height by one of these barometers is simple enough—*e.g.*, divide the difference between the readings at the lower and upper stations by ·0011; the quotient will give the approximate height in feet, thus—

Lower station ...... 30·385 inches
Upper station ...... 30·025

·360

$$\text{Divided gives } \frac{\cdot 360}{\cdot 0011} = 327\text{ft.}$$

—A. TREYER EVANS, Newport, Monmouthshire.

[58223.]—**Heights and Boiling Points.**—Any thermometer registering up to 212° Fahrenheit will do. Thermometer being sealed, is not influenced by the pressure of the atmosphere, and therefore, not influenced by its height above sea-level. It is only used to tell the temperature at which the water boils. There being less atmospheric pressure at high elevation, the water boils at a lower temperature. Thus, water would boil at a lower temperature in a partial vacuum than in the open air. You will find the tables you require in Molesworth's "Rule for Levelling with the Thermometer."

B = temperature of boiling water at any station deducted from (212° Fahr.).
H = height of station above level of sea in feet.
$H = 520\,B + B^2$.

This result is subject to correction for the temperature of the atmosphere by multiplying the difference of height so found by K.

K = correction due to $T + t$.
T = temperature of lower station in degrees Fahr.
t = temperature of upper station.

The values of K vary approximately in the proportion of ·0011 per degree Fahr.

TABLE SHOWING VALUES OF K.

$T + t$.	K.	$T + t$.	K.
40°	·973	120°	1·062
50	·984	130	1·073
60	·996	140	1·084
70	1·007	150	1·096
80	1·018	160	1·106
90	1·029	170	1·117
100	1·040	180	1·129
110	1·051		

—ELAG.

[58224.]—**Letter Punches.**—Quite possible for you to engrave a die for striking up matrice. Small chisels and files and light hammer, with patience and skill, all that are required.—T. C., Bristol.

[58225.]—**Dynamo.**—TO MR. BOTTONE.—Such a dynamo should light well four 5-candle-power Swan lamps. Swan's lamps are incandescent lamps. What do you mean?—S. BOTTONE.

[58228.]—**Feed Pump.**—Fix ½in. ram on crosshead.—W. W. E.

[58228.]—**Feed Pump.**—Capacity of your cylinder = 2½in. by 2½in. by 5in. by ·7854 = 24½ cubic inches, or, say, 26 cub. in. includes steam passages. Steam at 40lb. is about 475 times more in volume than the water from which it is raised; therefore, you will require $\frac{1}{475}$ of 26in. water each stroke, or, as pump only forces one way, that will be $\frac{1}{237}$ of 26in., and a revolution = 0·9 cub. in. If plunger connected to cross head, make it ½in. diameter; if to valve-rod, make it 1¼in.—T. C., Bristol.

[58229.]—**Mending Saucepans.**—I suppose you mean metal pans. In that case, cracks cannot be repaired, and they are only worth old metal.—HEXHAM.

[58230.]—**Bicycle Cranks.**—Is not this query answered (bar the lending of the tool) by the illustration on p. 285, same number?—ESSAR.

[58233.]—**Safety Blowpipe or Jet.**—Yes, there is room for such an article. Why not send a description of it? Perhaps it is only an old idea resuscitated.—T. J.

[58233.]—**Safety Jet, or Blowpipe.**—There are such things in some makers' catalogues as valves to prevent the gas running back into the bag, and so causing explosions; but unless "G. B." is going to allow people to play with his weights while the light is burning, there is not the least necessity for anything of the kind, either with the "safety" jet, or the "mixed" gas jet. As long as you keep your weights on the bags, you are perfectly safe from fear of explosion, unless you put oxygen into a bag which has before contained hydrogen, and has not been completely emptied.—MAGISTER.

[58234.]—**Horse-Power of Engine.**—Square the diameter of the cylinder in inches, which multiply by the speed of the piston in feet per minute, and divide by 6,000; the quotient is the power of an engine by Admiralty rule. Example: What is the power of an engine of 42in. diameter, 3½ft. stroke, and making 85 per minute? The speed of the piston will be 7 (the length of the double stroke) × 85 = 595ft. per minute. Now 42 × 42 = 1764 × 595 = 1,049,580 ÷ 6,000 = 175 horse-power.—LABOUR.

[58234.]—**Horse-power of Engine.**—You say nothing as to the speed or number of revolutions per minute—an important factor. However, you will find a simple formula on p. 283—57830.—ESSAR.

[58235.]—**Stuffed Birds.**—Why not try the method recommended by the Editor in "Answers," on p. vii., Nov. 20th? It seems to me, the initials being the same, that it is an answer to your question. At any rate, you cannot do anything better.—TAXIDERMIST.

[58236.]—**Electrical.**—I should say quite impracticable without having a lock specially made.—MAGISTER.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

57632. Technical Education, p. 109.
57635. Milk Analysis, 109.
57647. Pietermaritzburg, 110.
57649. Air Compressors, 110.
57650. Dynamometer, 110.
57661. To Mr. John Grey or other Correspondents, 110.
57665. Hints on Silvering on Glass, 110.
57668. Lunar Glaciation, 110.
57669. Plating, 110.
57679. Ball-Bearings, 110.
57682. Working Single Lines of Railway by Staff, 110.
57683. Int. Science Exam. of London, 110.
57685. G. E. R. Locos., 110.

57895. Violin Bow, p. 190.
57900. Upholsterer's Fringe, 190.
57905. Yield to Investors, 191.
57906. Bearings for Lathe Mandrel, 191.
57907. Pneumatic Ejector, 191.
57910. Ink for Embroidery Printing, 191.
57914. Furnace for Bending Plates, 191.
57917. Valuations, &c., 191.
67923. Locomotives, 191.
57936. Formula for Object-Glass, 191.
57944. Binary Star Orbits, 191.

Walnut Stain.—Imitation black walnut can now be manufactured very cheaply. One part of walnut peel extract is mixed with six parts of water, and the wood is coated with the solution. When the material is about half-dry, a solution of bichromate of potash with water is rubbed into it, and then your walnut is ready. In this way excellent walnut can be made from poor pine, and it is said to defy detection except upon very close examination.

QUERIES.

[58238.]—**Air-Pump and Condenser Combined.**—Would any of your numerous correspondents give me the following particulars? I have a horizontal engine, 10in. by 20in., making 90 revolutions per minute, cutting off at ⅝ of stroke, 60lb. boiler pressure, and I want to attach a condenser and air-pump combined to end of piston rod, which comes off at cylinder bottom, and am in a fix how to get sizes and design of common jet condenser; and if any of your readers, who has experience in this line, would kindly give me a sectional drawing through the "E. M." of air pump and condenser combined, with sizes of pump, condenser, injection pipe, discharge pipe, valves, and whether double or single acting would be best, and whether plunger or bucket, it would greatly oblige. I may add that I have got a pond, and plenty of water in it, close by; said pond is about 3ft. below level of engine cylinder. Will vacuum lift water that distance for injection? and what means could I adopt to feed the hot water to boiler?—ONE IN A FIX.

[58239.]—**Screw-cutting—Faulty Thread.**—I wish some practical reader of "Ours" would kindly explain the reason of a lathe cutting a thick and thin thread alternately. Some lathes show it more in left-hand thread then right. Some blame the leading screw for being bent, or out of pitch, and others the nut, or slack saddle; but I have had the leading screw out in some cases when it has not been bent.—LOUIS.

[58240.]—**Water-Closet Drain.**—I am interested in a block of eleven houses. All the w.c.'s empty into one drain. The Local Sanitary Authority (Urban) claim this drain as a public sewer, stating that where two or more w.c.'s empty into the same drain that drain becomes, under the Public Health Act, a public sewer. Can anyone inform me whether this is the case, and, if so, under which Section of the Act the power is given?—S. B.

[58241.]—**Pedal Organ for Harmonium.**—Will Mr. Fryer kindly explain in what way the arrangement of the pedal organ for American organs described by him would have to be altered to suit an Alexandre harmonium having about 15 stops?—BASSO.

[58242.]—**Boiler.**—Will "A., Liverpool," kindly give the thickness of his boiler plates, the diameter of his tubes, thickness of fire-box, how tubes are fastened in? Small sketch will greatly oblige—H. R. W.

[58243.]—**Stone Polishing.**—Can any correspondent inform me how to polish limestone pebbles and the larger kinds of sea shells? I have ground them down on lead laps with emery powder, but cannot polish them.—AMATEUR LAPIDARY.

[58244.]—**Life at Great Sea Depths.**—What is the greatest depth at which living creatures have been found? How does air get there? Would not animal tissue be completely crushed at the lowest Atlantic depths? Why should the fact that the body is, as it were, permeated by the pressure prevent such crushing of the parts? It is said that at great heights in a balloon the travellers bleed at the pores. Why should this be, internal and external air pressure being equal?—AT SEA.

[58245.]—**Varnishing Picture.**—I want to varnish the coloured plate given with "Lett's Yule-tide Annual." Will some reader kindly inform me what kind of varnish to use, and how to apply it? Will the picture require stretching on a frame, and, if so, please explain how this is done and how to make the frame?—PEINTURE.

[58246.]—**Microscopical Examination of Yeast.**—Will a brother reader give me practical instructions on examination of yeast with the microscope?—YOUNG BREWER.

[58247.]—**Tartaric Acid.**—Could any reader give me a cheap and reliable process for manufacturing tartaric or citric acids?—EXPERIMENTALIST.

[58248.]—**To Prevent Oil Penetrating Leather.**—Can anyone tell me how to treat leather so as to hinder oil from acting upon it—that is, from soaking into it?—JASON.

[58249.]—**To Glue Cloth to Tin.**—How can I prepare a tin surface to cause cloth or leather to adhere firmly to it? Have tried glue on the tin, but it breaks away, the tin surface being smooth. I thought of coarse japan. How would that do? Smooth surface on plaster casts. How is this managed? I have seen casts glazed and quite smooth, and would like to know how to do it.—JASON.

[58250.]—**Perkin's Heating Apparatus.**—Is Perkin's heating apparatus set up by any besides a firm at Liverpool? Also, can his furnaces be replaced by any other high-pressure furnace or boiler adapted to Perkin's pipes? An answer by any of your readers to the above inquiries would oblige many, besides—AN ANXIOUS ENQUIRER.

[58251.]—**S.E. Engines.**—Would any of your numerous readers give me a sketch of the old Dover mail engine of the S.E. Railway? What was her power, and what bore and stroke her cylinders had? Also of the newest type of engine on the S.E.R.?—PISTON ROD.

[58252.]—**Hardening Steel.**—I have some steel, which I can harden very well the first time; but, having softened it, I cannot harden it. How is this? Will some of our readers help me?—SOFT.

[58253.]—**Paint.**—What is the best kind of paint, or other coating, for inside of large iron tank to contain petroleum oil, the paint to resist the chemical action of mineral oil and help to make the riveted joints oil-tight?—PETROLEUM.

[58254.]—**Gas Burners.**—Will one of your correspondents guide me to a cheap and efficient means of testing the consumption of individual burners? Also of accurately testing the light given?—F. P.

[58255.]—**Protecting Iron.**—Can any reader inform me if there is any enamel or other composition known which will adhere to a malleable iron pipe and prevent it burning when exposed in a furnace to a continuous orange-red heat?—K. H. M. C.

[58256.]—**Motor for Propeller for Boat.**—I have got a canoe, 12ft. 6in. long, 2ft. 4in. beam, and I should like to work it with a propeller. Will some kind reader say what would be best to work same? Could I make an electro-motor? I think it would take up the least room.—POLLY.

[58257.]—**Porridge Stirrer.**—Is there any instrument in the market, analogous to the meat-jack, which will stir porridge while boiling, or how could I construct such a machine at small expense?—TIME IS MONEY.

[58258.]—**White Coating on Galvanised Iron.**—I have a galvanised-iron washing-machine, and am bothered by a white coating that is constantly forming on it, especially when soda is used. Can any of "Ours" tell me how to prevent this?—H. A.

[58259.]—**Haggis.**—Can any of your readers kindly give me a recipe for a haggis?—T.

[58260.]—**Leclanche Batteries.**—It appears impossible to get authentic information from the MECHANIC concerning the value of the Leclanché for lamps of small power. I intended to light two Swan's lamps of one candle-power each for microscope; but the correspondence is so discouraging that I have given it up for a time. "C. D. R.," in letter to the Editor 25048, says it is impossible to light any lamp at present manufactured by any number of quart porous cells (Leclanché) in series, be it 5 or 50. Mr. Bottone, 58088, in a reply to query, says it would require, at least, 25 such cells (Leclanché) to drive one 10 c.-p. lamp. Will any electrician answer the following? Is it possible or not to light a small lamp by means of a Leclanché, porous pots or agglomerate blocks? If so, how many? What advantage have the agglomerate blocks over the porous pots? How long do the blocks last? I should not require the current for more than a minute at a time.—HUGH.

[58261.]—**Soft Water Injuring Pipes.**—A friend has recently built a house, which is heated by hot water circulating in pipes, and complains that the water, which is very soft, has an erosive action on the pipes, which, if continued, must, in the process of time, eat through them. He has been advised to mix a little plaster-of-Paris with the water occasionally. What will be the probable effect of this treatment, and will any reader suggest a better cure? Can anyone report similar cases?—J. N. D., Tuxford.

[58262.]—**Microscopical Objectives.**—It has often been proposed to construct the lenses of microscopical objectives of precious stones, as the most obvious method of obtaining any material improvement upon their present powers. One objection to this, however, suggests itself—viz., that though a dry objective of, e.g., topaz would, no doubt, be infinitely superior in all optical qualities to one of glass, yet no dry lens is to be compared to an immersion; and although a fluid for immersion of about the same refractive index as the stone might be found, would not the difference in the R.I. of the glass cover of the slide go far to diminish the advantages of this construction? If Mr. J. W. Stephenson, or other authority, would give his opinion on this subject he would oblige and instruct many besides—HOMOIOS.

[58263.]—**Gyroscope.**—In Vol. XXVII., p. 518, is given a description of an electric gyroscope to show the revolution of the earth. I am wishful to make one; but from the description given cannot see how the contact is made and broken. The two poles of the battery are connected with the centres on which the gyroscope swings; that being so, it seems to me electricity will make a short circuit through the metal, and not pass around the electro-magnet. If anyone can give me fuller instructions they will oblige.—HARRY BOND.

[58264.]—**Oboe.**—Will any reader with a knowledge of the oboe kindly tell me how the instrument is suited for accompanying the piano and singing, and whether its tones are readily appreciated by listeners when played by itself? Is the fingering as difficult as that of the clarionet, and is more wind required? Any remarks, in favour or otherwise, concerning the instrument (especially regarding its tones) I shall be glad to have.—F. W. E.

[58265.]—**Black Picture Moulds.**—Could any of your readers inform me of what the composition consists used to produce a black, polished surface on picture mouldings? It appears to be a resinous substance laid on in the form of a paste, and stamped out into different patterns.—WILLIAM SAYSELL.

[58266.]—**Scene Painting.**—Could any readers of ENGLISH MECHANIC give me a few hints on scene painting, and also the proportions of the ingredients of the distemper used? I find a difficulty in shading in distemper. Ought the shading to be put in at once?—SCENERY.

[58267.]—**Guttapercha for Boots.**—Will someone kindly describe the process of re-soleing and repairing boots and shoes with guttapercha? Should the gutta be prepared in any way—i.e., hardened or toughened? If so, how? What is the value per lb. or per 100lb. of suitable gutta? I take this opportunity of informing you that your paper penetrates further into the ends of the earth than perhaps even you suspect. During a residence of many years in China, I was an irregular recipient of it myself, and have also seen copies some considerable distance in the interior of the Flowery Kingdom, generally in the possession of missionaries. I know two Chinese gentlemen in Canton, of more than local fame, who have a lot of bound vols., and they know how to appreciate them. A lot of odd copies was almost the entire literature of a friend of mine in Sandakan (Borneo). In a description of the papers received at the Royal School in Siam, I was glad to see the "E. M. and W. of S." well in position.—ALFRED PAWLEY, 767, Harrison-street, San Francisco.

[58268.]—**Steam Pressure Gauge.**—I have one of Bourdon's steam pressure gauges on my boiler. It indicates pressure of steam correctly. Usual pressure worked at is 70lb.; but when the small cock underneath the gauge is turned off, the pointer does not come down to zero. I want to know if this is proper? I can't make out what else the cock can be for, unless for this purpose. The gauge goes to zero when steam is off only.—ENGINE DRIVER.

[58269.]—**Oil Siphon.**—Will any reader advise the best kind of siphons for the lubrication of shafting in mills?—MILLWRIGHT.

[58270.]—**Volumetric Analysis.**—Can Mr. W. J. Grey, or any of "Ours," give me the following information? How can I prepare Fehling's grape sugar copper test, what proportions most convenient, and how used? In volumetric analysis are volumes of the same standard solution in direct proportion to one another—viz., if it takes 25cc. of $KMnO_4$ solution to reduce two grains of iron, then to reduce four grains 25 × 2cc. will be required. Is this correct? I see from a chemistry book I have that Dr. Clarke's soap solution is not in direct proportion to the amount of $CaCO_3$ present, and therefore he uses a scale. Again, how can I find out the amount of organic matter present in water by a standard solution of $KMnO_4$, and what strength should it be? Can I use H_2O instead of alcohol in Clark's soap test to dissolve soap in for standard solution?—CAERLEON, Mon.

[58271.]—**Marine Glue.**—Can any of "Ours" tell me the properties of marine glue, its use, how it is made, what it is soluble in, its chemical composition, &c.? I expect "Spon's Workshop Receipts" would say something on the subject.—CAERLEON, Mon.

[58272.]—**Lead Tartrate.**—Can lead pyrophorous be made in a powder, because lead tartrate, when heated in a tube, adheres to the side, and cannot be shaken into air when the tube is broken?—CAERLEON, Mon.

[58273.]—**Twine-Maker's Size.**—Will some reader of the "E. M." give me a good recipe for making size as used by twine manufacturers—one that will give a good gloss?—W. A. J. H.

[58274.]—**Regenerative Gas Fires.**—I observe from the answers to No. 58098, and from other sources, that the difficulty with regenerative gas burners is the great amount of heat developed. Can this not be utilised by Mr. Fletcher, or some other gas experts of "Ours," in constructing a gas fire which will give a great heat with a small consumption of gas? Something in the form of the "gill" stove used for heating air in churches, but with glass in the side next the room to throw out light and radiant heat, might succeed. In my house gas is used for all purposes, and the only objection to it is the expense. This, I hope, can be remedied by the adoption of the regenerative principle.—B. SC., Plymouth.

[58275.]—**Dynamo.**—To "W. H. E."—Having nearly completed my dynamo (armature, 8in. by 4in.) from instructions received from you, I should like to be informed as to the manner of carrying out the test it should go through—as to its capabilities, &c. I have a voltmeter reading up to 100 volts, but not an ammeter. The machine is shunt wound, and I intended, at present, working ten 20 c.-p. lamps off it. It is supposed to give about 25 ampères at 50 volts, working at about 1,500 revolutions. How can I calculate what resistance to insert in F.M. circuit for a varying number of lamps? Res. of armature (16 B.W.G., 24 sections) = 0·18 ohm; res. of F.M.'s (18 B.W.G.) = 33 ohms.—ELECTRA.

[58276.]—**Bicycle Spokes.**—Will anyone experienced in bicycle matters inform me how it is that the spokes in my bicycle are constantly breaking off short in the hubs? It is a high-priced machine, with all the so-called modern improvements, and by an eminent maker, and yet the spokes of the wheels often snap off the hubs while in use. As soon as I have one put in another goes, and the maker tells me that all machines are liable to go in this manner, and that he cannot account for it. Lately I have ridden it with a spoke out of each wheel, and the thing seems to stand a lot better thus. Are the spokes screwed up too tight, or are they of inferior quality? I may mention that I am not a random rider, and do not put machine to any unnecessary trial.—ALPHA.

[58277.]—**Rope Driving.**—Will some reader kindly inform me of the rule to get the horse-power of cotton ropes of any given diameter? Also the rule for getting the horse-power of hemp ropes?—E. RIGG.

[58278.]—**Overhead Motion.**—I am desirous of fitting an overhead motion to my lathe; but my flywheel is flat for a strap. Would a very narrow strap answer to impart the motion in the first instance to the overhead? Which is the better for general work—a parallel drum or a shaft with coned pulley, which can be moved along it as required? If a drum is the better, would it run lighter if made hollow?—T. H. C.

[58279.]—**Bellows v. Fan.**—Has any brother amateur made a double blast bellows for forge, and, if so, was it a success? Which is the right kind of leather to use? What is about the cost of enough for an 18in. circular bellows? When made, is much saving effected, taking in efficiency into consideration? Which is preferable—a fan or bellows, and which is the easiest to fit up?—T. H. C.

[58280.]—**Bunsen Battery.**—Would two Bunsen cells (carbon, 7½in. long), charged with bichromate solution in inner cell and saturated solution of salt in outer, run a 2½ c.-p. carbon filament lamp? If so, for how long?—IGNORAMUS.

[58281.]—**Burke and Holmes Cell.**—Could some kind reader give me a description of the above? How many would run a 5 c.-p. carbon filament lamp, and for how long? Please give all particulars of how to charge, as I am in total ignorance of the subject. Do they give off fumes?—LONDINIENSIS.

[58282.]—**Mariner's Compass.**—Can any reader of the "E. M." explain the contents of the vertical brass tube affixed to the exterior of the binnacle of Sir William Thomson's Mariner's Compass? Also, what portion of the deviation its contents compensate?—DEVIATION.

[58283.]—**Carriage Wheels.**—Can any of your readers inform me why the hind wheels of a carriage are invariably made larger than the fore wheels, and what would result if the reverse were the case, or if all the wheels were of equal diameter?—COACHMAN.

[58284.]—**Electrical.**—The difference of potential zinc and carbon in the contact series (S. Thompson's "Electricity") is 109 volts; should not this be micro volts? Also, where shall I find Ayrton's and Perry's results in contact electricity?—GEO. BROWN.

[58285.]—**Zinc Cylinders.**—Will any reader kindly tell me how to make these, such as are used in the new bichromate batteries outside the porous pot?—UNINITIATED.

[58286.]—**Bicycle Repairs and Alterations.**—Will any of "ours" kindly give me some information on converting a 54in. racer bicycle into a moderately strong roadster? It has Eolus balls, both wheels. What new parts are necessary? I have a front wheel rubber, but it is in two pieces. Is it possible to make two safe joints in

ially, are there any books or periodicals published
articles on bicycle construction or repairs? —
ER.

'.]—**Divorce.**—To Mr. Wetherfield.—Would
lly give your opinion in the following case? What
e the probable charge of a solicitor to conduct a
case on behalf of a poor man suing *in formâ*
? About seven years ago the wife left her husband
ie while her husband was absent, taking a lot of
ith her, and went to live with a man as his wife,
n she has had four children. There would be no
or opposition whatever. Would the husband have
by a local solicitor, or one in London, and would
band have to attend the trial personally?—W. F.

.]—**Screwing.**—Thanks to Mr. Westwood for
y on screwing machine. I cannot understand the
ose wheels each side of centre driving-wheel, and
nd of chuck to grip the bolt; also cost of a machine
1in. bolts. If Mr. Westwood will say, he will greatly
W. G. L.

.]—**Resilvering Lamp Reflectors.**—I have
lamp reflectors, silver (?) on copper, which have got
arnished. I should be much obliged if someone
ive me some practical hints for resilvering and
g them, if it is worth while for an amateur to
it.—Friar Bacon.

.]—**Leyden Jars for Wimshurst Ma-**
—Will Mr. Wimshurst say if a 24in. diam. plate
larger Leyden jars than the 17in. machine, and, if
how much so? Will not the old form of Leyden
rer as well as the new kind?—Induction.

.]—**Spark Coil.**—Will anyone who has had to do
luction coils say how many pint-size Bunsen cells
connected to a ¼in. spark coil without risk of injury?
w many pint-size bichromates?—Induction.

.]—**Dynamo.**—To "W. H. E.," Coventry.—
kindly give me quantities and sizes of wires to
dynamo with, Gramme armature, 5¼in. diam. and
ıg, with sheet-iron rings 1¼in. deep? The F.M.'s
he same system as described in your article on the
er, except that there is only one pair of F.M. cores,
am. and 7in. long. How many lights might I expect
ch a machine?—H. E. J.

.]—**Lantern Lens.**—I have a 1-1 plate portrait
plate do., and Victoria lens. Which would be the
ise for front lens of lantern? Also size of con-
I should require to cover a 10ft. disc? Also, what
an oil lamp would be best? Would a Mitrailleuse
be any use: it has sixteen ¼in. wicks and glass
?—W. W. E.

.] — **Stiffness of Cast-iron Steam**
lers.—Taking a vertical cylinder of an indefinite
and without flanges or ribs of any kind, the material
st-iron, having a direct modulus of elasticity =
00, and a transverse modulus of elasticity =
(Unwin, "Machine Design"), and weighing 0·26lb.
ic inch, will some reader kindly tell me how much
e distorted by its own weight when laid on its side
ng (of course, I am fully aware that this should not
if cylinder is to be vertical; but I want to know
able result), the thickness being 1in. and the mean
eing taken as 1ft.? Please give the smaller diam.
esulting elliptical figure; also the smaller diam. for
, originally two, three, four, &c., feet up to 10ft.
he thickness being 1in. in every case. If the thick-
ncreased, will the deflection be decreased inversely
ube of the thickness, or how?—Glatton.

.]—**To "F.R.A.S."**—Will our esteemed con-
be good enough to indicate a course of study that
able me to intelligently comprehend the most
problems of astronomy? I have a fair acquaintance
mentary mathematics, and have been an observer
e time; but I want to be prepared to understand
hematical part of the science. Would "F.R.A.S."
st of suitable books?—J. J. H.

.]—**Type Metal.**—Will some reader give direc-
r mixing same? I cannot prevent the metal turn-
k and throwing off a large quantity of dross. I
ery appliance for mixing any quantity.—Volt.

.]—**Gutta-Percha Boots.**—Will some reader
directions for mending same? If I put on a new
annot, with any amount of care, prevent the new
rting company with the old.—Volt.

.]—**Boiler.**—Will some reader of "Ours," who
small boiler work, kindly give me the over-all
ons of the smallest size suitable for the following
engine? Two cylinders, 3in. dia.; stroke, 4in.;
; steam, 35lb.; cut-off, ½. Boiler to be horizontal,
ernal flue, to be cased so that heat shall pass over
ide, and to be heated with petroleum. Also quantity
ecessary?—Ora et Labora.

.]—**Mixing Machine.**—I have large quantities
icals to mix, in a powder condition. In some cases
o mix 20cwt. of one powder with 100cwt. of another;
cases 100cwt. one, and perhaps 5cwt. of another, and
f another together, and all must be most thoroughly
As a subscriber from the first, will some of our
ends advise me the best kind of machine for the
and, if not objectionable to our kind Editor, annex
sketch, with full particulars and dimensions?—

.]- **Legal.**—Will Mr. Wetherfield kindly answer
and plainly as possible? A person dies without
a will. Is it necessary or compulsory that the
kin should take out what is called "Letters of
tration," and, if so, must it be done by a lawyer, or
kin? What is the simplest, best, and least ex-
way to have it settled?—Ignorant.

.]—**Magic Lantern.**—I want to fit to a lime-
tern a rack to hold two slides at once—one above
r—so that by turning a small handle working a
wheel one slide travels downwards while the one
been exhibited moves up, to be replaced by a new
Can any reader tell me how to construct such an
nt?—Hexham.

.]—**Peroxide of Hydrogen.**—Will any reader
form me of the latest process for the manufacture
de of hydrogen on a large scale?—Amateur.

[58303.]—**Forge.**—Will some reader kindly give me details for making a small (inexpensive) forge, and what kind of blower to use? I can find nothing in the last four vols. of "E. M." I have a fireplace and chimney in the room where I intend fixing the forge.—Boreas.

[58304.]—**Sulphate of Mercury Batteries.**—To S. Bottone.—Having made a few of these semi-dry batteries, I find them well suited for incandescent scarf-pin lamps. I also wish to know whether I could use them for electric bells by leaving the zinc in contact with the paste without losing their energy, and also about how long would they last in that position? I presume you mean they are to be recharged by spreading a newly-made paste on the carbons, or only simply moistening the flannel with water again? If a new paste has to be made, how can I recover the mercury from the used-up sulphate, as the mercury does not seem to deposit itself on the zinc plates? Would it make any difference if I arranged them as an ordinary voltaic pile, thus: carbon, sulphate paste, wet flannel, zinc, carbon, paste, &c., or connected them alternately as separate cells by wire? — An Amateur Electrician.

[58305.]—**Organ Blowing.**—Can anyone inform me in what back numbers "Organ Blowing by means of Weights" has been treated upon? I wish to know what weight would be required to blow a small organ of seven stops; also a lock-stitch sewing machine. I believe it is not considered practicable with regard to the organ; but still I have seen it in action, and at an organ builder's, too. —Power.

[58306.]—**Barometer.**—Can anyone tell me whether there is any rule as regards the length of the glass tube in Babinet's barometer, the description of which appeared in the Mechanic of Sept. 11? I have made one, which works well; the tube is about 3ft. long. I should like to know whether the working is affected by the length of tube. Mine works to about half the scale of the Jordan glycerine barometer.—C. F. S.

[58307.]—**Frosting Glass.**—Can any of your readers tell me how to frost glass by means of a bath of hydrofluoric acid or other preparation? I am acquainted with the gas method, but that is impracticable for my purpose.—P.

[58308.]—**Length of Strap.**—How can I find the length of strap on two cone pulleys, the strap not crossed? —Amateur Jack.

Liquid Carbonic Acid.—At a recent meeting of a German society some interesting details were given by one of the speakers as to the uses and the manufacture of liquefied carbonic acid, which is becoming quite an extensive business. The idea of raising sunken vessels by its means was spoken of, but it was stated that this notion had not been successfully carried out. It is well known that Krupp, at Essen, employs liquid carbonic acid as a means of exercising great pressure on steel castings during solidification. Another use is that of removing the outer rings from condemned ordnance. Experiments were made at Essen by warming the entire gun, and then cooling the inner tube intensely and rapidly by means of liquid carbonic acid. Complete success was obtained, the inner tube contracting so much that the outer rings could be easily removed. It was mainly owing to the improvements in the method of manufacturing the liquid dioxide which were worked out at Essen, that its systematic supply on a commercial scale has been developed, first by the firm of Kuhnheim and Co., of Berlin, and later by a company which has taken up their business. It is being largely used in the preparation of soda-water, &c., and for forcing beer from the casks in the cellars to the taps. At present the company are delivering eighty bottles per day of liquid acid, each bottle containing 8 kilogrammes, and costing 16s. This daily manufacture is equivalent to 320,000 litres of gas. The bottles are of wrought iron, and are tested to 250 atmospheres. Solid carbonic acid is made by allowing the liquid in a container to become gaseous, and rush out through an outlet, over which a porous bag is secured. A large portion of the gas escapes as such through the sides of the bag; but so much heat is absorbed that another portion solidifies, and is caught in the bag like snow, which can be made, by pressure, into a substance like chalk.

Poisonous Caviare.—At a recent meeting of a Russian Medical Society some observations were made in regard to several poisonous varieties of fish, especially three Asiatic species of Schistothorax and the Japanese Tetrodon inermis. It seems that the roes of these fishes retain their poisonous qualities for a long period; in one of the experiments made a portion of roe that had been preserved in alcohol for six months was given to a mouse to eat, with the effect of killing the animal in half an hour. The symptoms of the poisoning consist of vomiting, purging, syncope, tenesmus, cramps, and dilatation of the pupil, followed by collapse and death. Apparently there is no guarantee that the roes of these poisonous fishes may not find their way to the consumers of caviare in the ordinary course of trade.

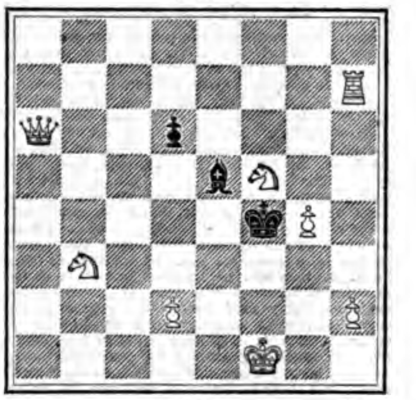
M. Menier, of Paris, electrical engineer and contractor, has purchased a large property, Rue de Chateaud'un, Paris, and is rebuilding it on a new system. He will sell electric light to all the lodgers in the house at a reasonable rate. It is the first time this speculation has ever been tried in Paris.

CHESS.

All Communications for this department must be addressed to J. Pierce, Langley House, Dorking.

PROBLEM DCCCCLXIX.—By W. B. Huggitt,
Newcastle-on-Tyne.

Black.



White. [8 + 3

White to play and mate in three moves.

SOLUTION TO 967.

White.	*Black.*
1. Q-Q R 2	1. Anything
2. Q or R mates	

(Six variations.)

NOTICES TO CORRESPONDENTS.

Correct solutions to 966, by A. Bolus (the best problem yet seen in the English Mechanic); to 967, by Link and A. Bolus (very good, quite a novelty); to 968, by A. Bolus.

A. Bolus.—We are glad you mastered 966 after all. The problem is quite correct, and shall appear.

Link.—You have overlooked in 966 that if 1 $\frac{}{\text{Q takes B}}$ 2 $\frac{\text{Kt-Q B 8 (ch)}}{\text{K-K 4}}$ 3 $\frac{\text{B-Q B 7 (ch)}}{}$ P covers.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 9, and unacknowledged elsewhere:—

Thomas Knowles.—C. P. White.—Morris Cohen.—E. P. Alexander.—G. Pottier.—Smith and Coventry.—Plumber.—Church Hill.—J. Resroc.—G. B.—S. E. Peal.—N.—Old Racer.—Apprentice.—F. H. Walker.—Severn. J. M. B.—A. R. F. K.—Mnemonikos.—New Subscriber.—B. L.—John H. Hindle, jun.—Young Ghazi.—H. S. Wilson.—C. Goddard.—Simplex.—P. C., Hornsey.—T. C., Bristol.—W. Van Eys.—Acolyte.—Sand-Rat.

Shamrock. (We believe the first velocipede or dandy-horse was described in the *Journal de Paris* of 1799. There are numbers of engravings of all sorts of machines of the kind in our earlier volumes.)—John Hamilton. (See Hints No. 5. Any number of similar queries have been answered in recent volumes, even in numbers lately issued.)—Amateur Turner. (See answer to B. Shaw. 2. Why not?)—C. S. (For full information about the Indicator and its Diagram see pp. 89, 130, 244, 272, Vol. XXXV.)—Inquirer, United States. (See p. 93, No. 1,018. Know nothing of the price. Makers will supply that.)—Smoky Lamp. (Get some fresh wick; see that it is dry, and then, if it is properly trimmed, the lamp will not smoke.)—Ink and Paper. (It is obtained by dissolving tin in hydrochloric acid.)—Skins and Hides. (See the indices, or p. 456, Vol. XXXIV., p. 431, Vol. XXXVII.)—Life-buoy. (If you mean in water, about 1lb. per stone; but less will do; knitted yarn would do.)—Havelock. (If the weight could not descend, it would simply hang from the wheels, and would not impart motion. Don't you think that the clock-makers would have found out your ingenious "perpetual motion" long ago? You should construct the machine, and satisfy yourself.)—F. WILLIAMS. (See indices, or pp. 259, 586, Vol. XXXVI.)—EARLY RISER. (Methods of connecting electric bells with clocks have been frequently illustrated. See p. 267, No. 1,026, for instance.)—L. M. J. CAREY. (If you had not been at the Antipodes we should have referred you to p. 463, No. 643. Woodhead (5,296yds.) on the M. S. and L., Standedge (5,280) on the L. and N. W., Bramhope (3,763), on the North Eastern, are the three longest tunnels in England.)—EDINA. (The correspondent promised to send the recipe to any one advertising his address; but it is made by the ordinary processes of boiling the raw material and drying the gelatine. Cannot be done profitably on the small scale. 2. By brushing it over with castor-oil.)—X. Y. Z. (No. Flint is cheapest and best.)—B. SHAW. (Several works of the kind. Greenwood's "Turners' and Fitters' Handbook" is useful; but you will find a list of the books in Mr. Calvert's catalogue, Great Jackson-street, Manchester.)—A. A. P. (It is built up on a wooden mould, which takes to pieces, and so is removed when the bellows is dry. You can purchase much cheaper than you can make one.)—F. C. L. (We do not know. A patent agent would answer the question on payment of a search fee.)—LEGH S. POWELL. (See Hints No. 5. A query will be inserted, but it is doubtful if anything satisfactory will come of it. We believe the gas is invariably used for frosting with acid; dipping, as you say, always resulting in a more or less smooth surface.)—E. A. L. (The insertion of such a query would give too much opportunity for gratuitous advertisement. There is more light with the larger number of wicks; but there is also more difficulty in preventing smoke.)—L. H. A. (See p. 431, Vol. XXXVII. It is usually sufficient to scrape thoroughly clean, and then rub in a strong solution of alum. Perhaps arsenical soap is better for your purpose.)—B.Sc., Plymouth. (Recipe for muffins on p. 414, Vol. XXXVIII.; for crumpets, p. 372, same volume.)—HAY FEVER. (There is a good deal about hay fever in Vol. XXVII. pp. 478, 531, 555, 606; but see Dr. Pirrie "On Hay Asthma," published by Churchills, New Burlington-street, W.)—PHILOSOPHER. (According to the terms of the question, the steamer would be leaving the wind behind, and would have a current of air against it. 2. The lad would run with much greater ease without the kite. 3. No, not quite; the use of the paddles would increase the speed of the boat.)—JUAN XPTOBAL. (Skim milk; but see pp. 356, 377, Vol. XXXIX. 2. See indices. Several books have been recommended; but probably Sir E. Beckett's "Astronomy without Mathematics" would suit you.)—AN ANXIOUS MOTHER. (There is no examination for a "degree" of electrical engineer. Anyone can append such a designation to his name. A knowledge of the classics is certainly not necessary. If he is coming to London, let him attend the classes at the Finsbury Technical College. Full particulars can be obtained from Mr. Philip Magnus, Director of the City and Guilds Institute, Gresham College, E.C. Or he can attend at the Central Institution, Exhibition-road, S.W.)—F. W. DOBB. (See the indices. Nos. 1,065, 1,027, and many places in back volumes.)—AMATEUR JACK. (If they were received, no doubt they have been answered.)—JOHN SMITH, JUN. (Given many times. It is glycerine four parts, glue one, and whiting sufficient to colour. The ink is made by dissolving aniline in alcohol or acetic acid.)—H. (Drawings of expanding mandrels on p. 54, No. 1,017; p. 384, No. 692.)—A TEN YEARS' SUBSCRIBER. (We do not know, and the name is not likely to be published. 2. The process mentioned enabled good metal to be made from phosphoretic ores, and is a decided success.)—YOUNG KNOWLEDGE. (We must refer you to the indices, or to a textbook. Directions for making induction coils have been given so many times.)—G. R., ANTWERP. (We are afraid you will not succeed in applying a circuit maker to each of the six panes; but you can easily arrange so that when the window is surreptitiously opened, the bell will ring. You will find suggestive illustrations in Nos. 984, 987.)—X. Y. Z. (You should procure one of Mr. Latimer Clark's Transit Instruments. See p. 164, No. 996, or No. 776, p. 530.)—X. Y. Z. (In type.)

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Advertisements *must* reach the office by 1 p.m. on Wednesday, to insure insertion in the following Friday's number.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Horse-power **Vertical Engine**, pump, centrifugal governors, brass, superheater, made for exhibition, highly finished. No rubbish. Will exchange for useful back-gear Lathe, or any useful tools.—59, Monkton-street, Leeds.

Gas Engine.—I have a one-man-power Dorrington's Gas Engine, new, fitted complete with gas bag, igniting jet, &c., cost £8 10s. Will exchange to value of £6, having no use for it.—F. BYRON, Nenagh.

I have got a few New and Second-hand Singer's Medium Sewing Machines. Exchange or offers.—STAFFORD, 17, Bradshaw street, Shudehill, Manchester. Repairer of all kinds.

Wanted, second-hand **Violoncello** in playing condition. Offers.—W. BRIGGS, Market-terrace, Wooler, Northumberland.

Plates.—House of Commons Lobby, 1869; Paris, 1867; Edinburgh; perfect. What offers? Magic Lantern and Slides preferred.—R. TURNER, Cleveland Villa, James-street, Oxford.

Two three-burner **Glass Chandeliers**, may be used for gas or oil, cost £8. Exchange for amateur's Lathe and Tools.—1, Cornwallis-crescent, Clifton, Bristol.

First-class **Lantern Transparencies**, direct photographs, in exchange for Photographic Apparatus, Lenses, Microscopes, Microscopic Accessories and Slides, or other Lantern Slides.—Apply, PIGGOTT, Chemist, Huddersfield.

A Bargain.—4½in. centre **Lathe**, quite new, screw-cutting, slide-rest, and carriage complete, owner going away. Offers.—FRIAR, 3, Victoria-street, Luton.

Model Locomotive wanted. Will give new operatic £22 Musical Box, and cash for good model.—185, St. George's-road, Bolton.

Wanted, good **Microscope**. Will exchange good Valve. Send particulars.—185, St. George's-road, Bolton.

Wanted, **Model Rowing Boat** (no rubbish). Will exchange Silver Watch, lever, ¾-plate, quite new, heavy case, crystal face.—185, St. George's-road, Bolton.

Carpenter's Tool Chest and several second-hand odd tools. Exchange.—SAUNDERS, Dickleburgh, Scole.

3in. Astronomical **Telescope**, with finder, Barlow Lens, Terrestrial and two Astro. Eyepieces, two Stands. Exchange for Photographic Camera and Apparatus to value say £12.—WM. MARSH, 61, Sarah Ellen-street, Blackburn.

Violin, by Hopf, cost 20s.; tone much improved since bought; also large Library of Electrical, Chemical, and Educational Books, mostly new. Wanted, Influence Machine or offers.—WILLIAM GRIERSON, 4, Houston-street, Glasgow.

Wanted, **Leclanche Battery and Bells**, in exchange for Photographic Rolling Machine and Spirit Lamps, cabinet size.—BOYCE, 79, Clifden-road, Clapton Park, London.

England's **Photographic Dark Tent**, nearly new, for wet or dry plate. Exchange or offers, anything electrical.—C. N., 51, St. James'-road, Tunbridge Wells.

Wanted, **War Medals**, dated 1848, and earlier. Exchange Mutiny. Also groups issued to one recipient. All letters answered.—PRIVATE COLLECTOR, 23, Adelaide-street, Blackpool.

Wanted, Lathe and cash, or what offers for **Meteor** TRICYCLE, cost £17, perfect condition.—HAYES, 3, Francis-terrace, Crownfield-road, Stratford, E.

Wanted, about 25ft. of 3 or 4in. **Leather Belting**. Exchange Lane-Fox Incandescent Lamps, Switches, Fuses, &c.—G. PRITCHETT, Bishop's-Stortford.

Treadle Fret Machine, good as new.
to value of 14s. Scientific or Mechanical Apparatu
Stoke Ferry.

Books on Phrenology wanted for exch
condition, author, and published price.—G. PICKLE
shire.

Lathe, back and front head, rest, cran
treadle, 25s. Also Scratch Brush Lathe.—CATON, 3rd F
gate-hill.

Coil, stand and fittings, ⅜ spark: exchange
cost 25s.—CATON, 3rd floor, 60, Ludgate-hill, City.

Wanted, **Lantern**, Lamp, Condenser, or S
change, whole-plate portrait lens, hand dynamo casti
amateur anvil, or offers.—EVERS, Wath, Rotherham.

Nickel-Plating.—Complete Apparatus
tions. Exchange anything useful.—G. WRIGHT, 156,
ton-street, Dudley, Worcestershire.

Slides, coloured, "From Tan Yard to Wh
(Grant's Life), "Catacombs of Rome," novel Japa
Slides. Exchange slides.—13, South Parade, Leeds.

Large **Coil**, ½in. spark; small ditto, ¼in.
vacuum tubes, frictional machine, and apparatus, two g
electric bell, four good magnets, &c. Exchange.—B.
West-street, Abingdon.

One dozen pure nickel silver **Teaspoon**
change for anything to value of 3s. 6d.; sample 4½
Oxford-road, Sheffield.

100 yards **Venetian Blind Web**, exch
scope or model engine.—A. ROWE, 21, Chiswell-street,

150 good strong stand, half standard, and
PEAR TREES, for hot-water piping or anything usef
The Gardens, Wisbech.

54in. **Bicycle**, ball bearings both wheels
and cone bearings. Exchange either anything us
Villa, Whyke, Chichester.

Lathe Wheel, 4-speed turned gut cr
24in. bellows, youth's tricycle, 200 ENGLISH MECHA
only.—D. S., 8, Court, Walsall-street, Wolverhampton.

"**English Mechanic**," Vols. XX
XXXIX., 26; XL., 24; XLI., 23; XII., 17; 104 copies.
offers?—JAMES MCNAB, Alexander-street, Renton, S

⅜in. spark **Induction Coil**, and 2 cell
Battery, quart size. Exchange for pair of Lathe He
A. SMITH, 17, Fountain-road, Hull.

Exchange **Horizontal Engine**, 3in.
stroke, with governor, grease and water cocks, fo
under 52in.) or tricycle (on approval).—C. GLUY
Callington, Cornwall.

Mechanical Orguinette, almost ne
with tunes. Will exchange good silver watch a
WHEELER, 19, Horton-street, Frome.

Astronomical Newtonian **Telescope**.
speculum, 7ft. focal, fully equipped, matchless perfo
offers? No rubbish. Seen at 46, Park-street, Stoke Ne

Double-barrel **Air Pump**, cost £7 10s.
Stanley-road, N.

Musical Cigar Cabinet, Magic L
Slides, with Chromatrope, 10 Musical Bells, Rifle, w
making machine; Air Pump, double barrel, with
Below.

Steam-Pressure Gauge, Electric Bell.
Bell, Telephone, Medical Coil, with Platinum, Zinc
covered Wire for Coils, Shop Dial Clock. Offers.—E.

30 Pieces of Coloured Designed **Glass**
shaped; Concertina, Vol. I. "Amateur Mechanic."
Wilson Sewing Machine, Sewing Machine Stand. Off

Clearing Out.—Offers for the above w
use to owner. Wanted, Lathe, cash, or offers.—G.
Portobello-road, Notting-hill, London.

THE SIXPENNY SALE COL

Advertisements are inserted in this colu
rate of 6d. for the first 16 words, and 6d.
succeeding 8 words.

Motor Castings, materials for Elect
Indicators, Batteries, Galvanometers Intensity
MENDHAM, and Co., Bristol.

Variable Resistance Incandescen
STAND, invaluable for battery power, vide ENGLISH
Oct. 16. Price 3s. 6d.—As above.

Standard Ohm, in box, copper poles, g
correct to ten thousandth of ohm, 21s.—KING, MENDH
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turers of Improved Pattern. Numerous testimonials as
efficiency.—KING, MENDHAM, and Co., Bristol.

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ordinary combined, 2½in., 5d.; 4in., 10d.; 6in., 1s.; p
above.

Write for **King, Mendham, and Co.'s**
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Electric Depot, 10, Deansgate, Manchester.
Breast Pins, 25s. Electric Bells, 4s. Induction Coils,
Proprietor.

New Illustrated Price List of **Screws**, Bo
NUTS for Model Work, drawn to actual size, sent
stamp.—MORRIS COHEN, 132, Kirkgate, Leeds.

Fretwork.—Catalogue of every requisite
illustrations, free for 6 stamps.—HARGER BROS., Settle

100 Foreign Stamps, including unused
Brunswick, Saxony, Hamburg, Constantinople, free,
Foley-street, London.

Hard **Vulcanised Fibre** for Magne
MOSSES and MITCHELL, 68A, Chiswell-street, London.

Hard **Vulcanised Fibre** for all kinds of
—MOSSES and MITCHELL, 68A, Chiswell-street, Lond

International Inventions Exhibi
Avenue, Group 21, Stand 1683.—MOSSES and MITCHE
well-street, London, E.C.

Salves.—The Black and the All-wound Salv
for burns, scalds, ulcers, &c. A box of each for
UREN, 19, Ann-street, Dalton-in-Furness.

Planing, not exc
CLEGG, 15, Belinda-street

For **Model Wor**
Boring, Turning, and

RECENT IMPROVEMENTS IN GAS-ENGINES.

THE great trial to determine the validity of certain gas-engine patents will, when finally settled, have an important influence on the development of that useful machine; but in which direction it is impossible to say at the time of writing. The Inventions Exhibition disclosed the fact that many minds have been engaged in the work of improving the gas-engine, and the Patent Office records show that there is at present (that is within the last two or three years) quite a host of applicants for patents in connection with gas-engines. Many of the applications refer only to modifications in details of well-known types; but others are radical departures from accepted practice. For instance, as agent for a foreign inventor, Mr. L. A. Groth patents improvements in gas or oil motors, which consist in forcing a mixture of air and gas, by the motion of the working piston, quickly into a hot chamber until the mixture is ignited by the combined action of the compression and the heat of the walls of the chamber, the expansion resulting from the explosion, or rather sudden combustion, of the mixture, being the driving power. The regulation of the ignition at the precise moment of the dead point is effected by a valve, which admits more or less combustible matter, and by another which regulates the heat of the cylinder. Mr. P. M. Justice patents, as the agent of a foreign inventor, an automatic gas-motor, in which the igniter is rendered incandescent, and explodes the mixture as soon as the velocity of the incoming gas is diminished. After the explosion a vacuum is formed which draws in a fresh charge of gas and air, and the parts having returned to their former positions the charge is again ignited. Amongst the more novel and most recently completed devices is a compound gas-engine patented by H. P. Holt and F. W. Crossley, of Manchester, in which the passages for charging, igniting, and exhausting are governed by the movements of what is called the high-pressure piston, without requiring the complication of a separate slide. It would be impossible to explain the arrangement of this engine without diagrams, and we must, therefore, refer those interested to specification 15,311, 1884, price 8d., for details. It must suffice to say that the invention appears to be an ingenious attempt to adapt the compound principle to gas-engines by allowing the expanding gases in the smaller or high-pressure cylinder to exhaust into the large or low-pressure cylinder, which process of exhaust induces the flow of a fresh supply of gas and air into the high-pressure cylinder. Another novelty, patented by A. Davy, Sheffield (12,264, 1884, 6d.), consists in the use of a steam generator in combination with a gas-engine, in order to effect economy by utilising part of the heat of explosion in the gas chamber to convert water into steam. The explosion chamber is surrounded by the steam generator or water chamber, and a portion of the products of combustion are also exhausted into the generator and intimately mixed with the steam formed therein. The mixture of steam and products of combustion thus obtained is used for working the piston on its return stroke or for driving a piston of larger area in another cylinder—thus producing in two senses a compound engine. Another patent which seems to have some promise of success is that of E. J. C. Welch and R. C. Rapier (9,645, 1884, 10d.), which refers to an engine of the type in which the gas is burned quietly and continuously under pressure, and the hot products are from time to time passed into the working cylinder, where they impart motion to the piston. The suction and delivery valves of the gas and air pumps are so constructed that when upon their seats the pump pistons can approach them so closely that clearance is reduced to a minimum, while in order to vary the amount of air and gas delivered by the pumps, the suction or the delivery valves are caused to remain open for a certain proportion of the stroke of the pump piston when in the ordinary course of things they would be closed, or a direct communication may be made between the two ends of the pump, which is kept open during a variable *part of the* early portion of each stroke. The *gas and air are delivered* separately into the furnace of the combustion chamber. The burners consist of a tube closed at one end and open at the other, suitable openings being made in the closed end for the passage of the gas into the tube, and narrow slits or rows of holes are made lengthwise of the tube for the admission of air. The closed or gas entrance end of the tube is fitted closely into a hole leading into the gas chambers, while the body of the burner extends through the air chamber and out into the combustion chamber, it being made airtight where it passes out through the air chamber. When at work the gas enters through the end of the burner and mixes with more and more air as it passes along through the perforated tube until a point is reached at which it can commence to burn, and where carbonic oxide is first formed by the initial combustion. As more air becomes mixed with the carbonic oxide it is converted by further combustion into carbonic acid. In order to regulate and maintain a continuous combustion, a quantity of broken pieces of fireclay or other refractory material is placed above the burners. To reduce the temperature of the products of combustion, they are mixed after combustion with an excess of air or a proportionate quantity of water, which is converted into steam. In starting the engine, gas is turned on from the main, and air is admitted through openings in the bottom of the furnace so as to heat the broken fireclay and coils containing the water to be injected. The air and gas supplies and the outlet from the furnace are then closed, and water being admitted to the coil by turning the engine a few times, or by a hand pump, sufficient pressure is generated in the combustion chamber to work the engine. W. J. Hill, of York, patents a method of cooling the working cylinder by circulating air in passages around it, which air is subsequently used for admixture with the gas to produce the explosive mixture. E. Capitaine and O. Brunler, of Berlin, patent (7,500, 1885, 4d.) a novel form of engine, which may rotate on a fixed crank shaft, the crank being in a casing and the explosive mixture being conveyed to the cylinders through the hollow shaft. T. Parker, of Wolverhampton, patents a device in which there are three cylinders having pistons connected to the same crosshead. One is a working cylinder having a space beyond the stroke of the piston forming a combustion chamber, into which the other pistons force air and gas from their respective cylinders. G. C. Douglas patents an improvement which consists in introducing air in'o the motor cylinder while combustion is taking place, for the purpose of utilising the latent heat of the dissociated gas to increase the efficiency of the engine. By adjusting the volume of air pumped into the working cylinder, it is claimed that there is no necessity for cooling the cylinder with water and wasting useful heat. Any device which will prevent the enormous loss of heat, which is the greatest defect of gas-engines, is a decided step in advance, and it is in that direction that real improvement is to be looked for. We have thus jotted down a few notes of devices which may or may not be improvements, but for each one that we have mentioned there are at least a dozen, the novelty in which consists in modifications of the mechanical details. In this connection, complication of valve-gear seems to be a step in the wrong direction; while the device patented separately by H. P. Holt (15,312, 1884, 6d.), in which the passages for charging, igniting, and exhausting are governed by the movements of the piston without requiring a separate slide or moving valves, is an example of the kind of improvement which will probably be found most successful.

A GOOD METHOD OF ENLARGEMENT.*

ARTISTS all agree that an enlarged landscape is more artistic in its effect, and, at the same time, truer to nature, than a picture of the same size taken direct. There is a breadth and mellowness that at once appeals to them, for there is an absence of the usual painful sharpness which they so much dislike. On the walls of an exhibition this quality of breadth tells with particular force, for the picture is not usually viewed with such
close scrutiny as when held in th
examined in a strong light.

A copying camera, or some arrangem
the purpose, will be necessary. The fo
answers admirably:—A camera, large
the size of the enlargement required,
of considerable extension, should be p
table, or a long board, properly sup
good lens well covering a quarter plat
it should be reversed—that is to say
the lens should be towards the ne
enlarged. Now take a small camera
the lens, and put the hole in the fr
lens attached to the large camera, an
the requisite height with a box, or
ready to hand—of course, taking care
sufficiently rigid. Fix the negative to
by the means of pins, in the proper
dark slide, and remove, or turn down,
pull up the shutter. Now place a pi
cardboard at an angle of 45°, so as to
of even white light on the negative
ticular to have the reflector large en
the image on the focussing scre
arranged to the satisfaction of the op
stop inserted in the lens sufficiently s
sharpness to the extreme corners of
will be well to cover up the junction
two cameras with a focussing cloth,
suitable material at hand, to shut
light, as only the direct light from
after passing through the negative s
the lens. Now put the plate in the sl
the exposure, and in this operation
of course, be necessary before the r
exactly hit off.

I would, at all times, recommend a
and the employment of a liberal amou
in the developer; for the object sho
out in the transparency every gra
found in the negative, without the s
of veiling anywhere, and to do this
slow development will be neces
transparency should show as solidl
negative every detail when held up
As soon as the transparency is dry i
further operations.

The next step is to make a vigoro
the transparency, and the best way t
be to immerse a piece of albumenised
silver bath, instead of floating it on t
the usual way. Of course, this is n
necessary, but a more vigorous nega
produced by this plan. If the print
fixed in hypo in the usual manner,
toning, and if, after washing and
placed in the printing frame, and ano
sensitive paper be placed in contact,
made from it, a result will be obtaine
surprise those who make the experi
first time, for there will be a beauty in
positive that they could not possibly h
As, however, the time in printing
negatives is very much greater tha
some method of making the paper
becomes necessary. Waxing answe
but is not easy to accomplish without
practice. Flat castor oil has been
commended, and will be found mu
manage. It should be applied to th
negative, and after blotting off the s
the albumenised side should be care
with cotton wool to remove any
from the surface. Vaseline may be
same manner.

For those who might object to th
grain that would be visible on a clo
two other methods are open. The
can be put in the dark slide, and a dr
same size placed in contact. Draw
and expose to a gas flame about 6ft. a
six seconds, but the exact exposure
mined by experiment, and develop
manner—bearing in mind the remark
ment given above.

To avoid the possibility of halati
the spreading of the white portion o
into any adjacent shadow, as, for inst
into a mass of dark foliage, or th
window into the dark mass beyo
blurring the outline—it will be wis
dry plate with some non-actinic col
sienna. The contents of a moist wate
thinned with water, and applied wit
small piece of sponge, will answer a
all pictures of strong contrast, whet
or interiors, this is a most important
adopt. If rightly timed, a perfectly
should be the result. The other met
a print of the transparency on su
tissue, develop on glass, and if the
strong enough intensify with
potash until a suitable printin
Of the three methods, the l
object is to obtain an enlar
be recognised as such,
perienced observer. If
about 7½ × 4, or small

---

* Extracted from an article by Mr. VALENTINE BLANCHARD in the *Amateur Photographer*.

ransparency not more than 15 × 12, and all the perations are skilfully performed, then I do not esitate to say that the finished result will charm y its beauty all those who have not worked in his direction before, particularly if the original egative should happen to be faultless in every espect.

MENDING AND PUTTING ON BELTS.*

WE used to have a 30in. rubber belt, which gave us more trouble than a whole mill ught to give. This belt was 125ft. long, and ran nder a 42in. binder, about 12ft. from the crank-haft. No lacing would stand in that belt. Hooks vere no good, and rivets pulled out. The belt was "6-ply." We put the belt on again, and made a ement joint. It stayed there as long as we knew he place; 8in. from the end of the belt, we cut cross, taking care to work square. We cut down ll the thicknesses but the last, and split off a piece plies thick and 8in. long. Next, we cut back 8in. urther, and took off 4-ply deep, leaving 2. The ext cut took off 3-ply, the next 2, and the last 1. Ve then had the belt cut off in a series of steps, ve in number, and 8in. long each. When the belt roke the last time, it made itself too short, and a iece had to be put in. It was cut by the above ethod, and fitted the end of the belt exactly. A ottle of naphtha was procured, and the whole plice thoroughly rubbed with its contents. At e same time, the splice was carefully scraped, nd all half-detached pieces of rubber carefully aken off. The naphtha "killed" all the grease, nd smoothed the surface of the rubber. Rubber ement was rubbed all over the surface of both ieces of the splice. By means of a pad of cotton oth the cement was spread evenly, and, neces- arily, very quickly. It dried very quickly, and a econd coat was applied. As quick as the second oat "set," so that the fingers would not stick it, the two pieces of belt were laid together on a hard floor, on smooth iron (I used e engine pulley), and lightly hammered with a large-faced hammer, which had been ground her "rounding." The cement will "bite" as ick as it comes together, and the hammering st be done quickly. After hammering, I nched two rows of holes across the edges of each , and 2¼in. apart, and along both edges. Small per rivets were put in and riveted *very lightly*. n't over-rivet them; they are worse than useless so done, and soon cut the belt.

he belt must be cut to length, and the second ice cut after clamping up. The easiest way to a heavy belt together, so the clamp rods can rk, is to use a pair of blocks or differential in falls. Get a second pair of clamps and put m on behind the screw-clamps. Now put a e sling around the end of each outside clamp, ch on the falls, and draw up the belt. Take e that the rope does not draw against the belt. once saw this same belt cut half way off by the e around the back clamp. When drawn up so clamp-screws will reach, the falls may be taken and the belt drawn up by the screws. Make splice as the first was made. Instead of ham- ring on the pulley, we must have a hard-wood rd, or a piece of boiler iron to work on. Slip it er the belt, and let it lie on the clamp-screws le hammering and riveting the splice. "Gandy" ts may be put together in the same manner. e much naphtha to kill the oil in which they e been soaked, or the splice will not hold. For her belts the common scarf lap-splice will do, ng one part fish to two parts common glue.

E TREATMENT OF CONSTIPATION.

HORT of mechanically obstructive disease, there are many states in which constipation is the st marked feature. On the nature of these, rt from the mere symptom, the possibility of manent relief by treatment must of course ely depend. We may procure comfort with a but often we cannot retain it with many. bit cannot be reformed or expelled by purges. ordingly, when we proceed against the fault of it now under notice we must take account of onstitution and circumstances in which it is ed. By so doing we do much to insure the ed relief, though it may be that even then we omewhat of complete success. A bowel long ent in activity, dilated irregularly, with torpid gh thickened walls, does not soon, if ever, re- its original tone and contractility. The dif- is a pathological one, and arises from l as well as functional perversion. The to obtain relief are hindered and of some cause which m would undo the p must seek and inds, ho

potent at the time, are but temporary palliatives of discomfort so long as no pains are taken to trace the trouble to its origin. Whether it be a sedentary habit of life, an excess of food overloading and overworking the viscus, purgation draining and depleting it, gout, diabetes, struma, chlorosis, altering either the structure of the intestinal wall or the consistence of its contents, it must be sought for as a chief guide to the means of cure. It is not likely that constipation will ever form the chosen hobby of a specialist. A far too general view of medicine and its adjuvant sciences is necessary for successful treatment to encourage such appropriation. We are not, however, outside the sphere of nostrums. There is in our time, if anything, too much reliance on physic-taking for constipation. More might be done by appropriate dieting and by inculcating active habits of life than is now customary. It may be noted, with regard to diet in particular, that a free use of simple fluids, as water, or mild mineral waters, is of distinct advantage in assisting both digestion and and evacuation. There are also many aperient vegetable foods which, with the same end in view, we should like to see in daily use at the table. Almost any kind of wholesome fruit and green vegetable might thus be made serviceable. When, again, we come to medicines, we must remember that the disorder which we have to combat is a complex one. We cannot in this case, more than in any other morbid state, put a finger on one tissue as alone or invariably at fault. Thus in the costiveness of anæmia we have atony of the intestinal muscle combined with defective secretion, and both but part of a general tissue starvation; in the gouty disorder of elderly people the same conditions appear, though due to a very different dyscrasia; and so on. We may say therefore, speaking generally, that no single drug can be relied on to meet the intestinal difficulty. An agent which aids secretion either of bowel or liver will not alone suffice. The long-inactive muscular coat likewise requires assistance. A free purge may have its value now and then, but when the object to be attained is the correction of a habit, a milder remedy used regularly is much more effective. To meet these various necessities, perhaps no combination is superior to the time-honoured union of belladonna with the compound rhubarb pill and nux vomica, or the most recent mixture of the fluid extract of cascara with the last-named drug. An agreeable change of remedy is afforded by many aperient mineral waters. The effect of these latter, however, is unfortunately apt to pass off after a time, probably from their causing a too copious intestinal secretion. The action of saline or other enemata is not quite similar. More strictly local, and exerted rather on the fæces than the bowel, it gives relief without so much exhausting the latter by secretion or peristalsis; while the very rest which the colon thus easily obtains is itself a help to the recovery of normal nutrition and muscular tone. The chief points which we would therefore bear in mind, whatever the remedies used in combating the habit of costiveness, are the need for recognition of its primary cause, and the fact that its proximate condition is an atonic bowel.—*Lancet*.

SCIENTIFIC SYSTEMATIC METHOD IN ORDINARY MECHANICAL OCCUPATIONS.—II.

By PROF. COLEMAN SELLERS.

LET me now give you an example of the working of the scientific method in actual practice, covering a case involving calculations and experiment. Steam boilers have been made to serve the purpose of death-traps from the most culpable neglect of ordinary precautions for safety, coupled with gross ignorance of Nature's laws, until the authorities were obliged to step in and define by laws certain precautions that must be taken for the welfare of the community. Steam boilers are made of sheets of iron or steel bent into shape and joined by rivets. As the strength of the entire structure is limited to the strength of the weakest individual part of the structure, it is of moment that the true value of any particular kind of riveted seam be known by actual experiment. There is no way of making the riveted seam as strong as the body of the metal. It is now usual to so proportion the number and size of the rivets to the thickness of the plates to be joined that the metal remaining between the rivet holes shall about equal the strength of the rivets that unite them. In determining the pressure of steam a boiler already made can be permitted to work under, a calculation is gone into as to the strength of the n as measured by the area in section of metal n the rivets, and also measured by the size her of the rivets, and the strength of the umed to be the lowest result of the After this, it may be necessary to h of metal that forms the boiler, here the lesson of the ball and the string comes into play, and our present illustration is as readily understood. It does not require a very high order of talent to master the calculations that are resorted to to determine what strain will come on this or that part of the boiler, and we have to rely wholly on calculation for that information. The boiler must be made much stronger than the ultimate or breaking strength of the metal to insure its safety in use, and to allow for deterioration. The difference between the ultimate or breaking strength and the strain that it is to be subjected to in practice is regulated by what is termed the factor of safety. All well-considered specifications for structural metal work, for instance, call for the material to come up to some established standard of ultimate or breaking strength, and the amount of metal to be used in the structure is determined by a factor of safety specified. This factor of safety may be as low as four in some cases of boiler and bridge construction, when the known character of the material used warrants the course, or it may be as high as thirty in the case of matter subjected to shock or blows, as in the case of rapidly-revolving gear wheels. That is to say, it may be considered safe to strain the structure to one-fourth of what would cause it to break, or the case may require that we dare not strain it beyone one-thirtieth of its breaking strength. The question now presents itself, how can every sheet of iron or steel to be used in the construction of a boiler, for instance, be tested when such sheets are usually ordered from the mill of the exact size that is required, and to test a part of such sheet would destroy it for use. This furnishes me with a suitable example of the scientific method carried out with ease and certainty in every-day practice.

Steam boilers of locomotives are worked at a rather high pressure, say 120 or 130lb. to the square inch, and the metal now mostly used in their construction is steel of a low grade as regards hardness —that is, steel of considerable ductility. The plate in the rough is, when cold, scribed to the required size of sheet that it is to be sheared to, and on the shear line two marks are made by the prescribed stamp, one mark being made at one blow of the hammer and the other by the same punch or stamp at another blow, and at any convenient distance from the other, but in no case are the two marks made by a twin set of punches or stamps at any fixed distance one from the other. This irregularity of the stamping renders the after matching of the strip, or coupon as it is called, an easy matter with the sheet from which it has been cut, the shear cut being made directly through the marks. The matching is still further facilitated by numbers or signs in white lead.

The samples, or coupons, are stamped with corresponding numbers after verification, and the test piece goes into the shop to be dressed to the proper width for the test, and the sample is then broken in a testing machine, and, in a book kept for that purpose, entry is made of every particular connected with the test, and the sheet received or rejected on this record. Suppose, however, that a sample shows a higher tensile strength than the maximum allowed—namely, 65,000lb. per square inch—and that such specimen has an elongation or ductility as great as can be desired, it may be well asked why it should be rejected. In the book of record I have seen some such cases, and reference is there made to the book of the chemist, into whose hands such sample is sure to go. His chemical test had in all cases, up to the time I saw the book, indicated too much carbon in the steel, and a simple physical test of heating and plunging the hot steel into cold water has shown it to be capable of being hardened. It is not deemed wise to employ any metal that has hardening qualities in the construction of steam boilers. After many such trials, the officers have come to consider the tensile and ductility tests as final, and as expressive of the qualities wanted. Thus you see every sheet in every boiler has its physical quality when new recorded, and its marks enable its after history to be noted. No sheet of steel can meet with mishap afterwards without having the report of the mishap recorded on the page that marked its acceptance, and its life or durability also noted. Such, in brief, is the account of the admirable scientific investigation into the quality of the material used in boilers as reduced to practice, and so persistently pursued as to be now no longer a subject of comment. This method of test, however, is the outgrowth of systems that preceded it. Practice and theory must agree. The scientific engineer can lay claim to the title only when he is abundantly fortified by sound experience, and has learned to view all things evenly.

In the specifications of the Pennsylvania Railroad stress is also laid on the percentage of stretch before rupture takes place in the required test.

(1) Bending cold.—A strip from each sheet must stand being bent over double, and being hammered down flat upon itself without fracture.

(2) Bending after being heated and dipped.—A strip from each sheet must stand being bent over double, and being hammered down flat upon itself,

after having been heated to a flanging heat and dipped into cold water without sign of fracture.

The bending test has been insisted on for several years, but the certainty of the ductility test has caused them to make it the final mode of determining the quality of the steel submitted to them. In order to make the bending as uniform as possible, they adopted the plan of holding the strip to be bent between rigid jaws, and striking the projecting end with a 10lb. sledge until it is deflected about 135°, when it was removed from the jaws and held with tongs while it was hammered down flat on an anvil. The bending after heating and dipping was added to protect them against acceptance of hard sheets, by reason of the test strips being annealed, accidentally or otherwise, by the manufacturers. Time is an important element in tests, particularly so in bending tests. An expert giving testimony in a trial in which the reliability of the steam-engine indicator was in question, said: "I believe in the result of the use of the indicator when I know who works the instrument." The bending test is good when you see it done in a proper manner, or know who does the bending.

Hurry the bending of good metal and it may break. Proceed with the bending of poor metal with caution, let it rest a bit between each blow, and a skilful man can bend a strip of brittle steel, so that the specimen will deceive the most expert. It is a very curious property of wrought iron and steel that, after being strained above the limit of elasticity and near to the point of fracture, rest will restore its strength. The story is told of some tests being made on beams for structural work before some officers of the Government. One maker strained a beam up to a point near to the breaking point, and then invited the Board to test some champagne, saying that he was willing to let the beam remain under its heavy load until after lunch. When the test was resumed, a strength was shown that could not have been reached had the rupture been hurried to completion, and the metal had been allowed no time to accommodate itself to the strained condition.

We have come to the time now when, to hold our place in the world in competition with others, we should waste as little of our energies as possible in cutting and trying in any hap-hazard way, and endeavour to avail ourselves of the acquired knowledge of the world generally, and make scientific application of the knowledge in our daily work.

ON THE DETECTION OF ADULTERATIONS IN OILS.*

THE chemical examination of oils is a very important though much neglected study—important from the fact that the oils which command a high price in the market and are in general demand are frequently adulterated. The temptation to adulterate is great on account of the heavy increase in profit, and because the adulterant is often very difficult of detection. The purchaser is always at the mercy of the oil merchant, unless the oil be submitted to a chemical examination. Our former Consul at Naples reported to the State Department that immense quantities of refined cotton-seed oils are sent to Italy for the express purpose of sophisticating the native olive oil, for the reason that it can be brought to Naples and sold at less than half the cost of producing pure olive oil. The cotton-seed oil mixed with pure olive oil is exported to other countries. The price of fine salad oil is from three to four dollars per gallon, while cotton-seed is worth from seventy to ninety cents per gallon. The oils commonly used to adulterate olive oil are colza oil, sesame oil, and peanut oil. In the North of France poppy oil is used frequently because of its cheapness and neutral taste, and in Provence honey is used. In all probability glucose syrup has been tried. Linseed oil, the most important drying oil in the arts, so much used in varnishes and paints, is very often sophisticated. Even the seed from which the oil is made is mixed with other seeds. In India flaxseed is grown with mustard and rape. In Russia various proportions of hemp and linseed are sown together. Hempseed yields an oil of an acrid odour, mild taste, and yellow colour, used in Russia for burning in lamps and making paints, varnishes, and soap. The oils commonly mixed with linseed oil are niger, cotton-seed, fish, rosin, and coal oils. In this country, lard is adulterated with palm nut and cocoanut oil; the latter is a white fat with the peculiar smell of the kernel. It was formerly made by grinding the kernel, boiling with water, and subjecting the paste to a great pressure; a large quantity of milky juice is so obtained, which is slowly boiled, and the oil separates and is skimmed off. Twenty ordinary sized nuts yield about two quarts of oil. The strong taste of these oils is an objection, and may prevent their general use as adulterants and for the manufacture of oleomargarine. Lard oil, which is obtained from lard, is very valuable as a lubricant for machinery, and is also used for greasing wool in spinning. It is frequently adulterated with fish oils and cotton-seed oils. Lard oil is worth 1 dol. 20 cents per gallon, while cotton-seed oil is worth about one-half as much.

The chemical analysis and detection of the adulterated is sometimes simple, but generally it is a difficult and trying task, especially when three or more oils have been mixed. The determination of the percentage of oil used to adulterate is out of the question, and we must often be satisfied by simply proving that there has been a mixture, without knowing the nature of it. But little work has been done on oils compared to the vast amount of research given to other subjects. Chemists have avoided the study and analysis of oils as difficult and uninteresting. We owe almost all we know to the labours of Chevreul, and later to the researches of Prof. Allen and others. When oils are examined, chemical tests are the more important, but the physical tests are also very useful. At the present time we have not a characteristic test for each oil, as we have for each metal, that will distinguish it when mixed with other oils or that will identify it when alone.

When we examine an oil supposed to be adulterated, much can be accomplished by procuring a sample of perfectly pure oil, and subjecting them both to the same tests and observing their behaviour.

According to Professor Bechi, of Florence, the following test is reliable and delicate for detecting cotton-seed oil in olive oil. The reagent is a one per cent. solution of nitrate of silver in absolute alcohol. Place 5 c.c. of the suspected oil in a glass flask, add to it 25 c.c. of absolute alcohol and 5 c.c. of the test solution of nitrate of silver, made as stated above. The flask is heated in a water bath at 84° C. (direct heat must not be used). If there be any cotton-seed oil present, the mixture will begin to darken, the most minute quantity serving to discolour, and the tint assumed will depend upon the amount of cotton-seed oil present. The test depends upon the fact that cotton-seed oil will reduce nitrate of silver, but olive oil will not. This reduction is also caused by rapeseed oil, but according to Bechi, pure olive oil will remain without discoloration under this test. While experimenting with the test, I thought it might be of service in detecting cotton-seed oil in lard oil: accordingly, the sample of chemically pure lard oil was treated with absolute alcohol and nitrate of silver as directed, and then heated; there was not the slightest discoloration of the pure lard oil; even on standing for two weeks it did not darken, thus proving it had no action upon the nitrate of silver. The lard oil obtained from the woollen manufacturer was then tested in the same manner: when it had been heated for a few minutes, it began to darken and finally became quite black, thus proving that the lard oil was not pure, but mixed with some other oil.

The elaidin test is sometimes very satisfactory, especially in detecting a mixture of a drying and non-drying oil and detecting adulteration of olive oil. This test depends upon the fact that olein and oleic acid in contact with peroxide of nitrogen yield a crystalline, solid, fatty body fusible at 32° C., to which Boudet has given the name elaidin. The nitrous vapours made by the action of nitric acid on copper are passed through the oil, or it may be shaken with a fresh solution of mercurous nitrate, which has the property of retaining nitrous acid. Non-drying vegetable oils and most animal fats contain oleic acid. The following oils contain a high percentage of olein:—Olive, almond, rape, arachis (earthnut), castor, and the oils from lard and tallow. These oils form with nitrogen peroxide solid elaidin of a white or yellow colour, which in some cases is firm and resonant. The drying oils such as linseed, hempseed, and poppyseed oils, do not form solid elaidin with nitrous vapours, but remain liquid for more than two days, and become slightly coloured. The elaidin test was applied to the adulterated lard oil and to the pure lard oil by adding an equal amount of nitric acid (sp. gr. 1·40) and some copper turnings. The elaidin produced by the pure oil was more firm and coherent than that of the adulterated oil, and was of a lighter colour; also the nitrous fumes rose more rapidly through the pure oil. One curious fact noticed about the adulterated lard oil was, it could not be completely saponified with caustic soda; even when the latter was added in excess, a clear layer of unsaponified oil remained after several trials. This test clearly indicated adulteration, as pure lard oil will completely saponify with caustic soda. Prof. Allen has proved that shark-liver oil and African fish oil resist saponification. He tried to saponify the former oil with aqueous potash, with a solution of potash in absolute alcohol, and by heating it with solid potash, but it would not completely saponify; this, he thinks, is due to the fact that it contains a body allied to cholesterin, but fluid at ordinary temperatures.

Pure lard oil treated with nitric acid of sp. gr. 1·33 takes a yellow colour, approaching orange.

The adulterated sample of lard oil wit acid of the same strength gave a distinct colour on standing. That portion of the o resisted saponification with caustic soda was with nitric acid, and it soon became of coffee-brown colour, much darker than the

The determination of specific gravity is important of the physical tests. The visc an oil is a highly important feature; but, to be of any value in testing, much care observed. Both oils must be brought to t temperature, and kept so while flowing. adulterated and the pure lard oil were sub this test; they were brought to a tempe 80° F., and 5c.c. of each oil were passed t capillary tube. The pure oil required 960 to pass through, while the adulterated oil 1,080 seconds. The experiment was several times with different tubes, but the the times of flowing was constant. Both subjected to a temperature of 32° F. W pure oil was frozen, it was more coherent and much lighter in colour; the ad sample was quite yellow. When the ad oil slowly became liquid, a layer of ye formed first, which was quite differen pearance from the other portion, and was the adulterant. While we cannot depend single test, the evidence afforded by severa conclusive and satisfactory, and, in this was acknowledged afterwards that cotto was one of the adulterants.

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* By OSCAR C. S. CARTER, in *American Chemical Journal.*

WOOD SCREW HEADS.

IT may be questioned whether the pre portion of bevel, or angle, to the wood screws is the best, and the prop diameter between head and shank is wood screw has a head that is twice the of the shank, and its underside bevel p face that is two-thirds the diameter of t or the original wire: thus: diameter $\frac{3}{16}$in.; head diameter, $\frac{3}{8}$in.; bevel of b Thus the head is very flat or broad in co with the shank, or size of the original which the shank is formed. Nails, w driven into the wood and hold only by lo friction, have very small heads—in finish hardly enough to redeem the nail's form of an elongated wedge. Srews hold by t projections—the thread—and certainly do any larger proportional head than do n the heads of screws are "upset" in a machine; in some instances, as of short sc upset head absorbing one-third of the l wire cut for the screw. This great spre course weakens the tenacity of the metal, a to "broom" it out. To this weakness, inh the unfinished blank, is to be added the sl the head for the bit or blade of screwdrive cut, always of a generous width, extends i almost to the bottom of the bevelled hea than half-way, making the head weaker a downward, because of the decreasing dia the head), in effect nearly splitting the two. These are faults in the present cons of wood screws that are apparent on consid Suppose that the proportions of the scre changed, so that the diameter of the head be less and its bevel more. For instance, t foregoing size of screw: shank, $\frac{3}{16}$in.; dia head, $\frac{1}{4}$in.; bevel of head, $\frac{1}{4}$in. This woul a head smaller in extreme diameter but t deep as the present style, while the head w stronger because it was less upset fr original wire size, but the screwdriver cu not be any deeper. The long slant of the b the head would obviate the necessity of a c sink except in very hard woods.—*S American.*

A NATURAL GAS FORGE

THE *Petroleum Age* thus describes a trial at Kendall, Pennsylvania, Benninghoff's patent process of smelti steel, and glass with natural gas. Iron a were quickly raised to a white heat in a w trolled flame, which came from mixing na with air, and the metals were easily and tho welded. The invention seems likely to tionise the smelting of iron, steel, and gla United States. The forge is built of bric 33in. square at the base and 30in. in heig firepot is located at the central point, and top of the forge. Inch air pipes coming fan or blower are connected to $\frac{3}{4}$in. gas outside and on opposite sides of the form T the gas and air are mixed, and the forge through the same pipe. The opposite sides are in a horizont another, and have their directly opposite and 1 lighted, the two flames . An air-pipe in the vert.

given by Herschel, as 6 years and 202 days, it became evident that the 27th of November, 1885, would fall only 40 days short of the time of passage of the cluster which caused the grand display in 1872. From the 22nd to the 26th November this year the sky was unusually clouded at Dun Echt; but on the 27th there were broken clouds and occasional patches of clear sky. Between 6.13 p.m. and 6.21 p.m. Dr. Copeland counted 109 meteors, which might be referred to a common radiant in Andromeda. They were all moving slowly, and of all degrees of brightness, from the 2nd magnitude down to the faintest streaks. Occasionally there were meteors of the first magnitude, which left trains lasting for a few seconds. They came sometimes singly, sometimes in pairs, and sometimes five or six at a time. On directing the prism to the part of the heavens where they were most numerous, he succeeded in seeing the spectrum of seven of them. The spectrum was faint, and there was one relatively bright line, the position of which could not be determined, though it was probably not far from F. Dr. Copeland counted 2,000 meteors in the south-west between 6.30 and 7.30 p.m., and 864 meteors between 8 and 9 o'clock.

Col. Tupman said that from a comparison of the other observations it would seem that the maximum of the star shower occurred between 6.15 and 7.15, when the greatest density was attained, and the shower appeared to last without appreciable change for half an hour. Prof. Grant, of Glasgow, thought that the maximum appeared between 6.35 and 6.40. They were mostly of the second and third magnitude, with occasionally a fireball. Mr. Denning determined three radiant points in Andromeda on the 26th, two on the 27th, and one on the 28th. He saw a considerable display of Andromids on the 30th; but on December the 1st, 2nd, and 3rd, the shower seemed to have absolutely passed away. The Andromids themselves were slow-moving meteors, as they followed the earth, and caught it up; but Mr. Denning had observed swift-moving meteors with a radiant not very far removed from that of the slower moving bodies. The swifter bodies were also following the earth, but must correspond to a much larger orbit.

Mr. Knobel said: I am rather surprised at the small magnitude ascribed to these meteors. With me the sky was not clear, and although first magnitude stars were not visible, I saw a great many meteors through the haze.

Mr. Common said: I observed the meteors through a field-glass, and was struck by the time during which I could observe the streaks. To the eye they faded away in a second or two; but with a field-glass they were visible for much longer. In one case a streak did not disappear as watched with the glass for nearly a minute. The streaks appeared to be broken up into isolated patches, and reminded me of the stratified discharges seen in vacuum tubes. On looking towards the radiant with the field-glass, I saw a great many minute meteors which were not visible to the naked eye.

Dr. Spitta said: I think I saw the large meteor which left a train which Mr. Common refers to. It passed across the W. of Cassiopeia about 6.45. I did not observe it with the telescope, but I saw several small meteors with a 10in. reflector, but they did not leave any trains.

Mr. Common: Yes, the large meteor passed across Cassiopeia.

Mr. Ranyard: I am inclined to concur with Mr. Knobel that there were a great many meteors larger than stars of the 2nd and 3rd magnitude. There were some as bright as Venus. The thing that struck me most was the size of the radiant area. The trains of the meteors were rather short, as they plunged nearly vertically into the atmosphere. But in many cases there was no great difficulty in fixing the line of flight, and mentally carrying it back to Andromeda, and it was pretty evident that the meteors, were radiating, not from a point, but from an elliptic area of about 10 degrees by 6 degrees in diameter. It is rather difficult to explain such a radiant area connected with a flight of meteors if we suppose them to come up to the earth in different directions; but it has struck me as possible that the radiant area may be explained by the irregular shapes of the meteors which cause them to be deflected from their original direction when they enter the earth's atmosphere. Otherwise, we should have to suppose that outside the earth's atmosphere the different members of the swarm had very different orbits.

Col. Tupman said: I laid down the course of some 25 of the meteors which I was able to observe with accuracy, and on producing their paths backwards on a suitably-drawn map, it was very evident that they do not radiate from a point, but from a distinct area of somewhat elliptic shape. (Col. Tupman illustrated this on the black board, marking in the stars, and some of the meteor paths.) I would remind the Society that this may be explained by the theory which an anonymous writer in *The Times* advocated the other day, and which some astronomers of repute hold—namely, that the meteors were originally ejected from the earth in directions which differ from one another by a few degrees, and that consequently they come up to and intersect the earth's orbit again in similar directions. The difficulty which strikes me with regard to this theory is that if the meteors had been moving in such orbits for millions of years, they would have been perturbated and unequally retarded; and if it can be supposed that they all continue to cross the earth's orbit at the same point, they would not do so at the same time.

The meeting adjourned at 10 o'clock.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE third meeting of the session was held on Tuesday, December 8th, at the Association Hall, Mount Pleasant, the president, Mr. Isaac Roberts, F.R.A.S., F.G.S., in the chair. Five gentlemen were elected members of the society.

A paper by Mr. W. H. St. Q. Gage, F.R.A.S., was read on "Star Colours," which is a combination of a list of coloured stars that is now being published in the society's *Journal*.

Mr. J. Rand Capron, F.R.A.S., contributed a paper called "Andromeda Meteors," in which he states that the display to which attention was drawn by circular from Dun Echt took place on the 27th Nov., but earlier in the evening than was anticipated. It commenced soon after dusk, and lasted till 9 p.m. At times the stars fell almost simultaneously, and occasionally three or four at a time. A few of the observations when the shower was the thickest gave 40 to 50 per minute. Except for a short period only, there was always cloud and mist to some degree, so that the countings and estimates are possibly under the mark. The estimated proportion of large meteors was one in ten; these were white, with long yellow, or reddish-yellow, trails, and three or four times the brightness of Jupiter. A considerable proportion were referred to the radiant point, but frequently they were scattered all over the sky, and not so easily traced.

Mr. Johnson expressed his surprise that they appeared so early in the evening, as we were led to suppose that they would not appear till later on. He had observed some himself on the 27th, and also some on the following evening.

Rev. S. J. Johnson, F.R.A.S., also contributed a paper entitled "Notes on the Late Shower of Andromids." He had counted 387 in 58 minutes in breaks of the clouds, but this could not have been above a fourth of the actual number. None remained visible more than three seconds, and very few beyond one second. Frequently two or three passed across the sky simultaneously. No nearly stationary meteor appeared, but a radiant not far from γ Andromedæ would suit their paths.

A paper followed, by Mr. W. F. Denning, F.R.A.S., on "Meteor Shower near Cor Caroli, Nov. 30 and Dec. 1 and 4, 1885." He says: "While observing the decline of the great display of Andromids, Nov. 27, I noticed on Nov. 30 and Dec. 1 and 4 a few very swift, long-pathed meteors, directed from a radiant evidently near the northern horizon. These were brighter than the average, and left narrow transient streaks along their courses. On the night of Dec. 4 I saw several additional meteors, which indicated a point at 194° + 43°, and may be regarded as fairly accurate. I believe this is one of the richest systems, contemporary with the Andromids. From observations at Greenwich on Nov. 13, 1870, Mr. Grey deduced a radiant at 193° + 40°, which falls suspiciously near the well-defined shower of the present year. The shower deserves special mention, as one likely to be often observed during future displays of the Andromids, and probably also of the Leonids."

The President observed that the weather on the Continent having been fine, a very brilliant display took place on Nov. 27.

Mr. Edwin F. Sawyer, of Cambridgetown, Mass., U.S.A., sent a paper, entitled "On a New Variable Star in the Constellation Vulpecula D.M. + 27·3890°." It is a variable of the η Aquilæ type. The observations have not been numerous or continuous enough, owing to cloudy weather, to determine the period with certainty; but the period will not vary much from 4½ days, fluctuating from 5·5 to 6·7 magnitude. The position of the star for 18500 is R.A. 20h. 45m. 19·4s. + 27° 42·3'. The star is not in Argelander's "Uranometria Nova." In Heis' Catalogue it is rated 6·0; Harvard Photometric Catalogue, 6·1, which is also the magnitude of the Durchmusterung. The star is likely to prove an interesting one, owing to its short period, there being only three known variables of this type with shorter periods.

The President observed that variables of such short periods suggest rotation on their axis. We generally consider these stars to be larger than our sun—yet our sun takes 26 days to rotate; so that if such variables are larger than our sun, it is possible that they may have a dark side and a light one. Sunspots upon their surface would not cause the variation.

Rev. J. H. Honeyburne suggested that a dark body might intervene between us and the star at regular periods, thus causing the variation.

Mr. Johnson observed that we are yet without any reliable variable star theory.

WESTERN MICROSCOPICAL CLUB.

ON Monday week the members and lady friends of the above club assembled in large numbers at 7, Kensington-park-gardens, by kind invitation of Mr. Crookes, F.R.S., and Mrs. Crookes. In the library the company was interested by an exposition given by Mr. W. Crookes on the subject of "Recent Results in Spectrum Analysis." Mr. Crookes pointed out that spectrum analysis has been the chief means of investigation by which the existence of many of the rarer elements has been determined. In the spectrum of any substance are to be seen certain lines whose position is invariable for that substance; in fact, each element has its own distinctive autograph written in the lines of its spectrum. In his researches among the rarer minerals Mr. Crookes had been haunted for two years past by a couple of spectral bands of colour, which he could assign to no known element. One is orange and the other citron coloured, and they are brought out when the ignited sulphates of some of the rarer earths are caused to phosphoresce by the electric discharge. After long attempts to isolate chemically the bodies producing these coloured bands they were found to be due, the citron band to yttria, and the orange band to the very rare earth samarium. These belong to the earthy group of metals, and their properties are mostly those of aluminium. Samarium is present almost everywhere in nature, in every rock and earth, and in sea-water, but in such small quantities that it is probable that hardly a single ounce exists in an isolated form in the whole world. To obtain the quantity upon which he had been working, Mr. Crookes used up a hundred weight of the somewhat rare mineral samarskite. Strange to say, it has been found present up to as much as half per cent. in a coral from the Pacific, the *Pocillopora damicornis*, which seems to have the power of extracting samarium from the sea-water, and storing it up. So delicate is the spectroscopic test for samarium that one part in 2½ million parts of an inert substance will give the distinctive lines. A peculiarity of this element is that in a pure state the spectrum of its sulphate is not at all brilliant; but if it is mixed with calcium in almost any proportions the lines gain in sharpness and brilliancy. If yttrium be mixed with samarium in gradually increasing proportions in the combined spectrum of the two elements, certain lines are blotted out, and a prominent red line appears. The effects of mixing lanthanum, lead, and calcium with samarium were also referred to. A number of diagrams illustrated the various changes in the spectra. At the conclusion of his remarks Mr. Crookes, by means of a coil containing 60 miles of secondary wire, which was worked by a storage battery, showed the peculiar and beautiful spectra produced by samarium, yttrium, and other of the rarer elements.

A cordial vote of thanks to Mr. and Mrs. Crookes was moved by Mr. Walker, F.G.S., seconded by Dr. Gladstone, F.R.S., and was carried by acclamation.

The next meeting of the club will take place on Jan. 4, at the house of Dr. J. W. S. Meiklejohn, F.L.S. Subject, "Bacteria and other Allied Organisms."

The Basic Process.—The total output of steel and ingot iron made from phosphoric pig by the basic or Thomas-Gilchrist process during the 12 months ending September 30th, 1885, amounts to 945,317 tons, being an increase of about 10 per cent. upon the make for the previous 12 months. Of this year's make no fewer than 600,183 tons were ingot iron, containing under 0·18 per cent. of carbon, and were used in the manufacture of wire, tin plates, tubes, sleepers, boiler and ship plates, &c. The makes of the various countries included under the above gross total were:—England, 145,707 tons; Germany and Austria, 617,514 tons; France, 130,582 tons; Belgium and other countries, 51,514 tons—total, 945,317 tons. Out of the foregoing England made 70,813 tons, containing less than 0·18 per cent. of carbon; Germany and Austria, 424,862 tons; France, 62,390 tons; and Belgium, &c., 42,118 tons, giving the total of 600,183 tons.

In a paper on the size of the brain in exti animals, Prof. Marsh, of Yale College, has brou forward the remarkable fact that in the ra life during past ages the survival of any par group of animals depended upon the size brain as compared with that of their cont of the same class. Brains won then the brain of animals crushed out always found to be relatively those outliving them.

SCIENTIFIC NEWS.

◆

ɪHE death is announced of the distinguished palæontologist, Xavier Ullesberger, at ›erlingen, Lake of Constance, in his 80th r. Much of our knowledge of the lacustrine ages in the Lake of Constance is due to him, his extensive collection of Celtic and pre- ›oric objects is preserved at Stuttgart.

'un Echt Circular No. 102 gives elements ephemeris of comet Fabry calculated by H. Oppenheim, from observations on Dec. 1, ınd 7. T = March 9·7944 Berlin M.T.; - ☊ 132° 36′ 19″; ☊ 32° 17′ 32″; *i* 47° 18′, ın equinox 1885; log. *q* 9·69654. The emeris for Berlin midnight is—

	R.A.			N. Dec.	
	H.	M.	S.	°	′
Dec. 19	0	1	35	20	42·9
21	23	58	22	20	43·6
23	23	55	19	20	45·1
25	23	52	27	20	47·4

ɣhtness taken as unity on December 1 shows for December 25.

he small planet discovered by Prof. Peters 'linton, N.Y., on August 16, has been named ; it is No. 249.

hė richest collections of meteorites are ›e in London, Vienna, Paris, and Calcutta, Dr. Aristides Brezina has just published a ılogue of those in the Hofkabinet, Vienna, ll representing about 360 genuine meteoric ıes. The catalogue also contains an essay ıhe origin and classification of meteorites a map of the world, showing the localities ʳhich the specimens at Vienna were found.

mongst the afternoon lectures before ter at the Royal Institution we notice the ›wing:—Three lectures by Prof. R. S. Ball, D., F.R.S., Royal Astronomer of Ireland, "The Astronomical Theory of the Great Age," on Jan. 19, Jan. 21, and Jan. 23. lectures by Prof. A. Gamgee, M.D., F.R.S., 'The Function of Circulation," on March 9, 23, 30, April 6, 13. Four lectures by Wm. :. Austen, F.R.S., Chemist of the Mint, on ›tals as Affected by Small Quantities of Im- ıty," on Jan. 28, Feb. 4, 11, 18. Four lec- ›s by Prof. W. Boyd Dawkins, M.A., F.R.S., "The Ancient Geography of Britain," on . 25, March 4, 11, 18. Four lectures by f. Tyndall, F.R.S., on "Light," on March 25, il 1, 8, 15. Four lectures by A. Geikie, Esq., .S., Director-General of the Geological Sur- of the United Kingdom, on "The History Volcanic Action in the British Isles," on . 30, Feb. 6, 13, 20. Two lectures by Rev. 'aylor, D.D., Master of St. John's College, ıbridge, on "The History of Geometry; the ›ks and the Moderns,"; on Feb. 27, March 6. ' lectures by E. B. Poulton, M.A., on "The ıre and Protective Use of Colour in Cater- ırs," on March 13, 20. Two lectures by 'ard Grubb, F.R.S., on "The Astronomical scope," on March 27, April 3. Two lectures Prof. Oliver Lodge, D.Sc., on "Fuel and ke," on April 10, 17.

:. F. W. Brearey, hon. sec. of the Aëro- ical Society of Great Britain, has been nissioned by the executive of the Liver- International Exhibition to aid them in ›ising a collection of ›aëronautical appli- s, &c., in connection with the exhibition, ·h is to be opened in May next year.

ıe new balloon constructed at Meudon es a steam-engine on the plan advocated ıe late M. Henri Giffard, electricity having, pears, totally failed, owing to the lack of ınuous action. A velocity of six mètres 'ft.) per second was obtained, that is, ›ft. per minute—probably with a good ›e.

ıe International Exhibition of Industry, ıce, and Art, to be held in Edinburgh in ›oming year, has an artisan section which ıises to be of much interest, and may prob- be beneficial not only to artisans who are bitors, but also to the general public. -ⁱˢ the first exhibition in Scotland at which ı from artisans could be received, and as - —ill have an opportunity -which will be pro- - the Board of

of Telegraph Engineers and Electricians, held last week, Prof. D. E. Hughes, F.R.S., was elected president, and Dr. J. Hopkinson, D.Sc., F.R.S., one of the vice-presidents.

At a meeting of the North of England Institute of Mining and Mechanical Engineers, at Newcastle, last Saturday, Mr. J. W. Swan exhibited his portable electric safety-lamp, and read a paper on the subject, in the course of which he stated that the lamp and battery combined were capable of giving during 10 or 12 hours twice or three times the light of a common safety-lamp. On first lighting it gives the light of two candles, and after ten hours, about 1½ candle. As in the earlier lamp, the light comes from a filament of carbon, sealed airtight in a small tube, and this tube is protected by a bull's-eye of glass, so strong as to be practically unbreakable. The battery is a secondary cell, but another kind can be used, composed of zinc and lead oxide, with a special view to the occasional employment of the lamp for exploration in vitiated air. This is a primary cell, and only requires filling with liquid to make it ready to give light. It will sometimes be convenient to have a duplicate lamp within the bull's-eye, with a switch connection to enable either, but not both, to be lighted, so that in case a lamp should fail, the miner will not be left in the dark. The weight has been diminished to about 6lb.; but as weight is necessary if duration of the light is to be studied, it has been subordinate in the scheme of the inventor. According to Mr. Swan, a secondary battery such as he has adopted can be charged with even less trouble than attends the trimming of an oil lamp. It is only necessary to insert a couple of wires from an electric main into the charging sockets of the battery, and to leave it there from the time the lamp is handed in at the end of a shift until it is wanted again. twelve or fourteen hours after. Hundreds of lamps can be charged at a time in this way, and at very small cost. An engine developing an effective five-horse power, and a dynamo electric machine, correspondingly small, would suffice to charge 300 lamps at one operation. Mr. Swan hopes to add a foul-air detector to his lamp.

At the same meeting of the Institute a report was presented in reference to the proposed exhibition of mining and mechanical engineering plant, in which the committee stated that it has been decided to hold the exhibition in the grounds of Singleton House, Newcastle, with the consent of the City Council, the Durham College of Science, and the College of Medicine. Mr. K. Gibbons has been appointed acting secretary.

A new dairy having been established at the Royal Agricultural College, Cirencester, the Professorship of Practical Dairy Farming has been accepted by Mr. James Long, of Gravely Manor, Stevenage.

Several passengers who crossed the Atlantic in the Cunard liner *Umbria* on her recent trip arrived in London within 14 days of leaving San Francisco, the Midland Railway Co. having placed a special train at their service. The journey is the best on record in the history of rapid travelling.

The *Albatross*, the expeditionary vessel of the United States Fish Commission, is fitting out for a surveying cruise in the Bahamas, under the direction of the Navy Department.

Dr. Asa Gray, on the occasion of his seventy-fifth birthday, was presented with a silver vase by the botanists of America. The vase is decorated by representations of American plants, to which Dr. Gray has indissolubly attached his name.

It is understood that the Government have had under consideration proposals dealing with the Electric Lighting Act, the stringent provisions of which are believed to have hindered the employment of the "new light" by local authorities.

The *Arawa* (Shaw, Savill, and Albion line) has recently made another fast run from New Zealand, her full time from Auckland to Plymouth being 38 days, 10 hours, 48 minutes. She brought a cargo of frozen meat in first-class condition.

—ter has been let into the basin of the —d it is said that they will be —s by the New Year.

LETTERS TO THE EDITOR.

◆

[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆

THE MINUTE COMPANION TO λ ORIONIS — THE TRAPEZIUM IN ORION — GHOST IN A TELESCOPE—AN ICE CORRECTIVE FOR A CURIOUS "DELUGION" — THE NEW COMET IN PISCES — STAR DISCS AND APERTURE — CONVERSION OF PHOTO. O.G. INTO TELESCOPE—ASTRONOMICAL BOOKS.

[25108.]—WHAT may be the present magnitude of the minute *comes* south of λ Orionis (spoken of by Mr. E. M. Nelson in letter 25060, p. 278) I do not know; but, unless it be a variable, the estimations of its size seem curiously discordant. Struve (Vol. I., "Dun Echt Observatory Publications," p. 28, foot-note) calls it 12·0 = the 20th magnitude of Sir John Herschel! Now Herschel's 15·9 mag. = Smyth's 16, which the late Admiral thus defines on p. 427 of Vol. I. of his "Celestial Cycle": "What I term," he there says, "the 16th magnitude is the *minimum visibile* of my powers both in eye and instrument, and merely indicates a minute point that can be caught by glimpses, when watching under favourable circumstances of atmosphere and telescope." Smyth's telescope, as is thoroughly well known, was of 5·9in. aperture, but he never seems to have caught sight of the star under discussion at all. Webb, however, perceived it as "a very minute *comes*" with 5½in. ("Celestial Objects," p. 359), and goes on to add, "Glimpsed by Ward with 2⅞in. achr. 1875." It must have brightened since Smyth's time.

With reference to Mr. Nelson's concluding query, it may suffice to say that no change whatever has taken place in the relative positions of the four stars forming the trapezium of θ Orionis since the time of their first discovery.

In ninety-nine cases out of a hundred, a "ghost" in a telescope has its origin in the eyepiece, and is produced by the reflection of a bright image from the convex surface of the eye-lens of a Huyghenian on to the plane surface of the field lens, whence it is returned through the eyelens to the eye. It seems, however, pretty evident that this explanation will not apply in the case of "H. A." (query 58219, p. 289), inasmuch as he sees his "ghost" "with all eyepieces, and when they are turned round in tube always in same position in field." Hence we must, in this instance, refer his unwelcome spectre to the object-glass. With reference, however, to the latter being merely out of adjustment, I would caution my querist that this would be manifested, *not* by "a flare" on one side of a star, but by the diffraction rings which should equably surround the stellar image being all on one side of it: the side, in fact, on which the periphery of the tilted objective is furthest from the eye-end of the tube. A flare has its origin in the want of homogeneity in the material of the object-glass, and is an incurable defect; unless, indeed, the aberrant part of the glass be covered with a stop. Has "H. A." tried turning the lenses of his objective round in their cell? I strongly suspect that your correspondent's object-glass is an irredeemably bad one, though.

Might I venture to suggest to your correspondent "E. L. G.," that he should attend the lectures announced to be delivered during the forthcoming session of the Royal Institution by the Irish Astronomer Royal, Dr. Ball, on "The Astronomical Theory of the Great Ice Age."

I last night (November 10th) saw the comet in Pisces, referred to in the Dun Echt Circular, No. 100, which you quote in your "Scientific News," on p. 297. With a power of 40 on a 4½in. achromatic, it was discernible as a hazy, nebulous spot, not circular in form, though the bubbling and boiling of the atmosphere rendered it impossible to say in what direction its figure was lengthened. At intervals an exceedingly minute nucleus seemed to flash up. I subsequently attempted to observe [illegible]arnard's *Comet*, announced in the [illegible] Circular, No. 101; but wholly failed to find it. Why does not Mr. Grover (letter [illegible], p. [illegible]) give the aperture and power of the instrument with which his observation was made?

In reply to the personal appeal made to me by Mr. Holmes in letter [illegible], p. [illegible], I can only regret that my own practical experience with reflectors is far too limited to entitle me to speak ex cathedrâ with reference to them. I may, however, add that I should as soon think of arguing with Mr. Calver on any question in connection with the action of this form of instrument as I should of contradicting Sir Wm. Thomson on an electrical one, Mr. Sadler on a point in connection with stellar literature, or Sir William Gull on a matter of pathology. Having said which, I may add what is notorious, that as we contract the aperture of a refractor (the focal length remaining the same), the spurious discs of stars do, of course, increase quite notably in size.

With reference to reply [illegible], p. [illegible], it may suffice to say that 24in. is much too short a focus for the object-glass of a telescope of [illegible]in. aperture, to say nothing of the fact that the correction of a photographic lens is for the actinic rays, and that it would, almost certainly, not be nearly achromatic.

I am afraid to say how many times I have in one form or another, answered the query [illegible] put by "J. J. H.," on p. 306. Writing in a great hurry to save the post, I can only say here that my last two replies may be found on pp. [illegible] of Vol. XXXIX., and 256 of Vol. XLI. Ball's "Elements of Astronomy" in Longmans' Text-books of Science is a capital book to read for the purpose of obtaining a general view of astronomical science prior to studying the subject mathematically.

A Fellow of the Royal Astronomical Society.

BARNARD'S COMET.

[25109.]—THE comet was seen here on Dec. [illegible]th, at 11h., when its approximate position was R.A. = 4h. 0m. 40s.; and Dec. − [illegible]° 37′ [illegible] Tauri. It was rather faint, a little elongated in direction of the sun, brightening very gradually to the centre, on which a most minute stellar nucleus was seen. Diameter about 4′. **Herbert Ingall.**

Champion Hill, S.E., Dec. 12.

[25110.]—NOTHING in cosmic nature can ever be imagined so interesting to learn as the materials of comets. Yet it seems, from letter 25084, that another priceless opportunity, like that missed by Dr. Huggins some 20 years ago, has again been thrown away, of observing what absorptive effect the gas of one exerts on transmitted starlight. I say advisedly "gas," because only a refractive medium could have the effect Mr. Grover describes, of making a star look "larger and less distinct." No mere swarm of meteors can magnify. Why is no spectroscope ever ready on these precious occasions, to compare the star's transmitted spectrum with its natural one? There is now no conceivable observation so important, whatever way its results may tend.

Dec. 11. **E. L. Garbett.**

BRILLIANT METEOR.

[25111.]—I SAW a brilliant meteor on the evening of the 8th Dec. at about twelve minutes to six. It passed between ψ and δ Persei, almost due south —in other words, towards 2.5 (twelve o'clock being the zenith, and the course of the meteor the direction of the hour hand of a clock). The train remained fully a minute, and was at first probably 40° long. My position at the time was lat. 53° 42′ 42″, long. (W) 1° 50′ 3″, from the Ordnance map. If other observers have seen the same at some distance, perhaps its height, &c., may be calculated.

Wm. Davenport.

ASTRONOMICAL.

[25112.]—THE division in the ring of Saturn ought to be visible now, in a 2in. telescope, if ever: but, although Mr. Holmes asserts that he so sees it, as well as the crape ring, it is not visible to me. I have tried in vain on several clear nights this week, with a reflector stopped down to 2in., and find others have the same experience.

Can Mr. Holmes give any other evidence than his own in support of his statement? Has anyone else ever seen the Cassini division with 2in. aperture, or the crape ring with even 3in.?

I have experimented with side apertures since the appearance of recent correspondence upon this subject; but I have been unable to find out any deficiency in performance when adjusted perfectly for whole aperture.

On thinking the matter over, with the help of diagrams of the ray paths, I can come to no other conclusion than that Mr. Holmes is wrong, and that what is a perfect adjustment under use of whole aperture is perfect for a side aperture. I [illegible] this is a very interesting question to many amateur astronomers, and Mr. Calver [illegible] Mr. [illegible]

I [illegible]

[illegible]

[illegible] Mr. [illegible]

[illegible] Mr. [illegible] Mr. [illegible] Mr. [illegible] Mr. [illegible] time. **Jeekay.**

[illegible]—I PROTEST against the language by Mr. Calver in reply to my questions. I have not written a single word he can fairly take exception to. It is too much, when one is only asking for information, for the Editor to admit such personalities, and then cut out of the letters of the person attacked every word that indicates his opinion they are unjust. Mr. Calver would do much better to answer my questions than call names. **Edwin Holmes.**

[It is always "the Editor" who is in fault, according to Mr. Holmes. Our correspondent has scarcely ever come to words with his fellow-correspondents without blaming us for it. Besides the above, he favours us with a private letter, in which other correspondents are mentioned as having apologised to Mr. Holmes for their remarks in these columns. If so, Mr. Holmes may be left to enjoy what he dearly loves—the last word.—ED.]

DIAMETER OF STAR DISCS AND FIGURING OF SPECULA.

[25114.]—I CAN take no exception to Mr. Calver's remarks upon my extract from a former number of the ENGLISH MECHANIC: but I would like to say that if he had inserted in his first letter the qualifying remarks which appeared in his second one I should have considered my communication not necessary. Mr. Calver may rest assured I have no desire to enter into a controversy of words or cavil with him. I have too much respect and admiration for his skill and perseverance, but I would like to ask him to define, if he will kindly do so in the interests of optical science, the difference between the figure which defines best on stars, and the other which gives best definition of planetary detail.

May we not rather advance the proposition that a true parabolic curve only gives the finest definition of stars, and that good air is a most essential element, but that a curve which is not quite so perfect will give very good definition of planetary detail provided the aperture be large enough, and that an o g. or speculum which gives first-rate definition of stars will also give equally good definition on planets under equal conditions of the atmosphere? My reasons for thinking so are these. I have been for a long time patiently following the teachings of Mr. Wassell and those before him, and have lately finished a 12¼in. speculum, concerning which the owner writes me: "I had a glorious view of Saturn, though only 30° from horizon, crape ring, the bands, and blue-grey south pole cap." "With marginal 2½in. and power 225 I never saw Polaris and its companion so nicely before," and yet he observes regularly with professionally-made appliances.

"I had a pretty clear view of Venus with whole aperture at 15° altitude only," and lists follow of stars observed in all parts of the sky.

Now this 12¼ speculum was worked and tested in the workshop, and was not tested at all in the telescope till it reached the owner; the curve, however, was regular, and corrected to the true parabolic aberration. Again, if those interested will refer to "E.M." for Sept. 3rd, 1880, they will find these words, "The other mirror is 18¼in. diameter, and was originally figured by Mr. Cooper Key himself; but it was only perfect over the interior 14in.,
and consequently, while the whole ap
be used on the moon and planets, this
that should be used upon close doubles."
I am about to work a 10½ unde
similar to the 12¼, and will communica
to these pages, so that we may know
are justified in adopting the mathem
[illegible] **J. C.**

SMALL APERTURES

[illegible]—WITH reference to a lett
[illegible] allow me to quote the follo
from the article by the late T. W. We
printed in p. [illegible], Vol. XI., and stran
from the comments of Mr. Holmes:
case, therefore, of a luminous teles
the theoretical result is modified by t
power of the eye, and the aperture o
enters materially into the result
as giving a larger or smaller spuriou
making visible a greater or less numbe
in the case of a line, the luminous
they produce by their superposition."
and from Mr. Webb, April 15th, 187
in p. [illegible], should read "a patch pl
centre of the lens in some degree
character of the aberration, diminishin
width of the disc, and increasing the
the rings, while it somewhat dimi
magnitude."

THE OBSERVATION OF CLOSE STARS.

[illegible]—THERE appears to be
difference in the powers of different p
the definition of close doubles: some
high power for this purpose, while oth
well even better with low ones. The d
sight are little less than marvellous,
seem as possessing what is considered go
vision. No one can look over a file of
without having this fact forced upon t
and certainly among all the observe
doubles, no one is in the least degree co
Mr. G[illegible]. He stands far before a
in his power to see extremely close star
power to see faint stars in close pr
brighter ones. The star which heads
letter [illegible], "E.M.," I have observed ab
times with [illegible], and failed utterly to s
companion. Mr. G. has succeeded the firs
little over [illegible].
Might I ask him to favour us with
as to his mode of observation, and the
he gets with [illegible], to enable him to se
faint stars as elongations of bright
skill is evidently so great, that many
self will be glad to be benefited by h
although we can never hope to rival his
feats. **Edwin**

COMPRESSIBILITY OF WA

[illegible]—IT is quite true that whe
bursts under hydraulic pressure the pi
fly off as they would under air or steam
in the remarks quoted by Mr. P. J. Da
[illegible], p. [illegible]; but the reason of this
clearly understood. That reason is tha
gives way under a direct steady stress
no stored-up energy behind it. When
pressed, being highly elastic, it abso
quantity of energy before it can exer
static pressure, and as soon as such pr
comes the tensile strength of the iron, s
duce a rent, this stored-up energy esc
expansion of the air.
In the case of steam, there is not on
action, but as the steam is generated
of a great excess of water, itself he
temperature corresponding to the stea
this water is practically compressed stea
in the case of a boiler explosion, it
steam in the boiler which does the
the water—that is to say, it is the sud
of a large quantity of stored energy,
pressure, which has to be taken into acc
But water, unlike air, is very slightl
compressible: it requires a pressure
3,000 and 4,000lb. on the square inch t
volume by one-tenth, so that it cann
energy to any large amount by pressu
does apply, and transmit direct pre
the utmost facility.
A little consideration will, no doubt,
Davies that the fact he mentions doe
that water is more readily compressible
says, "some would have us believe."
owing to the actual compressibility, a def
tity of water, proportionate to the whole
volume, would escape from his tap H,
quantity proportionate also to the pres
culable from the ascertained ratio of
But he would say that a great deal m
does actually escape. No doubt
that of the water o[illegible]
containing vesse

etches, and allows water to enter in addition
due to the compression of the water, and
ie, when the pressure is released, the iron
ts again, unless it has been overstrained,
loing so forces out this excess of water.

Sigma.

HYDRAULIC RAMS.

3.]—I HAVE read with great interest the very
ive correspondence, entitled "Hydraulic
xplained," which has been going on in your
e paper, the "E. M.," and having myself
tle experience in fitting-up and repairing
must say that I agree with all that has been
garding the cause of the recoil. But one
cannot see—how our friend, P. J. Davies,
ak of water being very elastic. It may be a
I believe the main place where the water
backward motion is, the moment it shuts
ter valve it opens the inner valve, and
of the big column of water in delivery
ie shutting of inner valve sends the water
th great force.

xperience regarding springs is something
r correspondent, "W. A. J.," that they are
iination—not in every case. I would say
J. Davies, that under certain conditions
prings are really necessary. I would have
"P. J. D." had stated some of the conditions.
think where the spring water was near the
the ram as one condition; another con-
could be where the ram had to pump the
it of sunk well. I believe Blake gives out
to do this in such cases. I should say
would do what nothing else would. I am
see from your columns "P. J. D." is about
some experiments with the ram, of which I
see the results published in your paper.

is one question I would like to ask
)." in connection with rams. I have always
l to believe that the drive pipe of a ram
e thoroughly airtight—so much so that a
size of a pin point would spoil the ram (of
allow the little snift valve); I must say my
ce has been something different. I can now
three rams working splendidly with leaky
pes. I have even had, when everything
ed, to bore a hole in the drive pipe, and
ing so the effect was a complete cure. I
r this ram never went better than it has
is last 12 months. I would like if you
ive me explanation regarding this, and if
e had any experience like this.

er question I would like to ask "P. J. D."
your columns, is in connection with the
lift pump. What is it that causes the
oke in the pump? To let you understand
nean, when I pull down the handle it goes
elf with great force.

Plumber.

NTING HOLES IN DIVISION PLATES.

.]—As there seems to be a good deal of
experienced by some of our friends in
the holes of the divided circle, I describe
od I follow and find gives good results.

ose who can afford it, no doubt the auto-
unting apparatus described last week is all
be desired. I expect, however, that there
y who use the division plate, and, like
have to be content with more simple
ients than the automatic counter.

n a small camel-hair brush to one leg of
f wing compasses, set to the required
of holes, and at once mark off with the
ie holes into which the stop is to be

rush must, of course, be filled with pig-
I use whiting and methylated spirit,
ves a distinct mark, dries at once, and is
ly cleaned off.

W. R. W.

ENT OF PETROLEUM IN BULK.

.]—As you mention in the "Scientific
column, p. 277, the arrival of a cargo of
n in bulk, and say that "much has been
the fact," it may be of interest to some
o have some further information on this
which is in all likelihood the commence-
a thorough revolution in the petroleum
As I am myself personally concerned in
er, and it all came under my own observa-
n give all the necessary information.

ussians have used tank vessels upon the
Sea for some years past in transporting
oil; but that is only shallow water, and
ssels are employed. The conditions are
lifferent when the Atlantic waves are to
ntered. Several attempts have been made
the American oil over in tanks, and I
ve vessels have started at different times,
reached this country; in fact, I believe
n [illegible] d of, but founde [illegible] mid
liquid ca [illegible]
reater [illegible]

that of grain in bulk. It is true that it does not choke the pumps as grain can, but then it moves with much greater speed, and, in rolling from side to side, will produce violent shocks. If, therefore, a tank is not absolutely full, it is easy to conceive that very destructive action may occur. The success of the transport hinges therefore upon converting the liquid, movable cargo, into a solid and unshiftable one, by securing that, at all times, and under all circumstances, the tanks shall be absolutely full. This has been attained, and a system patented and put in actual work experimentally in the *Crusader*, which came safely across without difficulty, and without appreciable loss of oil, and has recently been discharged, and started on her way home.

She is a strong wooden sailing vessel of about 750 tons, and she has been fitted up with cylindrical tanks, in fact, ordinary boilers, in such a way that access can be had to all the exteriors, to admit of caulking in case of leakage; of course, this arrangement is merely a matter of convenience for a first experiment. A steam-pump draws the oil from all of them. From each tank a pipe passes up into a small cistern on deck, fitted with a gauge glass; now, if by change of temperature the oil expands, the tanks all discharge the excess into this cistern; if it contracts, the cistern is replenished from a provision for the purpose; if any tank leaks, by closing taps in the small connecting pipes, they can be separately examined, and the offending one discovered. In this way all danger is done away with, and all risk from fire absolutely avoided. No one could have told that the ship had a petroleum cargo, for it gave off no smell.

So much for the American part of the work. They were anxious to know how they were to deal with their cargo when they had brought it over, and of course sent over agents to prepare tanks to receive it, who, to their great surprise, found that we played-out Britishers were actually in advance of the Americans, and that here, in the heart of London, there was, ready to their hand, a system of tanks which they have readily admitted is not to be equalled in the world; and that though we do not at present, as they do, pump oil over 300 miles of hill and valley, we shall be quite ready, if it will pay, to send it in pipes (instead of casks) to any inland market. As a first step towards this, the *Crusader* was actually discharged by a pipe. The tanks of the Atlantic Storage Company (which already contain the greatest portion of the stock of turpentine in London) are situated at Bow Common, on the canal which runs from the Thames, near the Regent's Canal, to the river Lea. By arrangement with the Regent's Canal Company a pipe was run from their docks to the other canal bank, so as to enable tank barges to be filled without having to pass into the river, so that, having only to ply between that point and the storage tanks, a mile away, the operation of discharge was almost continuous with two tank barges; they were rapidly emptied by a powerful steam pump, and the oil transferred into large tanks underground, built solidly of concrete and lined with lead, coated to prevent any action of the oil. In all probability, future cargoes will dispense with the barge, and be pumped direct from the ship to the tanks.

It is evident that this will be a great economy, and lower the cost of petroleum in England; it will reduce the expenses of shipment in many ways, do away with the cost of barrels, which may be repeatedly used, while a ship's cargo will be discharged in a fraction of the time necessary for the oil in barrels. This, again, will stimulate the use of petroleum for fuel, increase the consumption, and so open a market for the vast possible production, of which much has hitherto run away to waste.

Sigma.

THE THEORY OF THE WIMSHURST INFLUENCE MACHINE.

[25121.]—I AM glad to see that some of your readers are working at a theory for the influence machine, and I very sincerely hope that a more acceptable theory than the one I sent you may be found. In this endeavour I think time would not be wasted if each searcher were to strike out and work upon quite new lines. Let the current theories each have their proper place, but no more. Little is yet positively known about electricity, and there is an amply large field for entirely new thoughts.

Mr. Taaffe appears to be indifferent about the metallic contacts between the brushes and the sectors, the two opposite sectors at the same moment, and between brush and brush; then views the machine being non-self-exciting with complacency, as due perhaps to atmospheric conditions. Let him attend to these points, arrange them as I have stated they should be, and he will find the machine freely self-exciting and more satisfactory.

James Wimshurst.

JORDAN'S SUNSHINE RECORDER.

[25122.]—THE difficulty referred to by "Edin-
h" (25105, p. 302) may possibly be explained by the sensitised charts having been exposed to daylight before insertion in the instrument. The trace ought not to fade away on placing the chart in water. The effect of sunlight on the preparation is to render it insoluble in water, and if, after exposure in the cylinder, the chart is immersed long enough (until the dark ground of the paper becomes white) the trace will remain clearly visible and more or less blue, according to the intensity of the sunshine which produced it.

Cherry Orchard, Staines. **Jas. B. Jordan.**

COMPOUND LOCOMOTIVES.

[25123.]—I SEND you the working of the above for September, 1885, for Crewe steam shed.

No. of engines	Coal used per mile	Cost per 100 miles			Big Compounds London Link
		£	s.	d.	
503	33·6	1	4	5	London and Carlisle
511	39·7	1	7	1	
	36·2	1	5	4	Average of No. 1 link (London link)
789	29·4	1	2	4	Jumbo's Carlisle link
678	37·8	1	5	0	
	33·6	1	3	4	Average
333	27·9	1	2	10	Holyhead link of compounds
1104	33·2	1	4	10	
	30·6	1	3	6	Average
395	28·8	1	2	5	Yorkshire link
2184	41·2	1	6	6	
	31·9	1	3	6	Average
66	28·9	1	2	5	Second London link of compounds
520	34·7	1	4	8	
	31·2	1	3	4	Average

The above table gives the top and bottom engines in each link and the average for each link, and it shows that the Jumbo's are 2·6lb. per mile less in coal, and 2s. per hundred miles less in cost. Then, comparing the second London link and the Holyhead link with the Yorkshire link, we find them about equal; but I wish to point out that 395 is a Ramsbottom 6ft. 6in. four-wheel coupled engine, and 2182 is a Jumbo. The former was over 12lb. of coal less per mile, and 4s. 1d. per 100 miles less in cost.

The above shows that the compounds are the heaviest in fuel and cost; the Jumbo's are the next, and the Ramsbottoms the lowest in coal and cost: thus showing that the compounds are a complete failure beyond the shadow of a doubt.

As an engine-driver, I wish to point out that our superintendents are making the compounds more dangerous, because they are trying to put more work into a little space, and leaving no room to do the work, nor even any space to get under the engines to oil them; and one of the compound tank engines—or choppers, as they are called—has to have a very small fireman, and he has to creep under the ash-pan to oil the engine when there is no pit. This is shameful work, and it ought to be stopped by all means. Have we any humane directors on the board that will see that the engines are made with some little regard to decency and safety? This said engine cannot be packed with one man, they cannot reach the low-pressure engine spindles, and it will have to be lifted with jacks, and the front springs taken out to get at the glands. What are we to think about the designer of an engine that cannot be packed without being lifted with the jacks, and that no ordinary driver can get under it if it breaks down on the road?

This is retrogression with a vengeance. Instead of the plain simple engine that Ramsbottom made, we have now the experimental engine that is always failing and always being altered to effect improvements; but the improvements are proving worse than the original, and the alterations go on without ceasing, with a deal of brag to throw the people off the right scent.

Crewe Sentinel.

[25124.]—G. D. SEATON says, in letter 25078, that "no more tender goods-engines are to be built at Crewe." If so, I hope that the goods will be made so that the drivers can get under them without the danger and difficulty that there is with the passenger engines, for they have to appoint a very small fireman, and he has to go under the ash-pan when they are not over a pit, and it very often occurs that they have to be oiled at the station where there is no pit available.

This is dirty, dangerous, inhuman, and cruel, and I trust that some of those good people who interest themselves in protecting the weak against the strong will insist upon a sufficient space being allowed for the drivers and firemen to get under the engines without running such dangerous risks as they have to do at present.

The engine men cannot get under if it breaks down on the road, and there is short space to work in if they could.

There is also another defect—the low-pressure engine's spindles glands cannot be packed. They want lifting at the front end with the jacks and the springs taken out, to be packed. The above are defects that want remedying before they ought to be allowed to run.

What are we to think of those who design and compel men to work such dangerous engines?

Compounds are a complete failure, as I have before shown, and as the present consumption sheets demonstrate, for they are a great deal higher in expense than the other engines.

One who is in Favour of an Old Razar.

LOCOMOTIVES.

[25125.]—In reply to "W. C." (25099), I regret to say I have no more particulars of the compound goods engines than those I have already given. As I have already said, I expect one will be out shortly. I hear that Mr. Webb, in spite of the numerous convincing proofs put forward that it is not, firmly believes that the system he has adopted is correct, and hopes that by altering the engines in those parts where they are found wanting, to achieve success. All I will say is, I would rather Mr. Webb had the job than I.

The following are the dimensions and particulars of the new 7ft. 6in. single-wheel engines of the Great Northern Railway:—Cylinders, 18½in. by 26in.; wheels: diameter of drivers, 7ft. 7½in.; leaders, 4ft. 1½in.; trailers, 4ft. 1½in.; all wheels wrought iron: motion open slot-link and eccentrics: crank-axle Siemens-Martin steel. Diameter at wheel-seat, 9¾in.; diameter at bearings, 8½in.; length of bearing, 7in. Boiler: Length of barrel, 11ft. 5in.; diameter of barrel, 4ft. 2in.; number of tubes, 186; diameter of tubes, 1¾in. Heating surface: Of tubes, 1,001 sq. ft.; firebox, 109 sq. ft.; total, 1,110 sq. ft. Grate area, 18·4 sq. ft.

Weight in working order:

	Tons.	Cwt.
On leading wheels	11	18
On driving wheels	17	—
On trailing wheels	10	16
	39	14

Tank holds 2,900 gallons of water, and the bunker four tons of coal.

These engines are not to supersede the 8ft., but the object was to build a cheaper and yet equally efficient engine, and I hear they give complete satisfaction. They are at present working between Doncaster and Peterborough.

G. D. Seaton.

AMERICAN v. ENGLISH LOCOMOTIVES.

[25126.]—From a New Zealand paper it seems that Sir Julius Vogel has decided to order engines from America instead of England, and reports they are *better*. How is this? Surely some of our English Mechanics will have a word to say on this subject. **An English Mechanic.**

STEAM BRAKES.

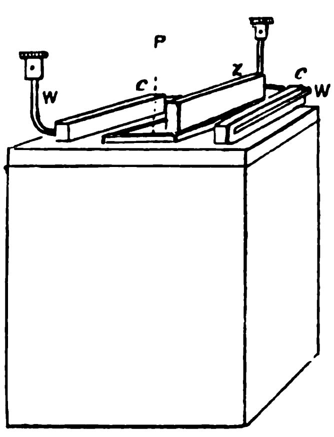
[25127.]—In reply to Mr. W. B. Thompson (p. 268, letter 25050), in my various letters upon continuous brakes I have pointed out the actual fact that a non-automatic steam brake is inefficient, and does not fulfil the Board of Trade conditions. I have always been in favour of making all steam brakes on passenger engines "automatic," so that they can be applied by the guard or by automatic action. Having a few months ago carefully examined and worked the apparatus at the works of Messrs. Gresham and Craven, Manchester, I am, of course, perfectly aware that steam brakes can be made automatic. My last letter upon the brake returns referred to the half-year ending June 30. Whatever alterations or improvements have since been made will receive attention when I deal with the figures for the second half of the present year.

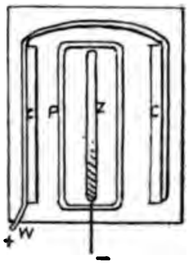
Clement E. Stretton,
Leicester. Consulting Engineer A.S.R.S.

NITRATE OF SODA BATTERY.

[25128.]—My modification of the above is as follows: Outer cell, box of pitch pine 8in. by 2in. by 4½ (inside) ⅜in. thick. Pitch inside with pitch and 5 per cent. g.p., varnished outside with crimson shellac varnish, made by mixing vermilionette with shellac varnish till the desired tint is obtained. The lid consists of a flat piece of ⅜in. wood with three mortises cut in it, the centre one for the porous pot, which is 4½in. by 2¾in. by ½in. (inside), with a carbon plate each side in the other two mortises. The carbons are about ¼in. away from the porous pot. The tops of carbons are coppered and then paraffined, the top of porous pot also being paraffined. A wire bent U-shape joins the two carbons while one end goes to the terminal. A zinc plate 5¼in. by 2⅛in. by ⅛in. goes in the porous pot. The solution for outer cell consists of nitrate of soda, two parts; water, one part; sulphuric acid, one part. If the battery is for experimental work, I prefer for the zinc plate sulphuric acid, one part, water, nine parts; but if it has to stand some time without being used, a saturated solution of sal-ammoniac is as good as any: E. M.F., about 1·9 volt; current, two amps. One gallon of the nitrate solution is supposed to give 800 working amp. hours.

I inclose sketch of cell with plan, where P is porous pot; W, connecting wire; C, carbons; Z, zinc.





Mercury cup connections are about the best for a light battery, but are troublesome when you often have to clean the cells, so I devised the following arrangement:—To the end of the carbon wire is soldered a small screw eye (I use those on picture rings with the ring cut off); another eye is screwed to the lid about 1in. from the first, and has soldered to it a small copper clip which holds the zinc wire; the zinc can then be taken out for amalgamating or otherwise without disconnecting the wires. The eyes and all the wires are varnished, except where contact is necessary. The connecting wires have short pieces of No. 12 wire, which must fit into the eyes. If I have not clearly explained anything, or any of "ours" would like to make the above, I shall be glad to send fuller instructions with Mr. Editor's permission.

P. C., Hornsey.

LATHE MATTERS.

[25129.]—In reply to "Tuebor," I may say that a twist can be cut with ease by using some sort of overhead to drive the fly-cutter, and connecting the screw of the slide-rest by a pulley and cord to the mandrel, either direct or through a second shaft on the overhead, as alluded to by me in a recent letter. If "Tuebor" knows of another plan, will he kindly communicate it to the English Mechanic?

A twist formed of adjacent eccentric discs can be done with an eccentric chuck, or by marking a ring of centres at each end of the piece, without one, but not, I think, a plain twist. There are many similar unorthodox expedients that can be used by those whose ingenuity exceeds their dollars, and I have long entertained a wish to write a paper on "Dodges and By-ways" of this class; but I have not been able to test one or two which I should like to add to the list if I find them of practical utility. Mr. Holtzapffel has given one or two in his Vol. IV., and I suspect that there are many means of achieving results similar to those obtained by expensive apparatus.

It is also sometimes possible, and may be advantageous, quoad speed, to reverse the order of processes in turning—e.gr., in making such a thing as a needle or bodkin case, I have begun by mounting a twist drill in the lathe, and using the back centre to insure a straight course, drilled the bit of wood, or half a dozen succession, and then mounted them on a and turned the outside. In this case I h doing other work with the drill, and was turn a needle case, and it struck me tha drill was just about the right size, I might way to work. I have several times since d same thing by preference. The fly-cut simple but splendid tool, but the eccentric of greater capability as a carver and planer in getting up a square base for a pedestal: same square base can be wholly cut with the lathe with care. But where inte cutting is necessary, speed is also necessary good work, and it is easier to give such hi to a light fly-cutter than to the work whic be cut by a fixed tool. Has any reader t Britannia Co.'s circular saw? My mind exercised about it. It will do all that is for it, and at the same time it is very uno I tried it at the Inventions, and on first foot on the treadle I thought it was stiff of oil, expecting, as I did, that it would lathe treading. But presently it got un and as the speed gradually increased, I soon conscious of the great power that was bein up in it, for it was far more inclined to go stop. Of course I had put into it, at the muscular tissue, all the said store; but was.

Now I want to decide whether thi economical expenditure of exertion on my the result is to give me a saw ready to re exertion by doing what no other machin kind will effect. No other circular saw w the foot will devour its food as this will.

O.

A WATER BAROMETER.

[25130.]—From the description given b your water barometer (25107) in last weel it is very hard to form an idea of it. course, knows the principle of the Sympie but the addition of the flexible tube, joined to glass tube, so as to make an joint, would be invaluable to lovers of mete Why do you use a tube with such a larg Of course the greater the bore the greater culty in measuring the height of the colum

There are two great objections against yo barometer.

1st. Water evaporating at ordinary t tures causes the readings to become gradu (I conclude your cistern terminates to a pipette through which the water evaporate

2ndly. Your barometer will not stand lower than 0° C, the water in cistern and tub ing. A sketch of your apparatus will oblig

Newport, Mon. **A. Treyer-E**

DUMPY THREE INCH.

[25131.]—In reply to "Ascalon," both T Saturn were visible in the field. Titan i for a 3in., as I find it a conspicuous objec 1⅛in. and four lens eyepiece. The visil Saturn is important, as Rhea, Dione, and were seen 50 years ago with a $2\frac{7}{10}$, the plan hidden by a stop. Those three satellites difficult objects with a 3in. of usual focu the unusual shortness of the focus and t thickness of the triple object-glass—(viz. of my dumpy 3in. which made me think formance sufficiently interesting to record.

The instrument I employ for measuring t is a double-image micrometer reading t I find it necessary to measure the power, to trust to that marked by the optician. eminent he may be. I have a telescope power marked 20 by the maker whic measured gives a power of 33; another, by maker, marked 150 gives 139; another, b ferent maker, marked 50 gives 39½.

My reason for extreme accuracy in the that I test a telescope by the lowness of t with which I can see a fairly easy double i by the usual method of dividing a very clo with a very high power.

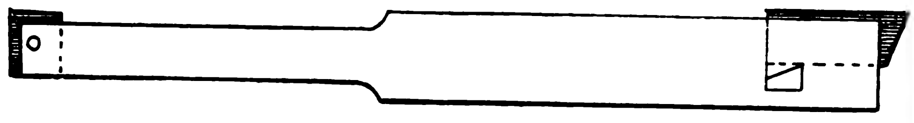
High eyepieces, such as ¼ and ⅛, have b ago discarded by experts for testing micro jectives; why they should be still empl telescope testing I cannot imagine.

As I have said before in these columns, believe in the use of any eyepiece over ¼in. lent focus on either a microscope or telesco that not on account of being troubled by or other natural defects, as I am able to u eyepiece with a perfectly clear field.

London, Dec. 12th. **Edward M. N**

A NEW SLOTTING TOOL.

[25132.]—Perhaps my fellow amat may like to kno ood new for me) for sl the think it worth slotting insid



slotting outside of arbor. The cutters move around their pins; thus the edge is not bruised, when, after each cut, the tool comes backwards; a little spiral spring, longitudinal in the round end, vertical in the square end, brings the cutter again in its place. On the round end, behind the cutter, is left a kind of feather, against which the cutter rests when cutting.

Sankimo, Dec. 3. **W. Van Eys.**

A SIMPLE AND HANDY COMPOUND SELENITE AND MICA STAGE.

[25133.]—THE ordinary compound selenite stages are expensive, and, therefore, the majority of microscopists are content with the ordinary simple films of selenite, giving blue and yellow, and red and green grounds.

It is my object to indicate how a very useful stage may be made for a few pence, which will answer most, if not all, the purposes of the most expensive apparatus.

A little reflection will show that a whole revolution of the films is quite unnecessary, every possible azimuth being attainable in a portion thereof. A lever motion can be made to give all the alteration necessary, and I therefore take a film of selenite and a film of mica, and mount on circular ieces of wood with projecting handles, as Fig. 1.

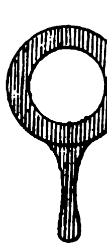
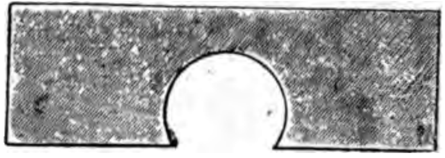


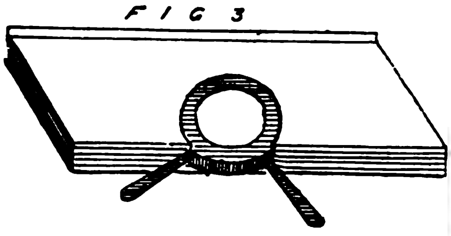
FIG. 1.

FIG. 2.



I then take 5 thin slips of wood a little larger than an ordinary slip, and cut circular pieces out of each, as Fig. 2. Only two of these are just large enough for the films to move in, and the other three, slightly smaller, form top and bottom and centre piece to keep films apart. I then glue all these together, with the selenite and mica films in place. When dry, these have a free movement of about 60° or so, and a thin strip at back, to lodge slide against finishes the affair.

FIG 3



I send rough sketch of finished stage No. 3, and think anyone who tries it will be pleased.

Edwin Holmes.

TRICYCLES.

[25134.]—THE auxiliary motive power for tricycles seems yet undiscovered. May I make a suggestion for practical heads to work upon? A cylinder for compressed air, exactly similar to an air-gun; a piston working from the crank, in a pump exactly like the air-pump; power derived going down hill, instead of the brake or supplementing it; compressed air remaining in the cylinder until wanted, and then released by some [illegible] resembling the trigger, and a succession given to the piston connected [illegible] to the driving crank, [illegible]

It seems to me simplicity itself; the only difficulty being, how much power could the tricycle force into the cylinder going down hill?

Angulus.

FUSING POINT OF ALUMINIUM.—CHEAP SODIUM.—TO CORRESPONDENTS.

[25135.]—I AM not aware that there is any relation between the fusing point of a metal and its conductivity; but if Colonel Ross has discovered a law connecting them, I shall be glad to learn it, especially as applied to the following metals:—

	Conductivity.	Melting Point.
Silver	1,000	1,000° C.
Gold	532	1,250
Tin	145	228
Iron	119	1,500
Lead	85	326
Platinum	84	1,910

There may be some relation between the figures in these two columns (which are from the 1884 French edition of Ganot), but it is certainly not visible readily. I would like to know what authority Colonel Ross has for stating that aluminium conducts heat better than silver. Miller gives Al = 665 compared to Ag = 1,000. If it be true that sodium has been produced cheaply by electrolysis (p. 303), we are certainly within a measurable distance of cheap aluminium, the advantages of which would be very great. I have received, apropos of my reply to query 58093, a long and very mad communication from some being who signs himself "Socialism." I must ask the indulgence of those correspondents who have addressed queries to me; I will endeavour to answer next week, but am very much occupied at present. **Wm. John Grey, F.C.S.,**

Analytical Chemist, Newcastle-on-Tyne.

Coloured Wines and Foods.—Most things that are pleasant to taste are not harmful in the economy. The proportion of things pleasant to look upon and admissible as edibles is probably not so large. The organ of smell seem to be the best indicator of goodness or badness, agreeable odours being as a rule quite harmless. Physiologists have usually condemned the use of various colouring matters in the manufacture of wines and foods, but more on general principles than on certain knowledge that added matters were of a harmful nature. MM. Cazeneuve and Lépine have found that the "rouge soluble" is innocuous, and "sulpho de fuchsine" appears to be likewise harmless. These colouring agents do not give rise to unpleasant effects of any description, even though ingested in considerable quantities. The workmen in the manufacture of the colours, spending many hours a day in breathing the atmosphere impregnated with the coloured particles, appear to suffer no inconvenience, live long, and enjoy good health. Saffranin, which is also employed to tint wines, produces toxic effects on animals if administered in considerable doses: the action of the heart is disordered, the breathing distressed, and diarrhœa, with albuminuria, set up. But even saffranin may be administered in minute doses without producing any marked deleterious effect on the health. Investigations of the kind employed in ascertaining these results are useful, for as pigmentary matters please the eye, and do not cloy the palate, it would be well to know which pigments may be used for such enjoyable purposes without carrying mischief in their train.—*Lancet.*

Filtering Shellac Varnish.—Shellac varnish made with alcohol may be filtered without difficulty, if it is previously well shaken up with a small quantity of some inert powder, such as plaster of Paris, chalk, phosphate of calcium. About 2oz. per pint is sufficient. The varnish may also be rendered clear by mixing it with one-fourth its volume of benzine or petroleum ether, shaking it frequently during one or two hours, and then setting it aside, when the clear alcoholic solution will collect at the bottom, and the benzine, containing some fatty or waxy substances in solution, will float on top. After removing this layer, the alcohol solution may, if necessary, be freed from nearly all benzine odour by gently warming. If the shellac is first extracted, in coarse powder, by warm benzine, it will afterwards furnish a clear solution in alcohol.

THE greater part of the coal now consumed by the French navy is in the form of briquettes. The same form of fuel is largely used in the merchant service, and is rapidly growing in favour.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[56755.]—**Magnesia Firebricks.**—With regard to the remarks of your correspondent, "Murano," in your issue of 11th inst., I have not observed the inquiry; but I venture to say that these are not made from soapstone, but from magnesite, which contains about 98 per cent .carbonate of magnesia, 1½ per cent. of lime, and ½ per cent. of iron. It is quite true that bricks from this material are being made in France by various steel manufacturers; but they are also being made close to Liverpool from my Greek Magnesite, which I can supply in large or small quantities, either in the crude state, or calcined and ground, or I can supply the bricks made. I have not seen the patent of Mr. Thomas for the manufacture of these bricks; but in the *Journal* of the Chemical Society for November, folio 1166, you will find a method by T. Schlossing. The bricks that are being made here are being made by a very experienced manufacturer, who, nevertheless, with myself, is still searching for a further improvement, which we believe is to be discovered.—GEO. G. BLACKWELL.

[57360.]—**Chronometer Balance.**—Will "First-class Honours" (page 225, No. 1077) stand by the idea that the force of gravity is greater at the Poles than at the Equator, after giving the question a careful reconsideration? It is understood, of course, that the comparison is supposed to be made at the sea level in both cases. Now, if it were so, it would be true of the water of the sea the same as all other bodies, and as the sea is continuous from the Poles to the Equator, would not the water immediately sink where the force of gravity was greatest, and rise where it was weakest till the equilibrium was restored, and equal quantities of it weigh exactly the same at both latitudes? And is this not exactly what has happened, resulting in the earth being an oblate spheroid instead of a sphere? And, again, is not a chronometer independent of gravity, and will it not run the same at all altitudes, excepting the variation that may be caused by the different atmospheric densities? Are not the momentum and inertia of the balance-wheel and the strength of the hair-spring the only factors that determine the rate of oscillation? And are not the first two in proportion to the quantity of matter in the wheel, regardless of the force of gravity, so that the period of oscillation would be the same on the moon as on Jupiter, assuming it to move in a vacuum with frictionless pivots in both cases?—J. W. THOMPSON.

[57360.]—**Chronometer Balance.**—Permit me to advise "First-Class Honours" to leave "Saunier's Treatise" to itself for a while, and to spend some time on an elementary work on mechanics, so as to acquire some little understanding of "the same laws which govern the movement of a pendulum and balance, &c.", and the material universe also. He might also digest the parable of the "Man of Straw" with advantage. What "Wen" did assert was, that the rate of a chronometer would not, apart from friction and temperature, be varied by removal from the Poles to the Equator; also, he stated, in pretty correct language, the reason of the variation in the force of gravity at Poles and Equator; also, the degree of such variation was quantitatively expressed in the original query, so that for "First-class Honours" to make what he calls "equivalent assertions" till he makes "Wen" say "that the force of gravity exerted on the mass of a balance at the Poles and the Equator is the same," appears, when taken in conjunction with the flourishing signature of this setter-up and demolisher of "straw men," not "simply absurd," but ignorantly ridiculous. In his reply to the query, "First-Class Honours," amidst a rather superfluous explanation, states that as to the balance at the Equator "its weight is less"; then proceeds to state that the result of this reduction of weight "would be—to lose time." Any small boy will tell him, and taking the ordinary meaning of a reduction in weight to mean a reduction in mass quite correctly, that a lightening of either a pendulum or a balance-wheel on a clock or watch will cause it to go more quickly—say, a boy of eight or nine years old. One a little older will explain to him why a pendulum goes slower at the Equator than the Poles, though it offers equal resistance to a spring or pressure at any place. As for the "valuable space of the 'E.M.', &c.", refraining from scribbling about things you don't understand is the best way to show consideration for it. Anyone "with a practical knowledge of watchwork" knows that a newly-cleaned watch is put together more or less stiffly, according to the skill of the workman; knows also that a reduction of the frictional resistances of the works is the exact equivalent of strengthening the springs, and that the result of either operation is to quicken the watch, just the same as lightening the balance-wheel does so. In anyone but "F. C. H.'s" experience, dirt causes a watch to lose, often largely. If he will take a very dirty watch—I have seen them just crawling—remove and clean, and then replace the escapement, he will have a little better idea of the meaning or effect of operations on a watch. Does he want to persuade intelligent workers that the dirtier a watch is, or the greater its frictional resistances are, the faster it will go? Or is he trying to graduate with "First-Class Honours" for some institution where people get taken care of? Certainly his entanglement of absurdities looks like it. I would recommend "F. C. H." to preserve his good intentions from being used to pave a nameless region by confining himself to subjects he understands, and to avoid rendering "confusion worse confounded" by scribbling foolishness on comparatively intricate subjects that a good many would prefer to have clear ideas upon; otherwise he will find his "reputation"—like his refutation—"gone."—WEN.

[57571.]—**Producing Fire.**—There are several easy and rapid methods of obtaining fire by friction, known to savages all over Asia and the islands. One is by taking a dry branch and a strip of dry cane 3ft. long, the former held down by the feet, while the cane, passed beneath the dry bough, is rapidly "see-saw'd" or pulled by each hand alternately. The dry dust made soon smokes, and at last ignites, especially easy if collected in a hollow. Another method is to rub a dry hard stick in a groove in a dry log. A third, by which a couple of jungle Bengalis once made me fire in literally less than five minutes by a drill made of sticks lying beside us at the time: one dry and hard, about 18in. long by ½in., held upright, and "drilled" by the palms of hands in a natural hollow in a dry log, the second man taking up at top as the first man's hands worked to the bottom. I can assure all readers of "Ours" that scientific men as a rule greatly over-estimate the importance and difficulty of the operation, which must have been discovered by many early races of mankind independently.—S. E. PEAL, Assam.

[57635.]—**Milk Analysis (U.Q.)**—As far as I know, there is no such apparatus, either generally or occasionally employed. The only way in which a funnel and return cooler is used in the analysis of milk being in the extraction of the fat from the total solids by ether, and this has to do with the determination of the casein only inasmuch as its removal, as well as the removal of the milk-sugar (unless this is determined by a Cu sol.) is necessary in this process, for the estimation of the latter.—B. B.

[57668.]—**Lunar Glaciation.**—In answer to Arthur Mee, the formation of cones or peaks like Pico is indicated in par. 3 of second column, p. 563; though by accident, only "central cones" are mentioned, as those in Tycho, Theophilus, Alpetragius, between which last and Pico there is not much difference in size. Selenographers will, of course, note that these vast piled cones therein resemble our terrestrial volcanoes, though the phenomena would all be intensely cold. The difference between these "central cones" and isolated ones like Pico is that the former are over old heat vents, that caused the formation of a lagoon and its ring, and when the floor solidified it went on still giving off heat and aqueous vapour (as our volcanoes do), and this slowly piled at the orifice, whereas Pico is due to a new though important heat-vent opening after the surface had solidified, and it hence has not got a ring. This seems how Linné has been filled in. The streaks within Plato and Archimedes I should suppose due to these floors being comparatively level, and having a thin coat of ice over them, Plato especially; not a mirror-like sheet, but one less covered by floe than usual, with numerous smooth lakelets or irregular stretches, too small to see, through which sub-strata faintly shows. Solar heat also would possibly be able to penetrate and affect the tint towards the end of the lunar day. I see the sign of – has been omitted in par. 11, col. 2, of 24669, and it makes all the difference. It should be "*minus* 60° or 70° Centigrade."—S. E. PEAL, Sibsagar, Asam.

[57740.]—**Free Reeds — Tuning (U.Q.)**—This query does not seem to have been answered by the gentlemen to whom it was put, and in common with one asking for a description of the method of tuning reed instruments, has been relegated to the "Unanswered." I can understand that "G. L. B.," having already described how to make the tuning apparatus, with sufficient detail for anyone willing to help himself, does not care to repeat, and probably does not see why he should gratuitously instruct someone who may possibly be a rival in trade. I cannot understand why the other gentleman has not replied, seeing that he has had time to write and draw several things which are calculated to raise a smile on the face of those who really know. To business, however. "Amateur Tuner" can make a tuning apparatus or bellows in this way: Let him take a piece of half-inch board about 18in. long by 9in. or 1ft. wide, and plane it up in a workman-like manner—but he will not want to be told all that. Then off the same board cut a piece about 12in. or more long, and hinge it to the other piece, so that the free edges are about in the same plane. The hinge is made with a good piece of sheepskin, lined inside with two pieces of millboard, which take the heads of the tacks used to hold the parts down when glued. The longer of these two pieces of wood is to be the upper surface or table: the shorter is the "bellows" board. The top board has three sets of holes made in it, over which the reeds are laid; the lower has, say, three inch holes bored in it, over which outside is stretched a piece of leather, held at its four corners by tacks. Holding the two boards with the upper or longer one level, we bring up the lower until its free edge is about 6in. from the edge of the other, and then run a piece of paper round all the edges, so as to get a pattern by which to cut a piece of leather or rubber cloth, which should lap over all the edges. Having cut that and glued it on, we shall find that we have something which resembles one of the feeders of a harmonium bellows, only the valve being on the outside it draws wind in instead of blowing it out. Attach a weight to the lower board, and rig up a pulley and treadle on a frame, so that when the foot of the tuner is pressed down the "bellows" closes, and when the foot is taken off, the weight will open it and draw wind through the holes in the top board. Some tuners just screw the longer board to a window-frame, and rig it up that way. The dimensions above given are merely arbitrary. Three double holes are sufficient, and each set is provided with a valve made of a bit of leather-covered wood, which swivels on a screw at one end. The standard reed is clipped down over one hole, and the reed to be tuned is clipped alongside, and the file is applied until the new reed is brought to the same pitch as the standard. It may be asked, What dimensions the holes should have? It depends on what reeds you want to file up. The complete set consists of seven octaves, the lowest note being 16ft. C. Make the largest hole, then, two-thirds the length of the vibrator of 8ft. C; the next, two-thirds that of Gamut G; and the smallest—well, not so large that some of the reeds will tumble through. File free end to sharpen, rivet end to flatten, and there you are—when you have had practice, and have the "ear." Now, to fine tune the reeds in an instrument, or tune a harmonium, make pitch C true with a fork, and keep the bellows always half-full, so as to have pressure equal throughout; make mid C true with pitch C, and then start to lay the "bearings." Here they are:—Make G below mid C about two beats flat. Some tuners make all the fourths below one wave slow; but you must settle for yourselves which you like best. To ascertain that G is really flat, let the key of C partly rise under your finger, which will have the effect of flattening C, which will then come into consonance with the flattened G; or if the key of G is allowed to rise, the beats will increase, and produce a very unmusical noise. Having got G right, make D, a fifth above, about a beat and a half flat to G; then A, a fourth below, about a beat flat to D; E, a fifth above, two beats flat to A; B, a fourth below, half a beat flat to E; F sharp, a fourth below, half a beat flat to B; C sharp, a fifth above, two beats flat to F sharp; and G sharp, a fourth below, about perfect with C sharp. Now start again from C, and make F, fifth below, two beats sharp; A sharp, fourth above, one beat sharp to F; D sharp, half a beat sharp to A sharp, and about perfect with G sharp. You see this scheme divides in two parts: an alternative is to make all the intervals in the first portion one wave slow—that is, one beat flat—and those in the second portion one wave sharp. Try the result with chords, and proceed to tune your octaves; but remember that it is hopeless to do more than make a compromise with them. Thus, if mid C is tuned perfect to pitch C, and 4ft. C to mid C, and 8ft. C to 4ft. C, you must not expect to find either 8ft. C or 4ft. C perfect with pitch C in all positions of the bellows. This matter has, however, been explained many times in back volumes.—N. E. CHILD.

[57800.]—**Spermaceti Emulsion.**—This query appeared in the number for Oct. 16, and in the number for Dec. 11 appears what purports to be an answer. I would merely hint on that point, that it would be well if those who intend replying to queries would do so as soon as possible. I have just an idea that even that "answer" would not have appeared if a previous reply written by this pen had not been inserted in the number for Nov. 27. The querist asked whether Mr. Grey or any of our chemical friends could give a "method of making spermaceti soluble in water." If the querist did not mean that, but merely how he could suspend spermaceti in a solution of sugar and gum, it is a pity he did not say so. Surely it is not too much to expect querists to put plain questions. I notice the matter, because two persons certainly can learn a useful lesson, which will probably not be lost on others. Ask explicitly; reply promptly and clearly.—T. J.

[57813.]—**Gramme Dynamos.**—In answer to "P. C., Hornsey," and "Clay," I am perfectly aware that the polarity shown in my sketch is the reverse to that generally shown in English text-books, and the same thing is generally learned by elementary students of electricity. I remember when I was studying to pass the elementary examination of the South Kensington Science and Art Department, that, our teacher made the following remarks:—"You will observe that when the needle is freely suspended, it points in the direction of the North pole of the earth, and now by the laws of magnetic attraction and repulsion, the end of the needle which points to the north pole of the earth has, of course, south polarity; but for the sake of convenience, I shall, during my lectures, call the end which points to the north the north pole." The whole question turns on the point whether it is best to use a nomenclature which is scientifically correct, or an illusory method which only tolerated, because it is easier for the elementary mind to grasp. In this scientific age every calculation is based, and every theory started and amplified, from some standard or some known law, and in the many problems I have had to solve, and the many calculations I have had to make, in connection with dynamo machinery, I have always taken the North pole of the earth as the standard of north polarity, and I wish to state once more that in the sketch I sent to the "E. M.," the poles there shown correspond to that standard. I marked that pole North to which the north-pointing end of the needle would point if the current were sent round the F.M.'s in the direction indicated by the arrows. The N.-pointing end of the needle points to the N. pole of the earth, consequently, that same pole will point to the N. pole of the magnet. I certainly have no wish to be discourteous to any reader of the "E. M." who is courteous to me: on the contrary, I have always tried to place whatever knowledge I may possess in the special subject on which I write, at the disposal of any who require, or ask for it. I should, above all things, like to hear the opinion of our "Sigma," whom I can freely acknowledge as far my superior in theoretical knowledge of the subject under discussion.—W. H. EAVES, Coventry.

[57859.]—**Electric Wind Direction Vane (U.Q.)**—The querist might adopt the following plan. To the shaft of the vane fit an arm A, at the end of which is a brass contact piece C,

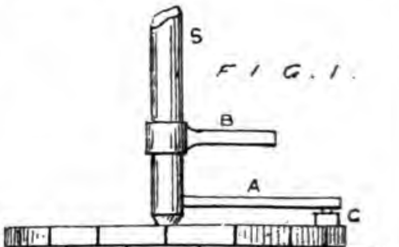
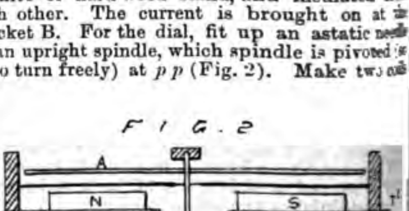


FIG. 1.

which comes successively in contact with the sections of the brass ring R as the vane turns. In this case there are 16 sections, mounted on an ebonite or hard wood stand, and insulated from each other. The current is brought on at the bracket B. For the dial, fit up an astatic needle on an upright spindle, which spindle is pivoted (so as to turn freely) at *p p* (Fig. 2). Make two coils

FIG. 2



of wire like 1 and 2, and join up in series to the poles as marked, and fix diametrically opposi each other between the needles A and B. O necting the terminal T^1 with any given sect the brass ring, the terminal T^2 to one p battery, and the bracket B (Fig. 1) to and making contact at the vane A on to the section just needle is deflected, and remains stationary over the two coils. It is now necessary to fix the remaining coils in the index-box, in all 32 in number, and coupling up as already described. Unless a special Leclanché is available, use Daniell cells, as an almost continuous current will be required. I shall be glad to give any further information as to dimensions, wire, &c.—JOHN H. HINDLE, JUN.

[57863.]—**Boiler.**—"L. W. D." inquired, in November 6th issue of this paper, what size engine I intend driving, and what the boiler is made of. The boiler is of ¼in. iron plate, riveted, tested to nine atmospheres, or, say, 135lb. water pressure. I intend to work at 60lb. pressure, and to drive a 4in. by 5in. vertical engine with condenser, cutting off steam at ¾ or, perhaps, ½ stroke. If "L. W. D." wishes, I can lend him tracing of boiler, which was designed by a competent man. Would "A., Liverpool" kindly state number in which "Invicta" published a description of a method of feeding boilers?—BELGIAN.

[57900.]—**Upholsterers' Fringe (U.Q.)**—It is impossible to answer such a vague query, fringes being made in such a variety of styles, and by more or less improved machinery, including hand looms for the making by manual labour of one piece, to power looms, which will make four or six pieces at one operation; but if the querist will advertise his address, I shall be happy to help him.—MARLOW.

[57951.]—**Figured Foil.**—If "Beta" would scatter some silver-sand thinly, but evenly, over some hard substance, lay his foil on that, and over it two or three layers of cardboard, I daresay he would produce the figured foil he desires if he stroked his hand over the cardboard. The foil can be grained in several ways, and I am almost sure Mr. Wimshurst has answered the question before. In manufacture the foil is, of course, grained by passing it through properly surfaced rollers; but it can be done by the method above described, or by simply laying it on a sheet of coarse glass-paper and rubbing gently, so as not to break through.—S. R.

[57955.]—**Organ Pedal Pipes.**—It is a great pity that querists do not state explicitly what it is they wish to know. The querist under this number will find a variety of scales in back vols., but it is almost a waste of time for anyone to attempt to answer so wide a question: surely the questioner ought to state definitely what he means. "Good full tone" means nothing at all definite, and the "scale" of the other portion of the query is equally indefinite. If a Bourdon stopped 16ft. tone is wanted, a good scale is 5in. by 3½in., and 8ft. speaking length. Let the querist read p. 81, No. 836, and then say which he wants, when he will, no doubt, get an answer. Diagram of concave radiating pedals on p. 300, No. 610, and a much better one with full details in No. 594, p. 563. Will gladly help you in any way; but do say what it is you wish to know.—N. E. CHILD.

[57956.]—**Arc Lamps.**—I agree with "Lear" as to the lamp described by Mr. Bottone. There is no automatic arrangement for separating the carbons so as to form the arc. In every efficient lamp there will be found an arrangement for bringing the carbons together in the first case, and then separating them the required distance to establish the arc. This distance is generally adjustable to suit various E.M.F.'s, a large E.M.F. giving a longer arc, and vice versâ. I shall be glad to let "Lear" have drawings and description of a very suitable arc lamp for, say, a large moulding shop and similar places, where they are found very effective; or, if the Editor thinks the drawings of any use to the generality of readers, they are at his service.—JOHN H. HINDLE, JUN.

[57961.]—**Small Dynamo.**—The mode of winding will make no difference. The mode of coupling would account for the drag. When another path is open, not all the current passes round the fields; hence the drag is less when the accumulator is on. I cannot say exactly, without trying, whether you have any power to spare, dynamos differ so enormously in E.M.F. Better try for yourself.—S. BOTTONE.

[57963.]—**Lamp Query.**—The wick is either choked with dirt in its pores, or it is pinched too tightly into tube. If the maker says "it" is in perfect order, better let him see "it," and point out where "it" is wrong. In any lamp of the kind, all that is wanted is a wick up which the oil can flow by what is called capillary attraction, and then it will burn properly if trimmed correctly, and there is not much difficulty in doing that.—N. E. CHILD.

[57964.]—**Boiler Query.**—Yes; such a boiler [illegible] drive such an engine; but how it will do it is [illegible]her matter, as you carefully omit to mention [illegible]essure of the steam.—ESSAR.

[illegible]—**Electric Boat.**—If you want the boat [illegible] that is re[illegible] [illegible]y hours it h[illegible] [illegible] will, no [illegible] can tell you how many cells will be required without having some information of what the motor is like. Whichever of these batteries you employ, they will certainly be cheaper than accumulators. See p. 389, No. 953, for description of a battery used with an electric launch.—NUN. DOR.

[57972.]—**Glaze.**—It is glair or white of egg (only) beaten to a froth and allowed to stand until the clear liquor can be poured off. A little vinegar and a pinch of salt may be added with advantage to the white of egg before beating.—NUN. DOR.

[57977.]—**Compressed Air or Water Pressure.**—The compressed-air scheme would be better of the two, because a head of 16ft. only does not mean much in water-power unless there is a large volume, whereas the air could be compressed to any desired extent. It would involve the use of more elaborate machinery, though. If water were only as "elastic" as stated on p. 280, it might perhaps be cheaper to use it compressed instead of air; but, unfortunately (or fortunately), water is compressible only to the extent of ·00005 of its volume for a pressure equal to an atmosphere.—ESSAR.

[57978.]—**Extracting Silver.**—Without anything more trustworthy than the query, I can only suggest that nitric acid would dissolve the silver out of the crushed stone, and that it might be obtained in the metallic state by throwing it down with common salt and fusing the white curd-like matter with carbonate of soda.—NUN. DOR.

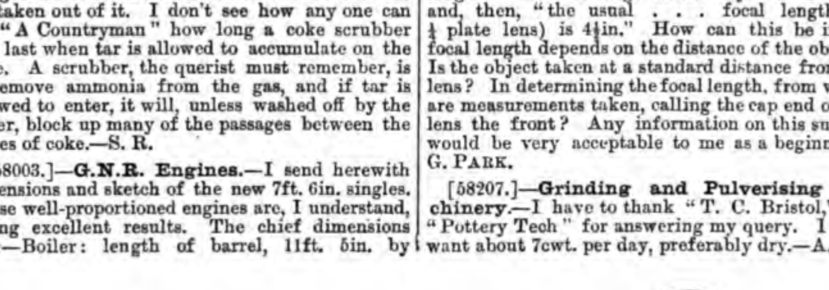
[57980.]—**Yellow Clay.**—The colour of bricks depends mainly on the amount of ferric oxide in the clay. Yellow clay contains ferrous oxide, rarely ferric; but good clay for yellow stocks can be found in many parts. Don't know where the "best" is to be had. "Fireclay" is rather indefinite when asking for chemical composition; but a general analysis of Stourbridge clay would give silica 65, alumina 23, water 10, ferrous oxide 2, and small amounts of lime, magnesia, and alkaline bases.—NUN. DOR.

[57982.]—**Coke Scrubber.**—This query is, perhaps, best answered by pointing out that before the gas enters the scrubbers it should have all the tar taken out of it. I don't see how any one can tell "A Countryman" how long a coke scrubber will last when tar is allowed to accumulate on the coke. A scrubber, the querist must remember, is to remove ammonia from the gas, and if tar is allowed to enter, it will, unless washed off by the water, block up many of the passages between the pieces of coke.—S. R.

[58003.]—**G.N.R. Engines.**—I send herewith dimensions and sketch of the new 7ft. 6in. singles. These well-proportioned engines are, I understand, giving excellent results. The chief dimensions are:—Boiler: length of barrel, 11ft. 5in. by 4ft. 2in. outside. Tubes: 186, 1¾in. dia. by 11ft. 9in. long. Firebox: length outside, 6ft. 2in.; breadth, 4ft. 0½in. at bottom; depth outside, 5ft. 6in. Cylinders: 18½in. dia. by 26in. stroke. Wheels: leading and trailing, 4ft. 1½in. dia.; driving, 7ft. 7½in. Wheel base: leading to driving, 10ft. 8in.; driving to trailing, 8ft. 5in.; total base, 19ft. 1in. Heating surface: tubes, 1,001 sq. ft.; firebox, 109 sq. ft.; total, 1,110 sq. ft. Grate area, 18·4 sq. ft. Weight:

	Empty.			Working Order.		
	tons	cwt.	qr.	tons	cwt.	qr.
Leading	11	0	0	11	18	0
Driving	15	14	0	17	0	0
Trailing	10	0	0	10	16	0
Total	36	14	0	39	14	0

—B.



[58068.]—**Conversion of Photo O.G. into Telescope.**—With the addition of a suitable plano-concave lens to his double convex, I should think "B.SC., Plymouth," would be able to produce an achromatic o.g. of about 75in. focus approximately. —H. A.

[58093.]—**Can the Law Interfere?**—I regret having overlooked Mr. J. Grey's answer to the above query; but was quite unaware I could interfere with another man's property, and having asked for a remedy, I felt myself insulted, or rather treated in any but a respectful manner (the fellow—gentleman, if you will—owning that it must be a nuisance), being a neighbouring owner of property. Had I have chosen my own careless way, I should have apprised his spiritual adviser of my application, and have offered to give double the sum he spent in the necessary fence to the nearest hospital.—CHRISTIANITY.

[58109.]—**Double and Treble Threads.**—An easy method of accomplishing this difficult looking question is to have an extra face plate fitted to present face plate to carry the driving stud of lathe, and turn freely on the shank of live centre, divided into any number of equal parts. Bind the two plates together to cut the first thread, and then move it one-half, one-third, or one-quarter for cutting two, three, or four threads.—WESTWOOD.

[58111.]—**Dutch Grammar.**—Elements of Dutch grammar, after Dr. Ahn's method; third edition; thoroughly revised, 1877, 8vo, 168 pages, price fl1.25 (2sh.) at Martinus Nyhoff, the Hague, Holland.—W. VAN EYS.

[58199.]—**Backing Plates.**—Thanks to "Magister," S. Bottone, and "Johnny Nash" for their answers to the above. Much obliged to the latter for recipe. Should like to know if S. Bottone ever has occasion to back his plates; if so, what the "dirty yellow or black mess" is composed of, and how is it to be cleaned off the plate again?—G. PARK.

[58202.1—**Photo. Lens.**—Would "B. Sc., Plymouth," kindly tell me how I could distinguish between a "rapid rectilinear," "wide-angle rectilinear," and "wide-angle landscape," and what the two former are used for? I do not quite understand Mr. Bottone's reply. He says "the focal length . . . is larger as the object is nearer"; and, then, "the usual . . . focal length (of ¼ plate lens) is 4½in." How can this be if the focal length depends on the distance of the object? Is the object taken at a standard distance from the lens? In determining the focal length, from where are measurements taken, calling the cap end of the lens the front? Any information on this subject would be very acceptable to me as a beginner.—G. PARK.

[58207.]—**Grinding and Pulverising Machinery.**—I have to thank "T. C. Bristol," and "Pottery Tech" for answering my query. I shall want about 7cwt. per day, preferably dry.—A. J. S.

[58015.]—**Boat.**—I should prefer about 4ft. 6in beam, and 2ft. 6in. deep, for a boat 16ft. long. As to sail plan, you could either have a lug, or a sprit sail. To our boat we have a suite of both; but the latter, I think, is the handiest, being so easily reefed. I inclose sketch. Fig. 1 is the lug sail; there is a sheave in the mast at *a*, through which the rope passes to hoist and lower the sail; at the end of the rope is a hook and ring, which slides freely up and down the mast, to which is attached the gaff P. R is the boom, and the hook D for the noose M. Fig. 3, which goes round the mast to keep the sail down tight—a very important point in sailing on a wind. For the jib, I would fix a rod of round iron across her bows at T, so that it could slide on, and would need little attention. Fig. 2 is the sprit sail, which is laced a fixture to the mast, the top of the sail being minus a gaff, the peak C is held up by a long pole H, called the sprit, which fits in a noose like Fig. 3, at O. By taking down H the sail is instantly made half size, shown by the

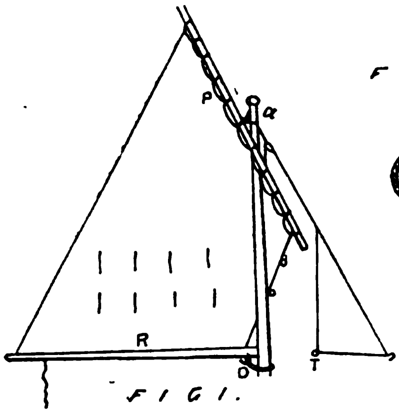


FIG. 1.

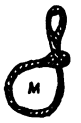


FIG 3

dotted lines. To take down sail, the jib is hooked off at K, H lifted out, the boom spired up, and mast laid in the boat—the work of about half a minute. Either sail can easily be managed by one man. I may also mention that a sprit will come nearer the wind than a lug sail. Any further information will be gladly given.—C. GODDARD.

[58102.]—**Electrical.**—The problem being well made to try one's patience at, I hesitated answering it until now, expecting that some of our fellow-readers might be pleased to work it out. In order to calculate with greater ease, you will allow me to replace T, W, w by a, b, c; thus, the three equations are

$$(1)\ a = x + z$$

$$(2)\ b = x + \frac{(y + 500)\,z}{y + 500 + z}$$

$$(3)\ c = x + \frac{yz}{y + z}$$

$$(4)\ x = a - z \text{ derived from equation 1.}$$

$$\left.\begin{aligned} cy + cz &= xy + xz + yz \\ cy - xy - zy &= xz - cz \\ y\,(c - x - z) &= xz - cz \\ (5)\ y &= \frac{xz - cz}{c - x - z} \end{aligned}\right\}\text{Derived from equation 3 by multiplying by } (y + z).$$

Then replace the numbers x and y in equation 2 by their corresponding worths, found in equations 4 and 5.

$$\begin{aligned}
(2)\ b &= x + \frac{(y + 500)\,z}{y + 500 + z} \\
by + 500\,b + bz &= (a - z)\,(y + 500 + z) + yz + 500\,z \\
by + 500\,b + bz &= ay + 500\,a + az - yz - 500\,z - z^2 + yz + 500\,z \\
z^2 + bz - az + 500\,z - 500\,z &= ay + 500\,a - yz + yz - by - 500\,b \\
z^2 + bz - az &= ay + 500\,a - by - 500\,b \\
&= \frac{axz - acz}{c - x - z} + 500\,a - \frac{bxz - bcz}{c - x - z} - 500\,b \\
z^2c + bcz - acz - z^2x - bxz + axz - z^3 - bz^2 + az^2 &= axz - acz + 500\,ac - 500\,ax - 500\,az - bxz + bcz - 500\,bc + 500\,bx + 500\,bz \\
- z^3 + az^2 - bz^2 + cz^2 - xz^2 &= 500\,ac - 500\,ax - 500\,az - 500\,bc + 500\,bx + 500\,bz \\
- z^3 + az^2 - bz^2 + cz^2 - (a - z)\,z^2 &= 500\,ac - 500\,a\,(a - z) - 500\,az - 500\,bc + 500\,b\,(a - z) + 500\,bz \\
- z^3 + az^2 - bz^2 + cz^2 - az^2 + z^3 &= 500\,ac - 500\,a^2 + 500\,az - 500\,az - 500\,bc + 500\,ab - 500\,bz + 500\,bz \\
cz^2 - bz^2 &= 500\,ac - 500\,a^2 - 500\,bc + 500\,ab \\
z^2\,(c - b) &= 500\,(ac - a^2 - bc + ab)
\end{aligned}$$

$$\text{Equation (6)}\quad z = \sqrt{\frac{500(ac - a^2 - bc + ab)}{c - b}} = \sqrt{\frac{500\,(\mathrm{T}w - \mathrm{T}^2 - \mathrm{W}w + \mathrm{TW})}{w - \mathrm{W}}}$$

You can now easily find x by introducing the above worth of z into equation 4, $x = a - z$. At last you find y out of equation 5 by using the afore-found worths of x and z. If you should want any further information about details of the above calculation, I should be pleased to help you.—X. Y. Z.

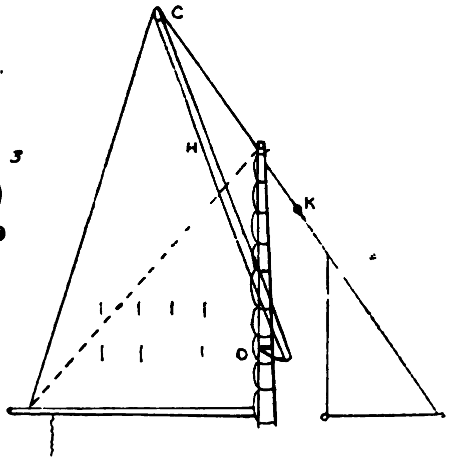


FIG 2

[58167.]—**Sanitary.**—The best and simplest earth-closet is, in my estimation, an invention of a Mr. Newton, of Newport, Rhode I., U.S. In my illustration I show it both open and shut, and in the latter state the leg support should be noticed. The cover consists of a box, containing the earth, and in this box is formed a hopper, with a passage between. When the cover is thrown back, the earth gathers from what was first the lowest part, but now the highest part, and will be over the passage, and ready to precipitate the proper quantity of earth the moment the closet is closed. The earth, therefore, in this instance, is deposited right through the aperture of the seat upon the refuse. H. S. WILSON.

FIG. 2.

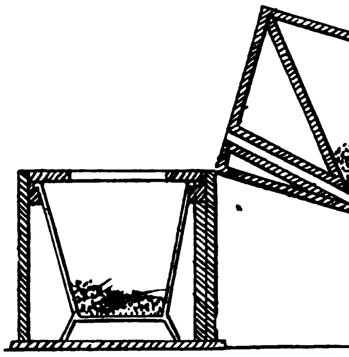
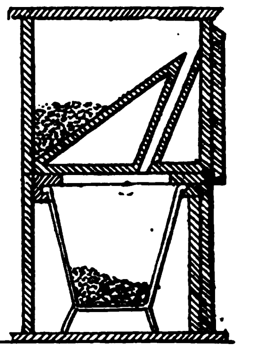


FIG. 1.



[58209.]—**Wheels.**—TO "T. C., Bristol."—Though not the original querist, I should be greatly obliged if you would further explain, as your answer is rather obscure to me, and the subject is one of interest as accounting for a custom seemingly empirical.—B. B.

[58209.]—**Wheels.**—If any amateur constructs a pair of wooden wheels and takes them to the blacksmith's to be fired, he will learn then that there is another important reason for making the wheels of the dished pattern, because if the spokes are vertical and there be the slightest untruth in the joints of the felloes, when the cooling fire forces them tightly together they will each point in different directions, and the result will be a wobbler; also, without the greatest care in allowance for shrinkage, both as relates to wheel and iron, the result will be to burst either felloes or nave, all of which probabilities are much lessened by adopting the dished form.—A., Liverpool.

[58210.]—**Engine for Electric Light.**—I should consider a gas-engine as economical as any, not requiring a skilled attendant constantly. It would not be worth your while to employ a stoker for a 2 or 3 h.p. steam-engine. As to the power required, you do not say how many lights in each room you require. Considering the size of the installation, you may reckon 10 lights of 20-c.p. per horse-power—of course, presuming you use dynamo and lamps of the highest efficiency. I shall be glad to give any further information.—JOHN H. HINDLE, JUN.

[58218.]—**Heating of Shafts.**—"Lubricator" asks a question that puzzles many besides himself. The oil that "Lubricator" uses may not be of the cleanest, and in that case his bottles, which I presume they are, will want looking to. I would take the wood that goes in the bottle neck, clean the hole in tube; then get a little fine emery cloth; rub the brass wire up and down a few times, and then they will lubricate; but oil your shaft before you place the bottle on, to give it the lead; I find for all hot necks, such as flywheel shafts, &c., there is nothing to equal castor oil.—MILL.

[58215.]—**Getting Clock Depths.**—If "Nomen" will procure a piece of small gaspipe with a ¼in. hole, cut it the required length, and then cut out four pieces of sheet iron or brass of equal length and thickness, and put it together by running a ¼ rod through the whole with a nut and washer at each end, he will get something like Fig. 1 in the sketch. He may then drill holes in the four legs equidistant from end or centre the size he requires, and screw the whole together till just movable with the fingers; next put the pipe in a small pair of vice-legs upwards, loosen one nut, and put in a pair of wheels, as in Fig. 2, set them the depth you require by opening or closing the legs, take the distance with a pair of dividers, and set it off on clock-plates.—SIMPLEX.

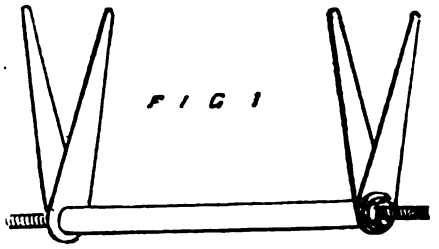


FIG 1

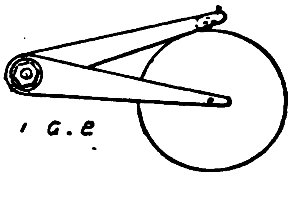


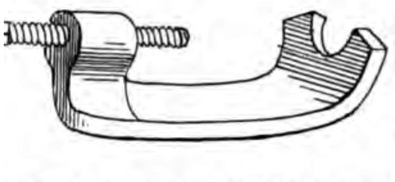
FIG. 2

[58226.]—**Colouring Brass Fishing Reels.**—"B. W." will require for colouring dark green the following: A stain made by dissolving 1 part white arsenic in 12 parts hydrochloric acid or common spirits of salts. The lacquer is made as follows:—One pint spirits of wine or methylated spirit, 1oz. of pale shellac, 1oz. turmeric; put them in a bottle in a warm place, and shake occasionally for three days; then strain or decant the clear liquid. Procure a flat camel's-hair brush, about 1½in. wide. Proceed as follows: Thoroughly clean brass by boiling and scrubbing in strong soda-water, rinse in clean water; make the articles hot by holding over a clear fire, and while hot brush over the stain; this will turn the brass nearly black; rinse once more in water, and then polish nicely with blacklead; heat the brasses again a little hotter than you can hold with your hand, and lacquer with the lacquer. Be sure you do not have the brush too full; better drain the brush as much as possible before putting on; pass the brush over the work lightly and quickly. A little practice will enable you to do it satisfactorily. If any parts are wanted bright, scrape the metal bright and burnish, and then lacquer with a lacquer made with dragon's blood, instead of the turmeric; in this case a ¼oz. of dragon's blood will do. Will some of "Ours" kindly give practical particulars of other colours.—AT LAST.

[58229.]—**Mending Saucepans.**—Throw them on the scrap heap: they are cheap enough without risking poisoning yourself by cement.—T. C. Bristol.

[58229.]—**Mending Saucepans.**—If the [illegible] is not too wide, clean it out and iron a cement made of 2 parts powdered blacklead. Melt the pan or ladle, and stir in the bla from Spon's "Workshop Rec found it answer fairly well.—J. I

30.]—**Bicycle Cranks.**—If you are mechanic
ı to do anything to cycle when crank is off,
e clever enough to make a tool to sketch.



it strong, say, ½in. gas thread for screw, of
–T. C., Bristol.

31.]—**Artificial Memory.**—Professor Pick
ıblish a work explaining the main features
system. I have, however, reason to believe
e did not actually invent any of the principles
ployed, much less did any of the "professors"
present day. Unfortunately, this subject has
to been monopolised by "professors" who
s proclaim themselves the inventors of
ples to which they have really no claim.
is not, so far as I know, at the present day
monical principle taught, secretly or other-
which has not been known to the initiated for
erably over a quarter of a century. It would
possible to properly explain here the applica-
f the principles referred to, and to merely
xamples would only mislead; but if "S. C. C."
advertise his address, I could communicate
er particulars.—MNEMONIKOS.

239.] — **Screw-cutting—Faulty Thread.**
ng a long time annoyed with the same fault,
d out that it was the adjusting screws on the
shaft, the nuts or collar being off truth (the
n my case), and I simply turned them up
n the face.—D. B. S.

239.]—**Faulty Thread.**—The lathe evi-
requires a thorough overhauling. The
, the slide-rest, the change wheels, and the
must be examined. If "Louis" is a novice,
e a competent man to rectify or examine. If
rew you are cutting is a different pitch from
g screw, it cannot be that which is wrong—
ut cannot be at fault.—WESTWOOD.

241.]—**Pedal Organ for Harmonium.**—
uerist will find the description of a suitable
action for harmoniums on p. 300 and 301 of
esent volume of the ENGLISH MECHANIC.
further information with pleasure, if re
ed.—G. FRYER.

243.]—**Stone Polishing.**—Try tripoli and
on a millwheel of hard wood.—W. C. HALL,

243.]—**Stone Polishing.**—You should grind
shells well, after having steeped them in
aquafortis; polish them with emery and
nishing off with polisher's putty and oil and
. Have you tried polishing the pebbles with
of iron? Dust some on a large flat cork, free
dirt and hard parts; wet the powder, and rub
ebble on the cork for some time, renewing
ide and water when necessary.—S. H.

243.]—**Stone Polishing.**—"Amateur Lapi-
' should get as fine a face as possible by not
any more emery, and but little water. If
emery has been used, a fine surface cannot
t on that plate, because the grains stick in the
After finishing on lead, rub with pumice-
then with fine hone (a small grindstone of
is very useful). After hone use a lap made
ton cloth, charged with a little fine washed
; no emery should be used after the first, and
uch water. This should be followed by
er lap with tripoli, unless a polish has been
ed with emery; if so, the tripoli may be
ed, and the polish finished on putty-powder
A little practice will be required. Be very
l to have everything free from grease, as this
l to good polish; use separate laps for each
ing powder, and keep everything clean and
rom grit. Cotton cord or fustian, same as
for trousers, will make a good lap, but should
shed with hot water and soda. I will write
if required.—W. POTTER.

245.]—**Varnishing Pictures.**—I should
the picture on to a good stout piece of milled
, give it two coats of isinglass size, and after-
, when dry, a coat of copal varnish.—H. A.

245.]—**Varnishing Picture.** — Cover the
e *with* a coat of size, then varnish it with
llowing varnish:—Dissolve 1oz. of Canada
in 2oz. of spirits of turpentine; apply with
—*S. H.*

]—**Varnishing Picture.**—The way to
d **varnish** the "Yule Tide" coloured plate
thi millboard from a stationer (it is
Ib millboard, and th
of the colou
one l

two corners of the coloured plate, take the other two corners, and lay gently on the pasted millboard, padding it down with a silk handkerchief, and go on padding from the centre outwards and forwards, the assistant laying it down before you. The object of this is to stretch it perfectly flat, and to avoid creases and air bubbles. When dry, give a coat of fine clear size, and varnish with copal or mastic varnish, to be obtained at an artist's colourman's.—B.SC., Plymouth.

[58246.]—**Microscopical Examination of Yeast.**—Yeast may be examined under the microscope in the following ways:—Put some fresh yeast in some Pasteur's fluid, and keep it in a warm place. When the mixture begins to froth up, spread some on a slide and examine (1) with low power without a cover-glass. By this means the various sizes of the cells can be seen and their grouping; (2) Cover a similar specimen with a thin glass, and examine with a high power; in this way the distinctive features of the yeast cells may be observed; (3) Stain the specimen with magenta; the protoplasm is stained, the rest remaining unstained; (4) Stain another specimen with a solution of iodine; the protoplasm stains brown; (5) Treat another specimen with solution of potash; the protoplasm is dissolved. The yeast plant grows much better in Pasteur's fluid when kept warm than cold. Boiling, however, kills the cells. Pasteur's fluid consists of—

	Parts.
Potassium phosphate	20
Calcium phosphate	2
Magnesium sulphate	2
Ammonium tartarate	100
Cane sugar	1,500
Water	8,576
	10,000

The composition of the other reagents may be found in any book on the microscope. I would refer "Young Brewer" to Huxley's "Practical Biology" for further information on the subject. I shall be glad to give any further information in my power.—ENAL.

[58248.] — **To Prevent Oil Penetrating Leather.**—Try indiarubber cement, as used by shoemakers; it is thin, like treacle, and sold in tins at the indiarubber shops.—J. F. C.

[58249.]—**To Glue Cloth to Tin.**—Try a thin solution of gutta-percha put on hot, instead of glue. Rough the surface of the tin before applying the solution. You will find this answer your purpose well if properly done.—G. FRYER.

[58249.]—**To Glue Cloth to Tin.**—The following will, I think, do what you want; the acid acts on the tin and secures it firmly:—56 parts of good common glue, melt, and add 3½ parts of gum ammoniac, stir well, and pour in 3½ parts of nitric acid and mix. N.B.—This is not from "Spon's Workshop Receipts."—R. A. R. BENNETT.

[58249.]— **To Glue Cloth to Tin.** — To fix a metallic to a soft substance requires a tough substance, not a varnish, nor yet a glue; but indiarubber cement, as used by bicycle makers for fixing tires. It is tough, and in sticks. Warm the metal and rub over with the cement, and while yet hot, apply the cloth, and press down with a hot flat iron. To fix cloth to plaster requires the cement sold in tins, and not applied with heat.—J. F. C.

[58250.]—**Perkins' Heating Apparatus.**—This system is fixed by many engineers; any suitable boiler may be adapted to his pipes. If you will give address in Sixpenny Column I will advise you.—BROOKE, Bournemouth.

[58252.]—**Hardening Steel.**—I should think you have a kind of steel which only hardens when treated in a peculiar way—viz., having heated to redness, thrust it into a piece of mottled soap. That done, return to fire, and heat to a white heat, then thrust into a vessel containing cold urine, stirring the article round to cool quick.—J. F. C.

[58255.] — **Protecting Iron.**—Try coating it with magnetic oxide of iron by heating it red-hot in a current of steam, as in the Bower-Barff process.—B. B.

[58256.]—**Motor.**—In reply to "Polly," many would like a motor in lieu of steam; but electromotors are not reliable enough. Hot-air engines may one day be used. There is an experiment being tried in Colchester—a propeller, with hand appliance, and there is no reason why a hot-air engine should not be used, in lieu of hand-power. Britannia Co. are making engines, but never yet for such purposes.—BOATMAN.

[58257.]—**Porridge Stirrer.**—I am afraid "Time is Money" will have difficulty in buying or constructing a stirring machine. Unless the motion could be varied just as by hand, the porridge would be sure to burn at some part. Why not adopt the cheap and simple "bain marie"? I am told they are now sold in London for the express purpose, called porridge pots. Put the meal, water, and salt into the inner dish 12 hours before putting on the fire.—B.SC., Plymouth.

[58257.]—**Porridge Stirrer.**—If you use the coarse oatmeal and keep the pan very slightly boiling, it will only require stirring every few minutes for about 35 minutes. Should they get a little stiff or baked to the bottom, put the pan on the cold slop stone for a minute or two, which will release it. Should advise a brass pan, or a pan which is made to boil in another pan of boiling water, if it be intended to make the porridge with milk. If fine oatmeal be used, they only require to boil half a minute after mixing. I prefer this kind, and have used them twenty years.—HEALTH.

[58259.]—**Haggis.**—Get the large and the "king's hood" stomach bags of a sheep, along with the lights, liver, and heart. Wash the bags thoroughly; boil the small bag and lights, liver, and heart together. Grate down one quarter of the liver, and mince the lights, heart, and small bag together with half a pound of beef suet very fine; add a breakfast cupful of oatmeal (which has been browned before the fire), salt, black and white pepper, and a breakfast cupful of the liquor in which the lights, &c., were previously boiled. Stir all together, put into the large bag, sew it up, and boil for three hours.—B.SC., Plymouth.

[58259.]—**Haggis.**—Procure a lamb's paunch, well cleaned and perfectly white. Next, parboil a lamb's pluck in water with salt and pepper until done, and chop it fine. Place a dozen chopped onions with 4oz. of butter in a stewpan, and fry these over a slow fire to a very light colour. To these add the chopped liver, lights, &c., 1lb. of oatmeal, 1lb. of chopped beef-suet, some chopped thyme and parsley, nutmeg, pepper and salt; stir all together, and with this fill up the lamb's paunch, which must have been previously pressed in a cloth to absorb all watery moisture. Carefully fasten any holes that may exist in the paunch by tying them up with string, and then tie up the haggis in a cloth much in the same way as you would a pudding, and boil it in a large stewpan with enough water to cover it. The haggis will require about three hours very gentle boiling to cook it. When done, take it carefully out of the pot, and gently remove it from the napkin on to its dish, and serve it while it is hot.—S. H.

[58260.]—**Leclanche Batteries.**—The Leclanché battery, with agglomerate plates, has actually a lower E.M.F. than porous cell form. Why do you not use a sulphate of mercury battery as recommended by me a fortnight ago? See query 58304 by one who has tried them. A six-block Leclanché can be used for a few moments for electric lighting, but it is most unsatisfactory.—S. BOTTONE.

[58260.] — **Leclanche Batteries.** — As the battery is only required to work for a minute at a time, a Leclanché might answer the purpose. I used such a battery to light a 2½-candle power lamp, and it lasted for five months without recharging; but being for observatory work, the lamp was but little used. This battery consisted of six large cells. I have since substituted a bichromate for the Leclanché, which, if made with lifting cells, is preferable, on account of increased power and time of working.—J. MILTON OFFORD.

[58260.]—**Leclanche Batteries.**—I should not advise "Hugh" to attempt to use the porous-pot form of above for lighting lamps for microscopic work. I know nothing of the improved form of the battery; but with 12 quart cells, ordinary pattern, I cannot light a 2½ or even a 1 c.p. lamp (cells arranged in "3—4's"). I am trying various plans, but so far can only recommend the Leclanché for working a "night-light" just to see the time by.—J. T. S.

[58260.]—**Leclanche Batteries.**—"Hugh" may be interested to learn that in my aquarium I have a 5-c.p. lamp lighted by 10 quart size Leclanché (porous) cells. These cells have been in work for the last six months (four of them I constantly use for bells), and are still in good order. True, I only light the lamp for a minute at a time to amuse my children, and to surprise the fishes in aquarium. Still, there is the lamp; and if "Hugh" lives in London I shall be pleased to let him see it.—L. C. D.

[58260.] — **Leclanche Batteries.** — I have a small installation of two lamps, about five volts, which I light very well with twelve agglomerate Leclanché's coupled up in two sixes, as I could not get quantity enough from any other coupling. I use one lamp with w.c., which I switch on before entering, and which I have tested for a quarter of an hour with hardly a perceptible diminution of power, the other lamp, which is not, of course, used at same time, is placed over a clock in my bedroom, giving sufficient light to see the time distinctly, although six yards away. N.B.—I am not an electrician.—AUSTEN, Bookseller, Canterbury.

[58260.]—**Leclanche Batteries.**—Your correspondent, "Hugh," says he cannot get authentic information from the MECHANIC. Perhaps the following may suit him. I have one of Swan's modified Leclanché batteries under my bed, which I use to light a 2½ candle incandescent lamp by means of a flexible insulated wire and presselle at my bed's head. The lamp is fixed on the mantelpiece against my watch stand, and I can see the time at any hour of the night whenever I awake without having to get out of bed. The battery has been at work about two years without recharging. I believe I was one of the first to adapt the electric light to this purpose.—WM. WRIGHT, Fiskerton Manor, near Newark.

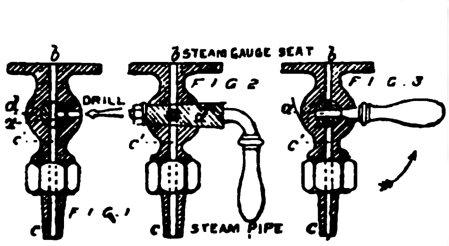
[58260.]—**Leclanche Batteries.**—Far be it from me to outrage the feelings of any correspondent on this matter by differing from him; but it seems to me the following is the answer required: It is possible, no doubt, to light an incandescent lamp by means of Leclanché cells in sufficient number; but what earthly good would it do when it could be done by means of a bichromate cell or two with considerably less trouble, no smell, merely nominal expense, and much more satisfactorily in every way? The chief advantage of the agglomerate blocks is that they are ready for use immediately when the battery is set up, and do not have to wait for some hours first. The mere fact that the querist does not require the current for more than a minute at a time seems to me to render it absurd to use the Leclanché cell, for the only objection to the use of the bichromate is that it soon gets used up, which, if he only wants it at intervals, would be removed. The plain reason why he can't get a satisfactory answer is that no one is foolish enough to try Leclanchés for such a purpose (for which they are pre-eminently unsuited), so no one can say from experience. There is a certain class of people, saith the ancient adage, who "rush in where" another class of people "fear to tread." Let me advise our friend not to enrol himself in the first list or he will find it to his disadvantage eventually. If I were in his place I would use Dale's Granule Battery, two or three cells, small size; or, as he only wants it at intervals, two or three cells of chloride battery by same maker. I expect these would give him every satisfaction, while the Leclanché cells he is so devoted to would cause him endless worry and annoyance, there being such a number to be kept in good order.—R. A. R. BENNETT.

[58261.]—**Soft Water Injuring Pipes.**—Inasmuch as the difference between soft and hard water consists mainly in the presence of calcium sulphate in the latter, it is obvious that by adding the sulphate the water will be rendered hard, and, therefore, less likely to attack the pipes. Under these circumstances the advice given would, I should say, be very good, especially as the water is not required for drinking, so it would not be injurious to the inhabitants of the house however much was put in.—R. A. R. BENNETT.

[58267.]—**Guttapercha for Boots.**—Get any size or shape of guttapercha and boil till soft like dough, then press with the thumb to the sole, making it the desired thickness. Price about 2s. per pound.—BROOKE, Southside, Bournemouth.

[58267.]—**Guttapercha for Boots.**— It is done with indiarubber cement. The boot and sole being heated, the cement is applied after the manner of heel-balling, and rubbed down with a hot iron. That done, warm boot and sole over a small lamp; when cement appears soft, clap together, and press down hard until cold. It is sold in England in sticks, 2in. long, 2d. each. You appear to want a quantity; but I know nothing about wholesale price.—J. F. C.

[58268.]—**Steam-Gauge Cock.**—I believe the fault is with the cock, which is not drilled so as to allow gauge to communicate with atmosphere when steam is shut off. Fig. 1 shows cock opened, with *b a c* in a line. Through side of body of cock drill a hole carefully, so as to reach plug hole *a*, but do not drill entirely through plug. Give a half-turn to handle; *b a c* will still be in a line, but small hole will be shut by the portion of plug marked *d*. The boiler and gauge will communicate. (See Fig. 2.) By turning handle quarter turn more, the hole *c* (steam) will be shut; but small hole will communicate with *b*, and relieve gauge from the pressure.—BELGIAN.



[58268.] — **Pressure Gauge.**— Although you shut off the pressure, you only shut it in gauge, and it will point the same till it gradually leaks off. The gauge works beautifully.—D. B. S.

[58268.]—**Steam-Pressure Gauge.**—Of course, the pointer will not move by just turning of the cock, as there is still a pressure of 70lb. between the cock and the gauge. If after turning of the cock you unscrew the gauge, you will find that the water will escape and the pointer will fall. The use of the cock is to shut off steam when the gauge is out of order and it is necessary to take it off.—S. W. W. F.

[58271.]—**Marine Glue.**—If this correspondent will turn to Vol. XXXVI. pp. 214, 233, 482, he will find an answer to all his questions. Marine glue is made by dissolving indiarubber in mineral naphtha, and adding shellac or mastic. I suspect the work he refers to would say just what had been copied from the early volumes of the ENGLISH MECHANIC.—NUN. DOR.

[58271.]—**Marine Glue.**—This glue is employed where the materials are exposed to the influence of wet. It not only cements wood, but glass and metals. It is made by dissolving by heat one part of pure indiarubber in naphtha, the indiarubber being cut very small. When melted, two parts of shellac are added, and the melting continued until the whole is well mixed by occasional stirring or shaking. While hot it is poured on metal plates to cool. Before using it requires to be liquefied by heat, and quickly applied with a brush, as it soon hardens.—BOBADIL.

[58272.]—**Lead Tartrate.**—Mixing the dry powdered salt with an inert substance like emery powder, might effect your object, by separating the particles of reduced metal from each other.—B. B.

[58272.]—**Lead Tartrate.**—It is evident that this correspondent has not made (at least, not properly) lead pyrophorus, for when it is properly made it is in the form of a black powder, which takes fire spontaneously, and appears like a shower of sparks when the tube is broken, and the contents are shaken into the air. The way I made some was by heating dry tartrate of lead (in a glass tube closed at one end and drawn to a point at the other) till no more vapours were evolved, and then sealing up the point with a blowpipe.—W. C. HALL, Mon.

[58274.]—**Regenerative Gas Fires.**—"B.Sc." makes a very common mistake in supposing that regenerative burners increase the total quantity of heat evolved. If the gas is perfectly burnt the total amount of heat is the same under any conditions, and a regenerator burner in a stove is not likely, under ordinary conditions, to give so satisfactory a result as a burner giving a lower temperature and a more diffused heat. The smell caused by regenerator burners charring the dust in the air is to myself most offensive, and any stove having an intense local heat must have that heat diffused and reduced to a lower temperature before it can come in contact with the inner surface of a stove. Increase of light by regeneration has no connection whatever with increase of total heat evolved, which latter is an impossibility.—T. F.

[58275.]—**Dynamo.**—TO "W. H. E."—If you wish to test the capabilities of the machine, take the current required for the full number of lamps the machine runs through resistance coils, for three or four hours; that is if you have not got the lamps. To regulate the E.M.F. of the machine you require a board having two sections of two concentric circles marked on it; following these two lines are two series of brass studs in the upper circle about 1in. apart, and in the lower circle about ½in. apart. You then wind zigzag from one stud to the other an iron wire (about No. 30 in your case); one end of the shunt wire is attached to the beginning of the iron wire, and the other end is attached to a lever which rubs on the brass studs, putting in circuit more or less iron wire as required. If you do not understand this I will send you sketch and further particulars.—W. H. EAVES, Coventry.

[58276.]—**Bicycle Spokes.**—One of the principal causes of a spoke breaking at the hub is due to its not being accurately fitted at the most important point, and that is the plain portion which screws into the hub, and by so doing takes the transverse strain off the threaded portion, which is the weakest portion of the spoke. When properly fitted, the plain portion should fit close up to the hub; if it does not, it is little better than when the thread is above the hub. I have a machine which is splendidly fitted in this respect, and none of the spokes have given way or even loosened, and I have been riding it for the last two years over rough granite roads, which often, "when riding fast," make the spokes ring out like the strings of a harp.—G. TOWNSHEND.

[58278.]—**Overhead.**—The flat wheel can have flat pulley overhead, and be worked by a flat strap. Many prefer a hollow barrel, but about equal number are made with sliding pulley.—BRITANNIA.

[58280.]—**Bunsen Battery.**—No, you could not light a 2½-c.p. lamp with two such cells; but if you use three cells, and equalise your zinc anode accordingly, and get one of Mr. Todd's low resistance lamps, as advertised in the Sale Column, you can accomplish your object for about 12 hours out of each charge for occasional lighting; but take care and remove the zincs when your light is not required. Better place your cells outside in a box, and as wire is cheap, run same to the room you require to use the light.—LECLANCHE.

[58283.]—**Carriage Wheels.**—The front wheels of carriages are made smaller than the hind ones, so that you can turn sharper. If they were made the height of the hind wheels, then the body would have to be elevated, otherwise you would not be able to turn quick, and would be in danger of overturning the carriage by the wheel rubbing against the side of carriage. Consult your carriage maker or a wheelwright.—BROOKE, Southside, Bournemouth.

[58283.] — **Carriage Wheels.** — High wheels run more easily than low ones on uneven roads, consequently the wheels are made as high as possible for the hind part of a vehicle, their height being only limited by the position of the door in most carriages, the necessity of making the step low and the advisability of placing them as nearly as possible under the weight. The front wheels, however, to permit of easily turning the carriage must pass under the body, and are, therefore, low. In America wheels are more of a height, but such a construction is objectionable an account of the space required for turning, and the inaccessibility of the body. If nothing but ease in running were desirable, the wheels might be of the same diameter—high for bad, low for perfect roads as railways.—J. MILTON OFFORD.

[58284.] — **Electrical Contact — Series.**—In my copy of S. P. Thompson's textbook the difference of potential of zinc and carbon in contact in air is 1·09 (not 109) volts. Ayrton and Perry's results as quoted were published in *Transactions of the Royal Society*, 1880, Part 1, p. 1. The cause of this so-called "contact" potential is chemical action (oxidation, &c.) at the exposed surfaces of the substances in contact. See papers by the present writer in *Philosophical Magazine*, Vol. VI. p. 142, and Vol. VII. p. 109; British Association Report for 1880; also a comprehensive *résumé* of the whole subject by O. J. Lodge, *Electrical Review*, Nos. 863, 364, 365, and one or two papers in the *Philosophical Magazine*, Vol. XIX., by the same author.—J. BROWN, Belfast.

[58285.] — **Zinc Cylinders.** — Cut sheet (or rather, plate) zinc to size required, make quite [illegible] and hammer round a mandrel.—NUN. DOR.

[58288.]—**Screwing.**—I presume Mr. Westwood meant to say there are three pulleys on middle part of spindle (between the bearings). Let us number them 1, 2, 3. Nos. 1 and 3 are loose; No. 2 is fast on spindle. Now, by means of two belts running in contrary directions, and which can be shifted with a double fork alternately upon Nos. 1 and 2 and 2 and 3, it is evident the spindle will revolve alternately in one, and then the reverse direction. If "W. G. L." will advertise his address I will, with pleasure, send him mine, and give him sketches if necessary.—BELGIAN.

[58288.]—**Screwing.**—The machine I spoke of is driven by two straps, the one straight and the other crossed; when the straight strap is on the fixed pulley the machine is driven right-handed, and when the crossed strap is on it runs the reverse way; the loose pulleys are each twice the width of the fixed one. I cannot give the price of machine to screw 1in. bolts; machines for screwing this size are made very differently. The largest machine I have seen to screw as above was for ⅝ [illegible] bolts. If "W. G. L." will advertise his address, I will obtain and forward it to him. "W. G. L." [illegible] query for screwing bolts in lathe. Wa[illegible]ting a few engineer's studs screwed both ends, I made them by screwing chuck on mandrel nose, and gripping my short pieces of ⅝ iron by set pin, put in the gear wheels (a 6in. gear lathe), gripped [illegible] my die [illegible] a lathe carrier, and forced up by loose [illegible] headstock allowing carrier to rest on tee-rest.—W[illegible]ESTWOOD.

[58289.]—**Re-silvering Lamp R[illegible]eflectors.**—Make a thin paste of 17½oz. of distille[illegible]d water, [illegible] of chloride of silver, 5¼oz. of cyanide [illegible] of potassium, and levigated chalk; spread it over [illegible] the reflector, leave till nearly dry, then clean it [illegible] off with a rag.—S. H.

[58290.]—**Wimshurst Influence [illegible]**
TO "INDUCTION."—To be [illegible] [illegible]ectric
den jars for plates of 2[illegible]
tionally larger than f[illegible]
matter of taste, or to

particular purpose. Ordinary Leyden jars will of course answer the purpose, only be sure that they are of proper quality glass. I have just now been testing some made in Germany, I believe, through which the electricity passes as freely as though they were of metal.—J. W.

[58291.]—**Spark Coil.**—It is impossible to say how much battery power a coil can stand unless we are told the size of the secondary wire.—BOBADIL.

[58291.]—**Spark Coil.**—There is not much difference between the E.M.F. of a Bunsen and a bichromate. Three pint cells of either of these batteries will be as much as an ordinarily constituted coil will bear. One good bichromate will generally be found ample.—S. BOTTONE.

[58292.]—**To "W. H. E.," Coventry.**—Wind your armature with a single layer of No. 18 d.s.c., and wind on the magnet cores 30lb. of No. 19 d.c.c. As near as I can judge from the data you have given me, the E.M.F. of the machine will be about 60 volts, so you will be able to light from 10 to 15 lamps of 20 c.p. each. Any further information you may desire, I shall feel great pleasure in giving you.—W. H. EAVES, Coventry.

[58293.]—**Lantern Lens.**—The ¼-plate lens would be the best. A 4in. condenser would be ample for your purpose. The mitrailleuse would be of no use. A good three-wicked paraffin lamp, with the wicks parallel, or, better still, a four-wicked lamp with the wicks arranged like a W, would give you the desired results.—S. BOTTONE.

[58296.]—**Type Metal.**—Instead of mixing the metals, "Volt" will do better to buy old type from a printer. In our works we are constantly using small quantities of type metal. I find it cheaper, as well as more convenient, to buy and melt up old type.—ION.

[58296.]—**Type Metal.**—"Volt" might have stated what metals he uses, and the proportions. Antimony is readily oxidised when fused, and with the old system of type-casting every dip of the ladle helped the work of oxidation. With the machines, however, it is only necessary to cover the bath with sal-ammoniac or charcoal dust, and even that does not appear to be an essential, the oxidised scum itself protecting the metal beneath. Lead with from 10 to 30 per cent. of antimony ought to give all that is required, and I should imagine that want of heat is the real cause of "Volt's" metal turning thick.—NUN. DOR.

[58297.] — **Guttapercha Boots.**— You don't make your work hot enough; look at No. 58267.—J. F. C.

[58297.]—**Guttapercha Boots.**—Does "Volt" put on the soles with the solution sold for the purpose? I never had any difficulty when I tried soleing 30 years ago. See that the old sole is perfectly dry and warm, and if too smooth cut wrinkles in it with something blunt. Since then I have put on indiarubber soles with nails, and this might be done to the g.p. soles over and above using the solution.—B.SC., Plymouth.

[58299.]—**Mixing Machine.**—For the purpose of mixing powders, nothing is so suitable as sieves, with meshes attached of such a size as to allow the powders to come through of the desired degree of fineness.—S. BOTTONE.

[58304.]—**Sulphate of Mercury Batteries.**—To S. BOTTONE.—Provided contact is not made too frequently, these cells might be used for the purpose you mention. The time they would last would depend on two things. 1st. How often the battery was used. 2nd. The amount of moisture in the cell. When the sulphate of mercury is exhausted, the cells must be re-charged by the addition of fresh paste. If the cell has only dried, then moisture is all that is needed. A considerable portion of the mercury is absorbed by the zinc, and the whole might be recovered from the spent paste, washing out the soluble sulphate of zinc, and distilling the residue with powdered charcoal in an iron retort; but I am very much afraid that the game would not be worth the candle. Arranged as voltaic pile, there would be a considerable loss of power through leakage; therefore, the other way is better.—S. BOTTONE.

[58307.]—**Frosting Glass.**—Glass can be frosted by allowing the vapour of hydrofluoric acid to act upon it.—W. C. HALL, Mon.

[58308.]—**Length of Strap.**—Two lengths between centres, and half of circumference of large and small pulleys, and allow a little for tightness.—B. S.

[58308.]—**Length of Strap.**—Of course your cone pulleys are of the same conicity. Calcu- if you had to do with two cylindrical spectively the mean diameter of are the length

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "B. B." has replied to 57635; N. E. Child, 57740; H. Hindle, jun., 57859; "Marlow," 57900.

57687. Village Car, p. 130.
57710. 7in. Breechloading 82cwt. Gun, 130.
57722. New M. R. Engines, 130.
57731. Planing Tool, 130.
57740. Free Reeds, 131,
57745. Lampholders, 131.
57750. Tramway Points, 131.

57946. Tractive Force of Compound Locomotives, p. 210.
57950. Chemical Reaction in Wall Paper, 210.
57965. Carbon in Ferro-Manganese.—Eggertz's Method, 210.
57971. Extracting Dye, 211.
57973. Winding Engine, 211.
57974. Cleaning Prism of Binocular Microscope, 211.
57988. Screw-cutting, 211.

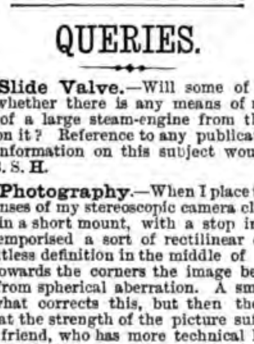
QUERIES.

[58309.]—**Slide Valve.**—Will some of our readers inform me whether there is any means of relieving the slide valve of a large steam-engine from the enormous pressure upon it? Reference to any publication or other sources of information on this subject would be gladly received.—B. S. H.

[58310.]—**Photography.**—When I place the two small landscape lenses of my stereoscopic camera close together, flat side in, in a short mount, with a stop in the centre, I have extemporised a sort of rectilinear combination. It gives faultless definition in the middle of the prepared plate; but towards the corners the image becomes weak, and suffers from spherical aberration. A smaller centre stop somewhat corrects this, but then the light is so lessened that the strength of the picture suffers. I wish to ask some friend, who has more technical knowledge of optics than I, if placing a concave lens close up to the large centre stop will correct the aberration without spoiling the light and definition? Dallmeyer's rectilinear, which is before me, consists of two similar deep convex meniscus achromatics. The concave side is placed about two diams. of the lens asunder. I wish to know, in the simple copying combination, which may be extemporised by placing two ordinary landscape lenses back to back as I have described? What distance asunder ought they to be? No doubt some readers have experimented in this direction, and I, and doubtless others, will be glad to learn their experience.—E. B. FENNESSY.

[58311.] — **Electrical.** — I am wishing to light a benzoline lamp by the ignition of a helix of platinum wire in a circuit. Will some kind reader help me by telling how many Leclanché cells will be required for the purpose, and whether they must be coupled in arc or series, and whether a short or long piece of platinum is best? Has the ordinary bichromate solution any effect on iron? I want to use some iron drums for bichromate batteries, if available.—J. T. P.

[58312.]—**Electro-Motor.**—I have parts of electro-motor, as per sketch. Field-magnets and bridge are of wrought iron, and pole-pieces cast; bridge piece, A, is 3in. by 2in. by ¼in.; F.M., 4in. by 2in. by ⅜in.; pole pieces, from D to E 3¼in., from K to I 1⅜in., from E to K 2in. Armature is also of wrought iron, pieces G and G being screwed to H. Diam. of armature, 3in.; length, 2in.; winding space on F.M. from B to C, 3⅞in. Will Mr. Bottone, or other beginner's friend, tell me if this should work all right? What quantity and size of wire for field magnets and armature, and number of bichromate cells (square, exposing 3in. by 2in. by ¼in. zinc to two carbons, 3¼in. by 2in. by ¼in.) to obtain best results? Would it be powerful enough to drive a rather heavy sewing machine?—YOUNG GHAZI.



[58313.]—**Fan.**—Will any reader inform me what size fan I should require and how many revolutions per min. to get a pressure of 5lb. per square inch, or should I require an air chamber?—B. L.

[58314.]—**The Bichromate Battery.**—I should be extremely obliged if some correspondent would describe all the different forms of the above battery, as improved from time to time by English and French makers. I know only of the bottle form, but understand there are other modifications. I wish greatly for the above information.—NEW SUBSCRIBER.

[58315.]—**Electric Bells.**—I want to ring three bells one circuit at once, and also each singly at times. I find they do not work well together, but in jerks. If two are coupled up without their contact breaker, the three work all right; but when one of these bells is required to ring by itself it cannot, but gives just one stroke. Extra battery power is no use. Advice will be gladly taken by—A. R. F. K.

[58316.]—**Dynamo.**—TO MR. BOTTONE.—I have a dynamo with Pacinotti ring and upright field magnets. The magnets are wound with 14lb. of 16 d.c.c. wire, and the armature with 2lb. 20 silk-covered wire. On running the machine, I can just obtain current to drive a Griscom's motor. Have I too much wire on the field magnets or too little, or has the armature too much, or not? The weight of F.M. is 21lb., and weight of armature 4½lb. Please tell me how to couple it for incandescent lighting.—J. M. B.

[58317.]—**Launch Engines.**—What is the usual rule adopted in proportioning engine power to pitch of propeller or the reverse, the required speed in miles per hour being given? What is the best form of elastic coupling between engine and propeller shaft?—SEVERN.

[58318.]—**Hot-air Engine.**—Will J. Sutcliffe give a sectional view of the two cylinders—hot-air?—J. H. WALKER.

[58319.]—**Soda Ash.**—What quantity of soda ash at 47·5 per cent. will it take to reduce five tons at 51·1 per cent. to 50 per cent.—APPRENTICE.

[58320]—**Cubic Inches in Sphere.**—How many cubic inches are there in a round ball of 12·5in. diameter?—APPRENTICE.

[58321.]—**Piano Query.**—Is there any mechanical method of plaiting the silk for the front of a piano? It is troublesome and difficult to do it evenly by hand.—N.

[58322.]—**Tinman's Jenny.**—Can any reader give sizes and shapes of rollers for above?—G. B.

[58323.]—**Bookcase.**—Have made a small bookcase of white pine, and want it to resemble polished ebony. Can any of "Ours" tell me what to use, and the way to apply it?—J. RESROC.

[58324.]—**Patent Circular Saw.**—Would some reader of "E. M." kindly let me know the size of toothed wheel and pinions, also size and weight of flywheel, of the patent circular saw manufactured by Britannia Co.?—CHURCH-HILL.

[58325.]—**Storage Battery.**—I have made a small dynamo, 100 candle-power, which works well; but as my motive-power is a windmill, I can't run the lamps direct from the dynamo, so am obliged to use a storage battery. I have tried to make a few cells, but failed, as the red-lead falls out of the holes in plates as soon as they enter the liquid. My plates measure 6in. by 8in. Will some good friend help me by sending full instructions for formation of battery, and best size and No. of plates required to light five 10-candle 20-volt lamps for one hour? I hope this query will be answered, as, if not, my dynamo and windmill will be useless to me. Is the red-lead mixed with any substance to make it hold, or is there any other plan than having perforated plates? My windmill is about one horse-power.—PUZZLED.

[58326.]—**Party Walls.**—A. is the lessee of licensed premises in a city street, B. is the owner of the adjoining premises, and C. is the ground landlord of B.'s premises. B.'s house has fallen down, and has been allowed to remain in a ruined state ever since A. entered into occupation next door. The party wall between the two holdings is in a dangerous condition, and liable to fall at any moment. A. is willing to rebuild it at his own expense; C. declines to interfere, being only ground landlord; B is disposed to be troublesome, and maintains a masterly inactivity. If A. cannot get any consent from B., what steps should he take to secure himself? Can he rebuild the wall without B.'s permission if he pays all charges? Would such proceedings constitute a trespass? If the wall falls there is a great danger that it will shake and drag down A.'s house along with it, and in doing so that it may injure or kill A. and his household, who reside on the premises. An answer or a reference to a standard work on the law of party walls will greatly oblige—KAYO.

[58327.]—**Painting Magic Lantern Slides.**—I should be much obliged if any reader could direct me to some source of information on the above subject. Are specially-prepared colours necessary?—S.

[58328.]—**Electric Light.**—I have a ½ horse-power Otto gas engine. How far could this be available for lighting a office that requires ten gas burners, and how can it be done? What would be the best apparatus for the purpose?—S.

[58329.]—**Testing for Metals.**—Given a white metal, to discover what it is, whether simple or alloy, and if latter, what metals form it? Only qualitative test wanted; please say simplest.—J. B.

[58330.]—**Cold Sawing Metal.**—Using "star" saws, ought the blade to be oiled during work for all metals, or for some, at least?—BELGIAN.

[58331.]—**Tempering Circular Milling Cutters.**—Can anyone give a good advice with respect to hardening and tempering milling cutters, without altering their truth? I have made some, with a deal of patience, and they look bright and correct, and run true; but I would not like to spoil the job during the hardening, &c.—BELGIAN.

[58332.]—**Double Cone Pulleys.**—I read, with much interest, the replies concerning these in No. 1074 (23rd October). Would wooden cones do? In order to make these on lathe, I shall require to put back centre out of centre; but as my back centre poppet is not fitted for the purpose, how could I make a temporary arrangement?—BELGIAN.

[58333.]—**Soapsuds for Turning.**—How could I prevent them from rusting the work?—BELGIAN.

[58334.]—**Oil and Soapsuds.**—Why is it that if a little oil is left on a piece of iron being turned, the tool won't bite if at the same time some soap-water is used?—BELGIAN.

[58335.]—**Screw-cutting Tools.**—Would any lathe man be kind enough to give the rules by which the end of a screw-cutting tool ought to be shaped in order to insure easy cutting and strength? A correct sketch, showing point and cutting edges, with angles marked and position of tool with relation to work, would very much oblige, especially if rules and sketches were given for both internal and external screw cutting.—BELGIAN.

[58336.]—**Screw Cutting.**—Should the tool never be moved sideways with top slide during the process of screw cutting?—BELGIAN.

[58337.]—**Keyways.**—How are small keyways cut on shafts or arbors? I suppose milling them with a circular cutter of proper thickness would do; but when no tools of the sort are available, what is to be done? I have an idea that the work is, perhaps, performed by means of a drill moving sideways, or the work moving in a perpendicular direction to axis of drill—for instance, putting drill in lathe chuck and fastening work on lateral side of lathe; but what sort of point should drill have?—BELGIAN.

[58338.]—**Surface Condensing Engine.**—I should esteem it a favour if any brother reader of "Ours" would kindly inform me what tube surface in condenser is necessary for a 17in. cylinder engine with a piston speed of 260ft. per minute, initial steam pressure 60lb. per square inch, and cutting off at one-sixth of the stroke; also the capacity of air-pump for same. No circulating pump would be required, as a natural stream is available. I should further be glad to know what proportion an indicated horse-power bears to a brake horse-power?—YOUNG ENGINEER.

[58339.]—**Legal.**—I shall feel greatly obliged if any reader of the "E. M." can enlighten me on the following case?—it is a family matter: A., for certain reasons, wishes to give all his estate (real and personal) to his younger daughter, B. (who is of age), although other sons and daughters are still living. I am told A. should leave his property to B. by a deed of gift, which will have to be stamped, after which no other duties will have to be paid, and that by so doing the sons of A. cannot upset the arrangement. Can this be done? If so, how should the deed of gift be worded? Does it require witnessing? What will be the stamp duty thereon? Under such a deed, would B. come into possession at the time the same is made, or at the decease of A.? Should not A. inform all his other sons and daughters of such arrangement?—C. W. C.

[58340.]—**Compound Interest, Annuities, &c.**—Will any reader versed in the subject kindly furnish me with the formulæ for solving the following problems, or refer me to any published tables by means of which the solution may be obtained? A sum of £50 is lent, the terms of repayment being that the borrower pay £60 by twelve equal weekly instalments of £5 each. What rate of interest per cent. per annum will the lender receive, and how can I ascertain how much has been paid, of principal and interest respectively, after any one or more of such instalments have been paid? Also the formulæ for ascertaining the same results where the instalments are fortnightly, monthly, or quarterly.—AUDITOR.

[58341.]—**Archereau's Arc Lamp.**—Could I run a small lamp of the above kind with 20 Bunsen cells? If so, how much candle-power might I expect, and for how long? What thickness (in millimètres) of carbons should I use? The battery is at present charged as follows:—Carbon block, 7½in. long, in porous pot surrounded by solution of bichromate of potash and sulphuric acid, as used in ordinary bichromate battery; zinc cylinder, 6½in. high, in glass jar, surrounded by saturated solution of salt. Would it be any improvement to substitute sulphuric acid for salt, and would it make cells fume? The lamp is described by "Bobadil" in last week's "E. M."—LONDINIENSIS.

[58342.]—**Lathe Queries.**—Will "Anglo-Dane" kindly say how a copper or brass cover for a kettle is spun in lathe? (1) By what means is the metal kept on the chuck? (2) What kind of tools are used in doing same? (3) Will the metal required to be annealed often before the cover is finished? (4) Are large and small articles (say 4in. and 10in. dia.) spun with the same speed? (5) Can a pan be spun in copper and brass, 4½in. dia. by 3in. deep, with nearly straight sides? I have spun a top 5in. dia. by 4½in. deep by 1in. dia. at bottom in sheet tin; but the copper and brass I cannot get to come up in the same manner without a lot of small wrinkles at the outside dia. of the disc. I may say that I have tried to do small half-balls in copper and brass, but have had the same experience as above, and also the slipping out of the piece of metal to be spun. If "Anglo-Dane" will give all particulars in detail for spinning, say, a 3½in. ball, I think "Fal" and the writer would, with experience, be able to do all they require.—CHARLES IRWIN.

[58343.]—**Clockwork Lamp.**—Will any fellow reader oblige by giving instructions to construct a clockwork lamp for burning magnesium wire, with diagrams if possible? A reference to back numbers will not avail, as I have none to refer to.—AERONAUT.

[58344.]—**The Richardson Arc Lamp.**—TO MR. S. BOTTONE, OR OTHERS.—Would you kindly give me particulars and sketch of the above arc lamp, as I should like to make one? I have seen one working, and it gives the steadiest and best light I have seen.—PICK.

[58345.]—**Lathe Countershaft and Overhead Motion.**—Will some of our authorities on lathe matters kindly describe the means of getting and reversed motion by the use of three pulleys on countershaft and two belts, an open and a crossed one, stating particularly which pulleys are fixed and which free? Also the lightest and most easy method of making an overhead motion with a drum the whole length of lathe bed, say 4ft. 6in. or 5ft.?—H. JONES.

[58346.]—**Observatory Shutter.**—A year ago, I built a Romsey observatory for a 5in. o.g. refractor. I made the shutter opening a little more than four diams. of o.g. (22in.). Would "F.R.A S.," or some practical observer, say if this opening is sufficient, or if any real advantage would be gained from having a wider slit?—T. R. CLAPHAM.

[58347.]—**Gas v. Hot-air Small Power Engine.**—Can any reader of "Ours" tell me which is the easiest and most practical of the above to use in a front shop window? I want about one man-power, as silent as possible, and information as to fixing and the best way to convey the fumes outside would be gladly received.—*MOTOR.*

[58348.]—**Fish.**—Would some of our chemical readers kindly inform me what I could mix with a quantity of fish taken from skins, so as to be able to bag and sell as a dry manure?—INTERESTED.

[58349.]—**Telephonic.**—In a telephone circuit, in which the receiver consists of a core of soft iron, and not magnetised steel, what gauge of wire would be most suitable to wind bobbin with, working with induction currents?—ELECTRA.

[58350.]—**Electric Lighting.**—I have a dynamo working at 110 volts, and I wish to use near the machine 100 volt lamps, each one taking 1·5 amp. What resistance must I insert with lamp, so that I may have the proper potential for it (viz., 100 volts)? Perhaps Mr. Bottone, or Mr. Eaves will help me out of my difficulty.—JAPANOS.

[58351.]—**Medical Coil.**—Will any of the electrical correspondents kindly inform me how a medical coil is constructed having four cells producing ten different qualities of currents with one cell battery? Also how a dial for indicating the strength of the currents is made and connected to the coils? Also how a switch is arranged for electing the secondary currents into the primary circuit at option? Any information on the above, with sketch, will be highly esteemed?—ICHI BAN.

[58352.]—**L. T. and S. R. Engines.**—Could any reader tell me the dimensions of these engines, size of driving wheels, cylinders, &c.?—BARKING.

[58353.]—**Soda Ash Analysis.**—Will any of our chemical correspondents kindly answer the following question? Give a method by which the carbonate and hydrate can be tested in one and the same solution, without any filtering or settling operations.—W. O. TALCOTT.

[58354.]—**Scum-Cock.**—We have a scum-cock on one of our boilers, which leaks badly (a very common thing, with these plug cocks, if much used). Will some kind practical reader advise me what to do to make it tight?—NOVICE.

[58355.]—**To "Prismatique."**—I desire to construct a 3in. or 4in. telescopic objective of short focus—that is, about eight or ten times the aperture. Will you very kindly say which form in your opinion gives the best results for these short foci, equal or unequal convex crown? I can use either Chance's or Feil's glass. Will you kindly give me the curves (in ratios of the focal length) for the four surfaces, in radii? If best results can be obtained by equi-convex crown, should prefer it so, but do not object to the extra cost if unequal curves give a lighter result. I have had some experience in making objectives (short focus) in America.—W. R. B.

[58356.]—**Crystal, or Washing Soda.**—Can any correspondent inform me how this can be kept in solution after being dissolved in water?—C. A. M.

[58357.]—**Vine Pruning.**—Can any of your readers give the most approved method of vine pruning for both out of doors and under glass, but without heat? Is early stopping preferable to winter pruning, or should the vine be allowed to make as much growth as it likes? and is it advisable to remove the unripened wood, or to cut out the old stuff and leave the new? When spurs are left on the rods, how long should they be, and, when they start, should they be stopped if they do not carry bunches? There is so much difference of opinion that I should like to hear the science of the matter.—HORTUS.

[58358.]—**Magneto-Electric Machine.**—Will some of your numerous correspondents on electricity kindly inform me as to the size, quantity, and whether s.c. or c.c., of copper wire necessary for the bobbins of the above machine with an 8in. magnet? Also if ½in. iron will do for the core?—SILL.

[58359.]—**Water Barometer.**—I read, with much interest, the letter by "G. F.," p. 303, describing his water barometer. If he can be induced to furnish drawings of same, I am sure they will be welcomed by the readers of "E. M."—ALONZO.

[58360.]—**Jordan's Barometer.**—Can any of "Ours" give me instructions in making a Jordan's glycerine barometer; also giving sketch and principle of same?—CAERLEON, Mon.

[58361.]—**Lathe.**—Will Mr. Eaves, or some other kind reader, give me a little advice. I have a lathe, 14in. centre, 12ft. bed, wood bed each side, 6in. by 12in., with iron plates on top. I have a slide rest, bolts on top, turns 3ft. when set. I have so much trouble to set it to turn true. How is the best way to set it? When I am turning a shaft, and get a little way from the end it seems to dither, and leaves the work full of little holes. Is it the fault of the lathe not standing firm—it seems to stand firm; it is the same with a heavy shaft 2in. or 2½in. through—or is it the fault of tool not being grond in the proper form? I think of having a circular saw to run in the lathe. Will it injure the centres if it runs on both centres? I mean both centres dead, have a pulley on shaft, and drive from a large wheel; man to turn it same as when turning iron. Must the centres in shaft be hardened, or will they wear without?—A MACHINEMAN.

[58362.]—**Steam-Pressure Gauge.**—Could any of "ours" oblige by telling me how to make a small steam-pressure gauge—one to work with a piston, to indicate up to 50lb. per sq. inch?—J. F. C.

[58363.]—**Recovering Oil.**—Seeing answer to query (Cleaning Cotton Waste), I am desirous to know if it would be possible to recover the oil now wasted, by cleaning metal which is covered by oil and emery mixed, and is at present a troublesome dirty duty to clean? I do not expect to gain much by recovering oil, but wish to cover the expense of apparatus.—MECHANIC.

[58364.]—**Firebrick Fireplaces.**—I wish to reduce the size of my fire. What must I use in such a state as to mould it into its place, and which will dry and harden by the heat of the ordinary fire? I cannot procure burnt bricks to fit.—SAVE FUEL.

[58365.]—**Brass Carriage Harness.**—I should be grateful for a receipt for making a good brass polish.—GROOM.

[58366.]—**Firewood Splitter.**—I should be glad if any of "Ours" would instruct me how to make a firewood splitter, and also how to make them into small bundles?—FIRE.

[58367.]—**How to Warm an Entran or Passage.**—Would some of our readers kin me, and others, how to heat my entrance hal weather, say, with a small coil of pipes with a of hot water, but having no flue? What mate they recommend to obtain heat, such as petrol coal, if not objectionable, colza oil, methylated A FROZEN READER.

[58368.]—**Railway Crossings.**—Please s in any place in England four railways cross on the permanent way of all being at different le

[58369.]—**Ammonium Bichromate.**—T W. GREY, OR OTHERS.—What happens when heated in air? Is anything left? Is the resid metallic chromium? An explanation, with would oblige—S. H. T.

[58370.]—**Watch Query.**—Would any of yo kindly tell me the best and speediest method o lever pallets for high-class work, and if there is tool for the purpose?—LORD PIVOT.

[58371.]—**Lifting Cable.**—Can you, or a readers tell me the approximate expense of lift marine telegraph cable (that may have got brol through), splicing, and making in every way before, and afterwards relaying, supposing it Atlantic cable, midway between Ireland and When the cable is lifted on to the deck of a s difficult thing to do to splice it, make the insulat and the broken part again water-tight?—ENQU

[58372]—**Wimshurst Influence Ma** Many thanks are due to Mr. Wimshurst for hi instructions for making up his electrical influenc but there are two points not quite clear to me. haps he will kindly explain. One is, How a discs fastened to the spindles, and what dista they be apart? The other is, Are all the bott Leyden jars to be connected together, or only each end, and thence to where led? Otherwis mation given by that gentleman in No. 1073 of last is sufficient to enable anyone to construct beautiful machines.—G. H. R. V.

[58373.]—**Finishing Small Forgings.** a number of small forgings, which require nicely; but filing and polishing is too expensiv reader kindly inform us how to finish black; n of lacquer, or similar application, but dull blac

[58374.]—**Cracked Bell.**—The church bell cracked some 5in. or 6in. up, causing the bell a most doleful sound, we drilled a hole at the t and cut a narrow slot out. This has improved very much, but has lowered the pitch. What to alter it? The bell weighs about 16cwt.—B.

[58375.]—**Boiler Query.**—I have a plain 5ft. 8in. long by 2ft. diam., to be fired extern some kind reader please tell me the best way boiler? I want to burn a good deal of rubbi turning chips and small coal. Also, can I lea fire under boiler all night? I can leave plent in, as there is a steam chest in the centre of to 16in. diam. 20in. high, through which we g boiler out.—J. A. T. BATCH.

[58376.]—**Electrical Instrument Ma Amateurs—VI.**—Would Mr. Bottone kin what proportion the sulphuric and nitric acids gun-paper are to be mixed? Also by what steel tool (Fig. 6a, page 292) is known?—A SCRIBER.

[58377.]—**Grinding-in Safety-Valve** some reader tell me the best way to grind-in safe —ENGINEMAN.

[58378.]—**Parson's High-Speed Engi** any reader explain the Parson's high-speed eng at the Lincoln's Inn Library, is employed f lighting. According to the *Electrician*, "th is driven, at no less than 12,000 revolutions per a Parson's high-speed engine, which justifies i running at the same rate. It requires some me to take a statement of this kind seriously; yet reason to regard the Parson's motor as a toy reality, a combination of turbines driven by consists of two parallel flow turbines to the rig of a central steam inlet; the steam exhausti from the first turbine into the the second, from into the third, and so on through twenty turbin series. The steam parts with a portion of its each turbine, and finally escapes at a pressure above that of the atmosphere. It is claimed t the first motor that has ever been made to w actual velocity of the steam as it escapes from —HIGH SPEED.

[58379.]—**Millstone Dressing.**—Can a correspondents give any hints on millstone What shape should the bottom of the furrows how should the furrows be marked out?—ORPH

PROF. HITCHCOCK, of Amherst Colleg large force of men, has been engaged in m the bones of a huge mastodon at Geneva, last accounts some 54 bones had been found ing a tusk 8ft. in length, and 2ft. in circu at its largest point. The skeleton, when co will be about 25ft. in length, and 15ft. in It is the intention of Prof. Hitchcock to h bones mounted and placed in the Mus Amherst College.

IT appears, from a work by M. Nicolai, on Railways Worked by the Belgian Govern that of the 49 years, from 1835 to 1883, profitable and 28 the reverse; but th 161,747,150f., during the good year the 81,784,430f. of lo balance 19,962,720f., or £79 the least productiv without remission s

VERS TO CORRESPONDENTS.

communications should be addressed to the EDITOR LISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

on one side of the paper only, and put drawings tions on separate pieces of paper. 2. Put titles and when answering queries put the numbers the titles of the queries to which the replies No charge is made for inserting letters, queries, 4. Letters or queries asking for addresses of rers or correspondents, or where tools or other ı be purchased, or replies giving such informa- t be inserted except as advertisements. 5. No king for educational or scientific information d through the post. 6. Letters sent to corre- under cover to the Editor, are not forwarded, ames of correspondents are not given to in-

ntion is especially drawn to hint No. 4. The ted to letters, queries, and replies is meant for l good, and it is not fair to occupy it with ques- as are indicated above, which are only of indi- rest, and which, if not advertisements in them- l to replies which are. The "Sixpenny Sale ffers a cheap means of obtaining such informa- e trust our readers will avail themselves of it.

CHRISTMAS DAY.

ext being Christmas Day, the publication of the IECHANIC will have to be completed some hours n usual. All advertisements must, therefore, ffice by 5 p.m. on TUESDAY next.

ving are the initials, &c., of letters to hand up ıesday evening, Dec. 16, and unacknowledged e:—

—Rev. A. W. Edwards.—H. Jackson.—Quite in I. H. H.—Enal.—J. H. B.—Village Blacksmith. —Amateur Plater.—Alchemist.—Music.— ateur.—A. B. C.—W. H. M.—G. H.— —Cilindro.—R. Meldrum.—Optician.—O. J. L.— —Dicey.—J. L. L.—Cape Colony.—Enquirer.— ton Pigott.—Young Millwright.—A., Liverpool. —T. T. W.—C. E. Stretton.—Fundo.

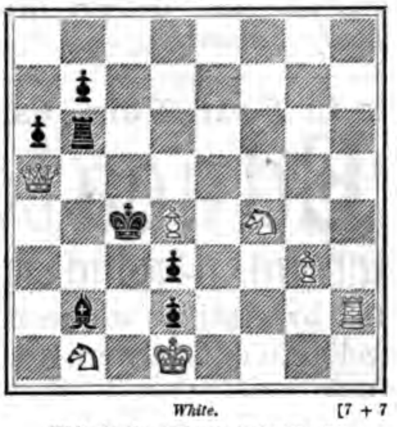
(If you mean near the S.S.W. horizon, prob- vas Diphda, Beta Ceti. Are you sure about the the compass? 2. About four months out of the —DUMBUCK. (Longmans, Macmillans, Lock- ad others publish works suitable for the purpose. ve been recommended by correspondents. You procure the Syllabus.)—AMETURE. (See No. 28; post-free 2½d. Several have been described, h see indices.)—W. LEMONQUENY. (The num- taining "Engine-Making at Home" are 1,039, 42, 1,045, 1,050, 1,054, 1,058, 1,061, 1,065, 1,072, . As you have the last, the others can be sent from this office for 2s. 1d.)—CENTAUR. (To ricycle by steam is to rob it of its great advan- he rider: it is a machine for healthy exercise. ever, p. 153, No. 917, for an illustration of Sir yn's steam tricycle.)—ORPHAN LAD. (Recipes ions supposed to have an almost magic effect in ıg mill bills have been given many times. See, ınce, the last volume, pp. 174, 196.)—NICKLE. ices, or procure Watt's "Electro-Metallurgy" kwood and Co.. Stationers' Hall-court, E.C.)— ER. (By a "distorted card," or by correcting . See "Magnetism," by Sir W. Snow Harris I. Noad, published by Lockwood and Co. The s much too technical to be treated in a popular n the space we could afford to devote to it.)—A ER. (Impossible to give any idea of the cause of ı of your canaries without an autopsy. Brass e objectionable, but we should think there must en something wrong with the birds.)—C. T. (See Hints No. 5. You can protect it by an application for a patent, which will cost er about 22s., and then you will have time to ut for a capitalist. It would be unwise to let nto the "secrets" until that had been done.)— S. (Possible, yes; but surely enough has been ecent back numbers about electric lighting in ıouses.)—J. B. (For methods of making magic ee pp. 258, 280, 378, Vol. XXII. The simplest elieve, printed with a solution of sulphate of when dry, a piece of bibulous paper which has ked in a solution of ferrocyanide of potassium ed over them, and on dipping into water, the is developed in a brown tint. 2. The ink for on glass was given in No. 996, p. 162.)—AMA- ECHANIC. (See indices. You are asking for es not exist, and must therefore experiment. the papers in Nos. 1,026, 1,027, 1,029, suit you?) NT DOUGLAS. (See previous answer. Several rms of electro-motor have been described in umes.)—A. AVERY. (Recipes for liquid glue in o. 1,053, and others in back volumes. If it must ı, use gum-arabic and water, and add a few carbolic acid. A few drops of alcohol, or oil of ill also preserve it.)—T. H. S. (The best way o have it properly lacquered.)—J. I. S. (Ap- you have the tubes of the lenses, and the best ld be to send them to an optician to be fitted ıses. Try some of those advertising in our) —BARRHEAD. (No useful advice can be given personal examination. See a letter on the treat- baldness in No. 1,061.)—STUART. (There is no ing" in the sense of an examination; but to e Institution of Civil Engineers you must be or apprenticed to a member of the profession. nothing to prevent you putting C.E. after your ıd leaving the public to find out what it means.) . (Perhaps you mean the article to which we ferred "J. B."—No. 996.)—W. T. W. (Mix ıog's lard and finely-powdered plumbago in equal ıd smear it very thinly over the bright work ıg.)—W. A. C. (Davidson's "House Painting," [illegible] and Co.. Stationers' Hall-court, E.C., [illegible] ge 33 of the [illegible] as "four distinct patents" unless separately patented. You should procure one of the handbooks issued by our advertisers.)—AMATEUR (You can make sulphate of mercury by heating mercury with rather more than its weight of sulphuric acid until a dry mass is obtained; but you had better buy it at the average price of 4s. 6d. per lb. Not explosive. 2. By means of a wire. 3. By measuring the distance between the terminals when the longest spark is obtained. 4. What are we to understand by a "model of a dynamo"?)—A ROYALIST. (See the articles in back volumes and in recent numbers. Ordinary sand will not do. You must procure foundry sand.) —CYCLIST. (Use varnish paints—that is the ground colours mixed with varnish, unless you wish to have the machine japanned or enamelled, which requires heat. See p. 263, No. 1,000; p. 415, No. 981; p. 19, No. 937; p. 89, No. 940—and so on.)—SLIDO. (They must be photographed to obtain the best results; but you can transfer by sticking on to glass with Canada balsam, and then rubbing away as much as possible of the paper.) —LEX. (1. Yes. 2. Not at all. 3. We believe some companies insure machinery generally, but not against mere "breakdowns.")

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLXX.—By G. T. SLATER.

Black.



White. [7 + 7

White to play and mate in two moves.

SOLUTION TO 968.

White.	*Black.*
1. Kt-K 3	1. K-B 5 (*a*)
2. K-Q 3	2. K-B 6
3. R mates	
	(*a*) 1. K-Q 5
2. P-K B 4	2. K-K 5
3. R mates	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 967, by G. T. Stringfellow, V. S. Pochin, and Hensing; to 968, by Link, V. S. Pochin, G. T. Stringfellow, and Hensing.

V. S. P.—In 969, if, as you suggest, 1. $\frac{\text{Kt-K 3}}{\text{B-B 6}}$ 2. $\frac{\text{Q-B 8}}{\text{B takes P}}$ and there is no mate. You are wrong as to the problem from *Cassell's Saturday Journal* being unsound, for if 1. B-Q 7 or B 8, P moves, and there is no mate. The object of the Black Pawn is to prevent your supposed cook. We shall be pleased to enter your name on next Solution Tourney, and thank you for your suggestion.

T. H. K.—Apply at Morgan's, 25, Great Queen-street, or Routledge's.

SOME interesting particulars are given by M. Escalle, director of the important works at Tamaris, in regard to the employment of blocks of compressed coal, in lieu of coke, for blast furnaces. With the ores of the country, which are argilo-silicious and small, the quantity of compressed fuel employed is 20 per cent., but with those of Motka or Phihals it reaches regularly 20 per cent. It has been found that by the use of these blocks a much higher temperature of hot blast is obtained, and that the proportion of combustible consumed—coke and compressed coal included, per ton of pig iron produced, is less than with coke alone. M. Escalle attributes this result to the quantity of water, 1 1·2 per cent., contained in the compressed coal blocks used by him, as well as to the nature of the volatile matters. The volume of gas obtained per ton of the compressed fuel, at these works, was 7,620ft.

THE French Society for the Encouragement of Arts and Manufacture has awarded the prize of 1,000f. (£40) for the discovery of a useful alloy to M. Marches. The alloy is prepared by mixing three parts of copper with one of manganese, and adding it in small quantities to the molten copper, after refining and just before casting. Copper so treated is only very slowly acted upon by sea water.

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The address is included as part of the advertisement, and charged for.

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1/3 Music! Music!! Music!!! 1/3

ALL who wish to play the Piano, Organ, or Harmonium at Sight, send this advertisement and 15 stamps to W. Walker, 81, Grosvenor-road, Bristol, for his MAGIC PIANOFORTE INSTRUCTOR (registered). £10 for every reader of this Journal who fails to play by it immediately. The "Lydney Observer," "Newnham and Blakeney Herald," says any one can play by this clever invention, without the assistance of a teacher, even though they have no previous knowledge of music or of the instrument itself. "The Oldham Chronicle" says, "This excellent contrivance, by which those who have never seen a piano can learn to play a tune in a few minutes." The "Forester's Free Press," says the arrangements are so simple, a child can instantly learn to play most difficult music.

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The English Mechanic
ND WORLD OF SCIENCE AND ART
FRIDAY, DECEMBER 25, 1885.

MICROSCOPICAL ADVANCES — ANCIENT AND MODERN.—III.

G. W. Royston-Pigott, M.A., M.D. Cantab.; F.R.S., F.R.A.S., F.C.P.S., formerly Fell. of St. Pet. Col., Cambridge.

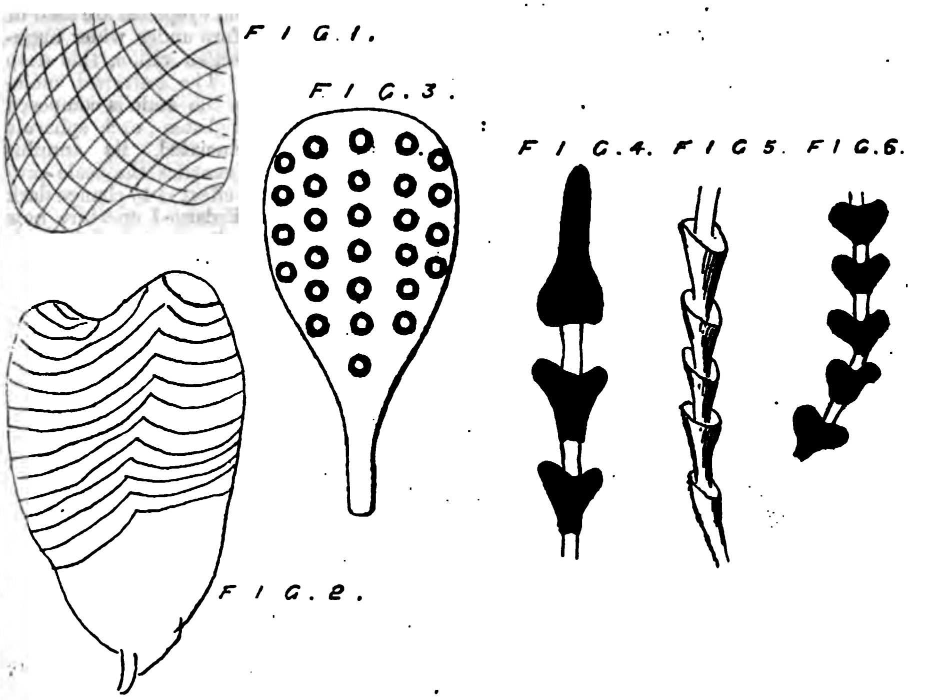
Black Dots, Test Rings, and Lines.

N nothing has the progress of microscopical powers been more pleasantly splayed than in the gradual development of e precise optical definition of dots and herules.

In copying with the camera lucida at power of 5, I was greatly struck with ievalier's representation of the "Podure," nich was executed by means of *la chambre ire*, by a talented young artist about 1839. itchard speaks scornfully of these French duras as being too easy. These scales he present Degeeria domestica), as shown Chevalier, are marked with black dots iearly arranged, as in Fig. 2A, and in other ale with double rows of dots, nearly rallel, and crossing each other at an acute gle. The contour of the scales in the steel graving is decidedly oval. M. Chevalier s the first to give this resolution, hich he does as following (translation):— Podure. The scales of the Podura have nerally an oblong form, but are of various es; with a mediocre microscope their rface appears blank, but with a perfect strument one discovers an infinite number points oblong, which imitate straight lines, ossed, oblique, or wavy, following the anges of the illuminations. It is not very fficult to discover these points upon the rgest scales. It is necessary to choose the allest, and we consider them as the best *t objects* to show the penetrating power of e microscope."

I was not aware of the existence of this ate in 1869, when I first published resolun of this scale. The merit of this micrope is shown by the award of the gold dal to Chevalier by the jury, who declare at "we have compared it with an excellent croscope of Amici, the best of those we ssess in Paris, and that we recognise, not th astonishment, but with a lively satisfacn, that *the microscope of Mr. Charles Cheva- is truly superior to that of Amici.*"[*] I find evalier's plate of the Lepisma is most uisitely formed of a double set of radiat- short lines of dots (denied by Dr. Carter).

he English resolution of the Podura is like a series of oat seeds arranged ewhat linearly (Fig. 6*a*), and the rpness of the outlines of these marks is regarded as a most severe test for objective quality (*as far as it goes*). tchard's Hair of Dermestes (Fig. 4) denstrates at sight the prodigious advance microscope has made. A minute transent cup, ornamented with four petals and ense black lines, marks the interferences tissues stopping the passage of light, wing transcendent definitions. No black diform attachments (as in Fig. 4) are at visible. Battledores still retain very gh the shape of Fig. 3. But there are e scores of the species giving great differes in detail. The spherular resolution of scales offers an interesting field of re- 's blackness of the spherical rings of illuminating ribs and mem- th the best remarkable examples of minute refracting spherules, of considerable variety, developing marginal black rings and focal discs more or less bright. Less than 1-90,000th, this bright central disc is scarcely visible; but those of 1-60,000th, or less, with a high but exquisite power, reveal the focal centre as well as the *black ring* in a slightly lower plane.[*] It is interesting in these objects to select silica beads of different sizes, representing those of well known diatoms, such as those of *formosum*[†] and *angulatum* for optical comparisons. When a brilliant white disk in diatoms also can be detected, it is generally accompanied, as before, by a jet black marginal ring all round the spherule; and in brilliant spherules 1-40,000th of an inch in diameter this black ring has been frequently estimated at 1-6th of the disc, or 1-240,000th of an inch thick.[‡]



PRITCHARD.

Figs. 1 and 2. Podura. Fig. 8. Battledore, azure blue. Fig. 4. Hair of Dermestes. Figs. 5 and 6 Hair of English Bat.

This very ring plays so important a part in the definition of diatoms, cells, and molecules that I shall ask leave to call it the *spherule test ring*, or, shortly, the *test ring*; for, if a glass giving 800 diameters will not show it in a minute spherule (1-90,000th) it cannot be rated as of the finest quality. In many experiments described in these articles, its use and appearance are of the highest value. I have to thank Mr. Slack for the following formula:—

"The silica films which give the cracks are made by allowing a solution of dialyzed silica to evaporate upon a slide. The beaded silica films are made by passing silica fluoride gas through glycerine and water —4 or 5 glyc. and 1 water."

Black margins can also be seen in fine hairs of exquisite precision of definition.

In dealing with such minute matters, the reduction of diffraction by a pleasantly-subdued light—pale blue glass has several advantages—an exceedingly fine glass of quite modern date (1885) thus showed me, last night, the extremity of a fine hair less than a millionth of an inch in diameter without any indistinctness, fog, or diffraction. Too much pains cannot be taken with adjusting the screw collar, and in the selection of the object. Generally it should be chosen as close to the covering glass as possible: the film of air introduces otherwise insuperable aberrations which no action of the screw collar can surmount, unless it be mounted in Canada balsam. And this is more painfully seen with oil immersions and dry mounts than with water lenses, and still more than with the dry objective. *The point of the hair is often more clearly seen if there be some subjacent structure.*

I shall now beg to record some rather amazing experiences with the definition of hairs with the finest glass I could recently obtain—a 1-12th oil immersion.

The advance of the accuracy and power of the microscope is well shown in the developed structure of hairs. A favourite object figured in antiquated books is the hair of the Indian bat. Quekett represents it as frilled with a kind of coronet of small hairs, ringed at regular intervals, leaving the intermediate transparent quill exposed.

The drawing now given was taken by the use of a fine oil-immersion 1-12th, and a large angle in the oil condenser. Instead of frilled hairs, which are purely imaginary, a beautifully *serrated cup*, with concave notches, is seen, and edges as black as jet, ornamenting the whole of the stem at equal intervals. After so many years of observation of this object, this result is perfectly startling, and throws a strong doubt upon innumerable accepted appearances. (Fig. 8.) The black boundary edges are very nearly 100,000th thick.

The *Hair of English Bat* also exhibits tests of a very high order. Pritchard's plate represents it as tufted with black appendages, through which a transparent tube is carried. The complete resolution of these tufts show that there are internal tubules somewhat spirally arranged in great profusion; the edges of which are marked very strongly black, with sudden interruptions. A more intense scrutiny reveals these tubes filled mostly with brilliant molecules varying from the 1-80,000th to the 120,000th of an inch in diameter. (Fig. 11, which may be compared with Pritchard's Engraving, Fig. 6.)

A very charming phenomenon is seen when *one stringlet of beads partly overlaps another deeper set*. As no light can pass through the spherules at the overlaps, intense blackness takes a variety of forms. The beads are not all quite spherular; some are ovoid (Fig. 12); solitary beads are observable, occurring in straight or curved clusters of two, three, or more, or in long chains. If an upper chain is brilliant with focal light, a lower set is often dark. As many as a dozen stringlets often appear packed at one place in different bunches or faggots, and, of course, lying in several different focal planes; and if the glass be transcendently fine, these spherules glitter with a variety of focal colours of great beauty. Pale turquoise and ruby colour, with shades of orange yellow and pale yellow approaching white. A very difficult object to draw, indeed, and I can only give a very rough sketch, as in Fig. 11. (Powell's 1-12th oil).

---

[*] The lower part of Fig. 7 gives a rough idea of the referred to, whilst the upper circle represents spherical forms.

[†] part of the circle.

[‡] several of my friends have assisted gment.

Advancing Angular Aperture.—As already described, a constant effect of small angular aperture is to darken organic structure. Black margins of cylinders, tubes, and spherules are made darker and broader. This black margin obeys a mathematical law. Its breadth varies as the refractive index increases, and as the aperture diminishes.

If the same power be attained, either with deeper eyepieces and weak objectives, as contrasted with shallow eyepieces and deep objectives, the difference in the appearances is very striking and instructive.

Here is a beautiful example—*Atropos Acherontia* (Death's Head Moth). Change of angular aperture gives startling results. The whole animal bristles with a forest of spearlets of exceeding sharpness, each feather having three or four long spines.

With low aperture the scales present a superbly rich and dark amber-brown colour by transmitted light. Tipped with a black point, a thin line of light runs up the spear, edged with fine black borders. It will be probably admitted that the black annuli, or rings, of each spherule, if they exist in this scale, are too deep and broad under a low aperture to permit any visible streamlets of light to escape through them, so as to effectively impress their existence upon the retina of the observer. Beads appear dark till sufficiently magnified and illuminated.

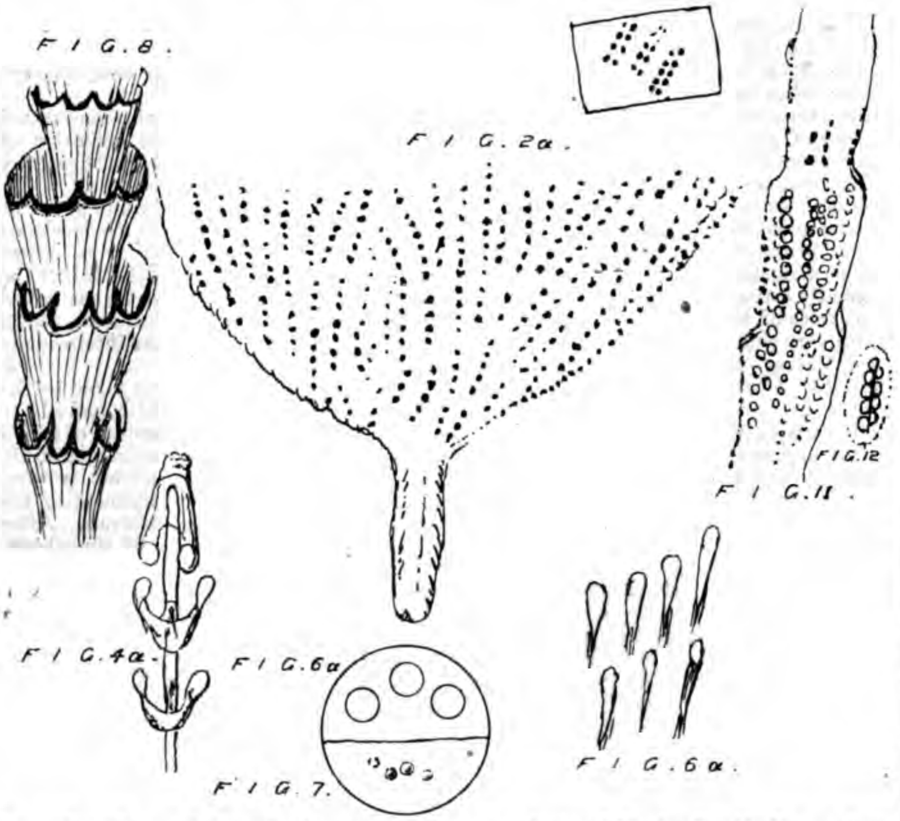


Fig. 7. Test Ring and Silica Beads. Fig. 8 is a new resolution of Fig. 6. Fig. 11. New resolution of English Bat's Hair. Fig. 2 a. Chevalier's Podura. Fig. 4a. Hair of Dermestes; new resolution of Fig. 4.

But as objectives and eyepieces are used of the same power as before under wider angular aperture of objective vision, this deep brown colour pales. The universal molecular system of which the scale is composed begins to light up and glisten; each spherule obeys the law enunciated, its annulus narrows; the light permeates the scale profusely. The general effect is to change dark into brighter tints. Enlarged aperture now enables a sparkling radiance to steal through the featherlet. As power is increased, masses of organic molecules, as yet invisible, contribute streaks and mottlings of prismatic colourings. And now, if high power and large aperture, with superb definition, be employed, a new vision of beauty and refinement bursts upon the eye. The scale glitters with brilliant gems. Since the molecules lie many deep, some cannot get light at all, and they appear jet black; others in lower planes are brighter. As they are found approaching the 1-90,000th of an inch in diameter, the central focal lights disappear.

To produce the best effects, a condenser, free from spherical aberration is employed of about 55deg. aperture, acting axially with direct light. Some other still more wonderful appearances will be glanced at further on, when transcendent definition is approached. (Bright daylight—even, I might say, dull daylight—is always preferable for the development of superb definition.)

Minute focal changes produce appearances of great interest, showing the actions of light upon refracting spherular bodies.

Supposing, first, a low focal plane be taken, there is a brilliant white disc, surrounded with its jet black annulus. If the corrections are very carefully attended to, under-correction causes it to turn crimson red, with a fainter rim. A true correction gives a bluish, or peacock blue sparkle in the bead. At the highest focal plane, the emanating cone generally produces an *intensely black dot above the spherule.* These black dots are seen often enough above refracting molecules, scattered about insect scales, especially those placed upo
bars connecting the ribs.

Such elevated dots may be ca
If the spherule be large en
1-20,000th in diameter, this
takes the form of a small bead
above without blackness: but
delicately shaded, so as to look al
tary.

In observing these niceties, t
care must be taken to reduce
aperture of the condenser as sn
venient for sufficient illuminati
can be but little doubt that a
hole placed over the condenser
effective aperture of both objectiv
denser.

Some of Pritchard's drawings
scales, battledores, and hairs are g

Possessing a very fine triple Dol
glass of 6in. focus (telescopic),
to copy with the camera lucida
Pritchard's plates; and also Chev
lished a few years later. Pow
Figs. 1, 2, 3, 4, 5, and 6 are
Pritchard.

THE AMATEUR WORKSHO

Planing Machines—Tool-Boxes

THE sketches here produced
small tool-box whose mov
automatic, both in the vertical an
directions. The alteration necessit
introduction of the vertical feed
the tool-box and the cross slide.
rather more than is desirable int
machine; but as the practice is no
will conclude this subject of tool-
description of the form here dimen

In the first place, the sizes of
wheels are reduced as much as
economy of space; and as the wo
to do consists only in moving the
slides, their dimensions (Figs. 14
practically determined by the sizes
their spindles. They will be bette
gun metal than of cast iron, as
brittle, and therefore not so liable
fracture.

The modifications required are
follows:—The total length of th
remains unaltered; but the secti
increased, since room has to be m
sliding mitre wheel to move al
hollow of the casting. This is bes
a slide of so small size, by hollo
internally, with a radius struck
centre of the axis of the whee
correspondingly rounding or belly
outside portion to give sufficienc
Its depth must also be increased,
the mitre-wheel and the nut shal
to travel within the hollow of the
alterations will increase the sizes of
to the dimensions given (Figs. 13
depth of the face being 6½in., as ag
in the tool-box on page 215.

The saddle-plate is also altered
new arrangements, being 8½in. deep
7¾in. as in the first instance.
extended ¾in. to the right-hand
centre line (Fig. 141) in order to
for the eccentric pin, *a* (Fig. 13
which the mitre-wheel *b* is thrown
of gear. A hole, having a doubl
bored right through the plate to the
dimensions marked in the Fig. 141.
the mitre-wheels whose outer dia
turned to correspond. A large shall
is turned in the face to take the
vertical guide.

At the lower end of the verti
bridge of metal (Fig. 142, *a*) for
or bearing for the vertical scre
support for the mitre-wheel—a
nuts, by which the wheel may be
adjusted, intervening. The cent
necessarily increased in diameter,
introduction of the mitre-wheels.
of these wheels also renders necess
in the width of the open
part where they come.

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* Messrs. Powel'
sort to their conc
frequently used it

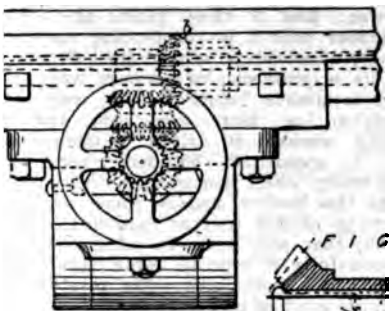


FIG. 140 PLAN

FIG. 146.

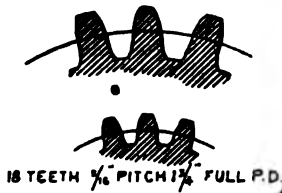
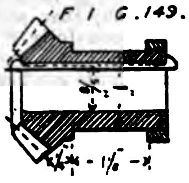


FIG. 149.



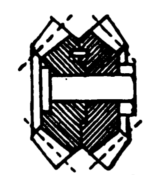


FIG. 148.

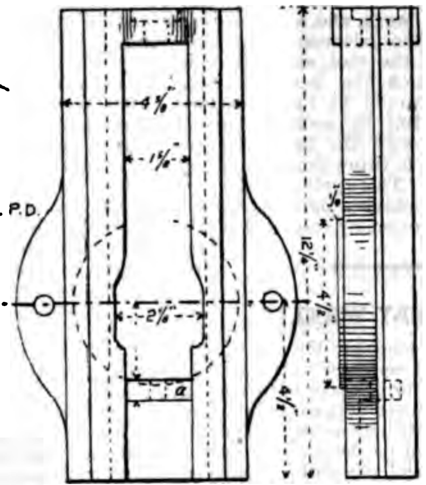
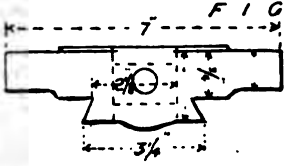


FIG. 142.



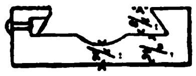
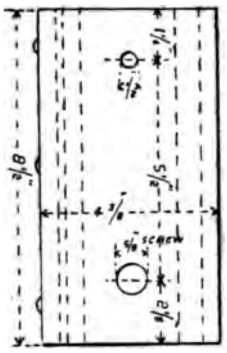


FIG. 145.



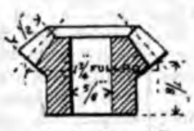


FIG. 147.

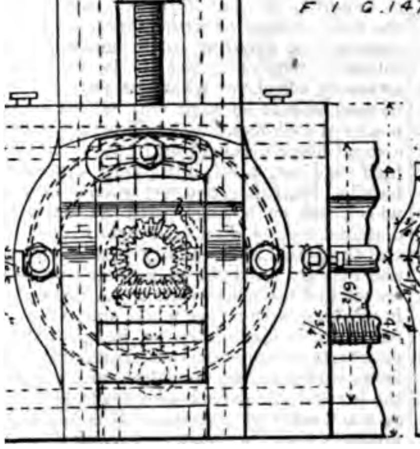


FIG. 138. FRONT VIEW

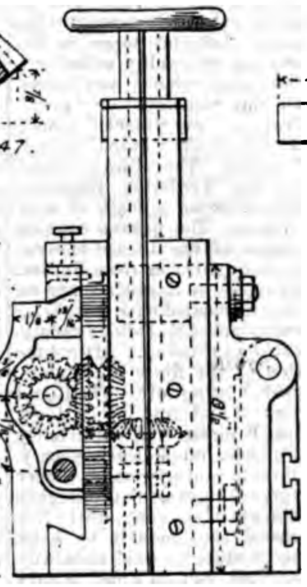


FIG. 139. END VIEW

FIG. 141.

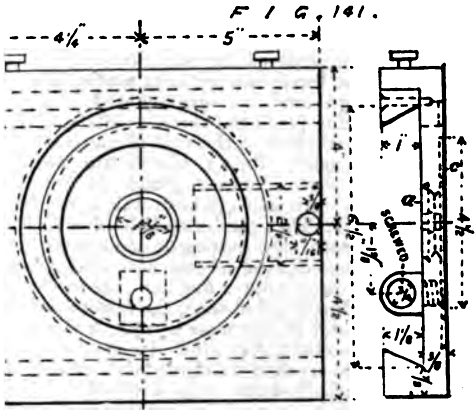
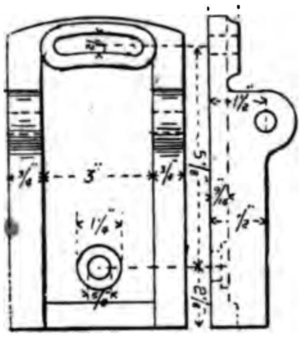


FIG. 144



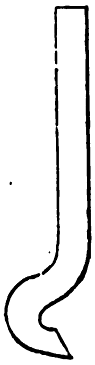
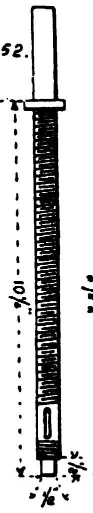


FIG. 155

FIG. 152.



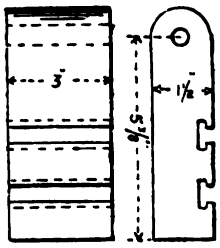


FIG. 145

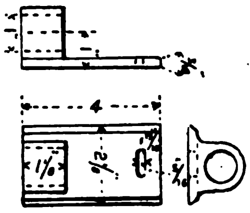


FIG. 150.

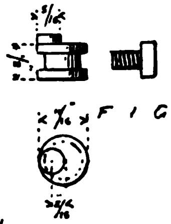


FIG. 151

FIG. 154.

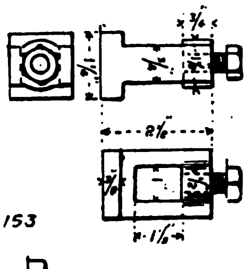
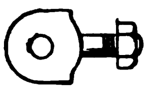


FIG. 153



ɘ back of the vertical slide is hollowed ı this case to clear the tooth-points of the ı mitre-wheel (Fig. 143). These are the alterations involved, an increase of ısions only, affecting the vertical slide, slewing-plate (Fig. 144), and the tool-r (Fig. 145).

r the method of making the mitre-wheel, er the reader to the instructions given ›age 490 of the last volume. The teeth 146) are drawn to full size in the large small diameters. The wheel (Fig. 147) is ly bored to fit the end of the vertical lle, and slotted to slide upon a short sunk :er. The wheels (Fig. 148) are attached own in the figure, while the wheel (Fig. is furnished with a double-headed loose or feather to slide in the groove on the -shaft. The provision for throwing it in ›ut of gear is illustrated in Fig. 150. The ıg piece a, having bevelled edges to move [illegible] groove in the back of the saddle [illegible] bossed up and bored to [illegible], which re- [illegible] The dovetailed strip, which slides in the back of the saddle-plate, is actuated by the eccentric (Figs. 138, 140, enlarged at Fig. 151), whose throw is sufficient to set the wheel in and out of gear. The rotative movement of the pin imparts a rectilinear motion to the slide by pulling and thrusting against the one side or other of the slot in the latter. The eccentric is turned either by a square key fitting into a recess in its front face, or by a slot cut in the head to take a screwdriver. The eccentric, and therefore the slide carrying the wheel, is set by the screw at the edge fitting into the turned groove and pinching it tightly. The pin and groove also prevent the eccentric slipping out of place when slackened. The slide and bearing can be made in wrought iron, or, if preferred, in gun-metal; but the eccentric should be of steel; also the bearing boss is not bound to encircle the wheel, but may be reduced to a fork merely formed on the sliding plate, and simply fitting in a groove turned out of the solid in the wheel-boss.

The elevating screw is slightly modified at its lower end (Fig. 152), and also its nut (Fig. 52). The dimensions supply the necessary ; where dimensions are absent, it is understood that those furnished in the last article (p. 215) hold good for corresponding parts, to which article, also, reference can be made for hints applicable to fitting up. The arrangement for slewing the plate is supposed to be unaltered, and also the division into degrees, though the division marks are not reproduced here.

The actual tool-holders (Fig. 184) are made of wrought iron, and their pinching screws of steel. Steel is best for the tool-holder also. The neatest way to make a small holder is to forge it as a solid blank with the flanges and boss piece "upset"—that is, hammered up out of the one piece of metal; then to file these to a neat outline, and cut the central tool hole out afterwards by drilling through and filing. The flanges may be square edged as shown, or veed, the front flap plate being of course cored to correspond. The points of the pinching screw should be hardened.

A peculiarity in a properly-made machine tool should be noticed. It is recurved (Fig. 155) in such a way that the cutting point is about plumb with the hinder part of the bar from which it is forged. If this precaution were not taken—that is, if the cutting edge were more to the front,—it would have a tendency to dig into the work, and so much the deeper the greater the advance of its point from the back of the tool, since the centre of the radius which the tool point would tend to describe would be in a line plumb with the back. But by making the tool point itself plumb with the back, the result of a hitch would be to throw the cutting point right off the work. This applies chiefly to heavy cutting. In ordinary light work, ordinary lathe tools are frequently employed.

EMERY AND EMERY WHEELS.

THE position of emery amongst the valued forms of alumina is not easily defined, for it has no pretensions to compete with the sapphire and the ruby, nor even with corundum, on the score of beauty; still, it has been found of the greatest use to the mechanic, and its employment in the industrial arts will increase rather than decline. Corundum is alumina in a pure, or almost pure, crystalline condition; emery is alumina with other substances, chiefly oxide of iron, which colours it grey to brown and black. The difference is now tolerably well understood, but nevertheless it is sometimes stated that emery is a mixture of corundum and oxide of iron.—the fact being apparently that there are so many varieties that it is not easy to determine a given specimen to be corundum, although it may more nearly approach to that pure crystalline state which should alone be designated with the name than it does to the finer specimens of emery. A mechanical distinction is, however, readily found in the character of the fracture—emery breaking almost invariably with a rough conchoidal surface presenting numerous sharp points, while corundum breaks into pieces having many plain and curved surfaces, and consequently grinds away the material to which it is applied by its superior hardness; emery, on the contrary, cutting into the metal as a file is said to cut. Nearly all the emery used in the world is shipped at Smyrna, the principal mines being in the districts of Thyra and Aidin, to the south of the chief port of the Levant. Some of the best specimens of emery come from the Island of Naxos, and it is said that French merchants will buy no other. The amount of stone annually shipped at Smyrna to Great Britain, the United States, France, Germany, and Belgium is about 7,000 tons, the relative quantity consumed in each country being represented by the order in which their names are given. The French and Germans take nothing but the best quality—that is, picked stone; English merchants are also particular as to quality; but of late years the shipments to the United States have been largely made up of the inferior or uncleaned stone. Good clean lump emery stone is shipped f. o. b. at £4 to £5 per ton (British), and the freight is generally low, as it can often be sold as ballast. Naxos emery, however, commands a higher price, as much as £10 per ton being paid f. o. b. at Syra; the present lessees of the mines, however, keep the trade in their own hands, and despatch the Naxos emery to their agents. The mines are opened by shafts and galleries, and the stone is blasted out by gunpowder and dynamite from the blocks of marble or masses of granite surrounding it; but in some mines it is readily extracted from the red argillaceous earth in which it is imbedded. No correct judgment of the value of the stone can be formed until it is cleaned, and not always then until a portion is crushed and the colour and shape of the grains are closely examined; they should be hard, bright, and coarse, varying in hue from reddish black to dark bluish grey. The emery is picked as fast as it is extracted, and often as much as 50 per cent. is rejected. When the pieces are large they are broken by sledge-hammers or a rude kind of stamping-mill, and sometimes it is necessary to split them up by subjecting them to a process of roasting. The mines are worked principally by Italians, but a number of native labourers are employed, and the lessees hold, at least in Asia Minor, under "firmans" granted by the Ottoman Government or the Department of Mines at Constantinople.

The emery, having reached this country or its destination, is first of all reduced by crushers to lumps about the size of hens' eggs, which are placed in a stamping-mill or "ground" in horizontal revolving mills with cast-iron plates, which may account for the statement that commercial emery is often adulterated with iron oxide. The stone found in some mines is often accompanied by considerable quantities of magnetic oxide of iron; but this appears to be no detriment, and some buyers even prefer ground emery which has been mixed with iron slag. The crushed emery from the stamping-mills is passed between chilled iron rolls, and is then sifted, the finer portions, and especially the dust, being carefully gathered for subsequent washing and levigation until it is fit to appear in the market as flour emery, of various degrees of fineness, suitable for polishing purposes. Grain emery and flour emery are the two staple grades at the mill, the former being sold for making emery wheels, the latter for the manufacture of emery cloth and knife-polishing and other powders. As a rule, the emery crushers themselves carry on the manufacture of emery cloth and paper, as the appliances necessary can be readily added to a crushing mill. The emery wheels best known in England now are the "silicate," or "grey" wheel, the "vulcanite," or "black" wheel, "shellac," or "red" wheel, the "union" wheel, and the "tanite" wheel. The silicate wheel was invented by Mr. Frederick Ransome, Assoc.Inst.C.E., who employed silicate of soda as the base of the wheel. The process consists first in the preparation of the silicate of soda. Beach flints, mostly brought over from France, and used in preference to English flints on account of their being associated with less chalk, are placed in a steam-jacketed boiler; caustic soda is added, and steam turned on. After some hours the dissolution of the flints is complete, very little solid residue being left. The liquid is then allowed to settle and run into a tank, where it is evaporated down to a consistency much like that of treacle, but as clear as sherry. This will remain fluid if properly made. Emery of the required degree of fineness is thoroughly mixed with this silicate of soda in a mill; this "pug" is then pressed into moulds by hand pressure. The disc produced would naturally harden by itself in time, but in order to save time it is baked, and is then complete and ready for use. In a modification (perhaps an improvement) of this process, Portland cement is used, the mixture being kneaded and pressed with narrow sticks while in the mould, and before heating is run over with steel rollers. Hydraulic pressure has been found to be useless. The manufacture of black or vulcanite emery wheels requires heavy and costly machinery. The base is indiarubber, oxidised oil, or other similar material. This is intimately mixed with the emery in steam-heating rolls (horizontal hollow cylinders) and squeezed into moulds in a powerful hydraulic press. The discs are then cured in the same manner as vulcanised rubber goods, after which they are ready for use. What is known as the red wheel is made with shellac as a base, and although the process is now considered old-fashioned, excellent wheels for some classes of work are the result. Shellac is heated in an iron pot; the emery, which has been previously heated, is introduced, and the whole is well mixed by hand with iron spoons. The pug is then put into moulds and squeezed in a hydraulic press; afterwards the discs are baked at a low temperature. The tanite and union emery wheels are made in America; the methods employed in their manufacture are kept secret, and jealously guarded. In the tanite wheel a solution of leather, and in the union wheels oxychloride of magnesium, are the binding materials. The tanite wheel has the reputation of being the best made in America. An emery wheel as a tool grinder or as a shaper and surfacing tool has no rival, considering the work it can do in a given time; but it is essential that it shall be carefully and well mounted on heavy standards, with long bearings protected from dust. The wheel should be mounted on a spindle with large washers on each side, held up to the stone by nuts screwed up moderately tight, care being taken to run the stone in such a manner that the nuts tend to tighten themselves by the motion, which is very rapid—the normal speed of the periphery of an emery-wheel being a "mile a minute."

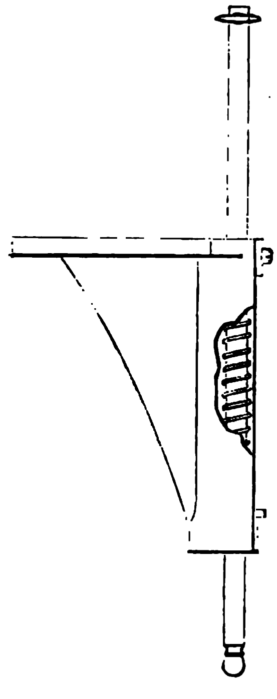
Emery wheels have been described as circular files which never grow dull. The emery grains throughout the wheel retain their cutting power; and if these grains are cemented together with a proper binding material, an emery wheel can be worked until 90 per cent. of its original weight has been worn off. A file is useless before 5 per cent. of its weight has been used up, and when being worked is driven by manual labour at a speed of 90 feet per minute. An emery wheel penetrates without difficulty into the hardest metals, some wheels even cutting chilled iron or hardened steel more easily than soft iron. In using emery wheels successfully, it must be borne in mind that as the wheel wears away the revolutions per minute must be increased, so that as nearly as possible the same surface speed may be maintained upon the periphery of the wheel. The economy of emery wheels in the operation of fettling or trimming castings is very marked, and this relates not only to economy in tools, but also in the saving of time. It has been stated by an eminent firm of engineers in London that an emery disc as a tool-grinder lasts out six 4ft. grindstones, and only requires truing once a month against the weekly facing of a grindstone. They calculate the cost of keeping an emery wheel tool-grinder in order as one-fifth of that formerly expended upon the maintenance of grindstones, and the time occupied in grinding tools one-half of that formerly required; but it is essential that an emery wheel, for whatever purpose it may be used, should be kept true, which is done by means of a diamond tool. This tool consists of a small black diamond set in the end of a half-inch steel bar, about 8in. long, fastened on a handle. In truing, the rest is fixed close to the wheel, and on a level with its centre. The diamond tool is then held firmly on the rest, and the point is gradually worked backward and forward until the projecting parts are removed and the wheel runs true. The difference in working with a true wheel and one running out of truth can hardly be imagined by those unaccustomed to emery-wheel grinding. In the latter case grinding is a disagreeable duty, and the jar and vibration render the task of holding on the work very irksome. It is not by heavy pressure that the most and quickest grinding will be effected; the article merely requires holding up well and constantly against the wheel. Intelligent users soon get accustomed to feel the bite. At one time considerable fear was engendered by the bursting of emery wheels, but it has now been proved that if they are kept true and are mounted in firm, non-vibrating bearings, there is little if any risk of an accident of the kind if the wheel is properly made. Emery wheels are made with about seven different grades of grain emery, and it is advisable to keep each to its own class of work. They can be made hard or soft, rough or smooth, slow cutting or quick cutting. As a rule, fast cutting wheels have a rough surface, and slow cutting a fine one. As in the case of an ordinary grindstone, the faster a wheel cuts the faster it will wear away. A wheel can be made so hard that after six months' usage no wear to speak of will have taken place; but the amount of work such a wheel would have turned out would be infinitesimal compared with that which a softer wheel would have done, and the money and time lost in working the hard wheel would have purchased many soft ones.

An Engine without Dead-points.—A German engineer is the inventor of an improved construction of steam-engine, the peculiar feature of which consists in the dead centre point being obviated. In this arrangement, a block is secured to the piston-rod, this block being provided with a diagonal slot, through which the crank-pin passes. The slot has concaved edges facing each other, and is provided with a recess at each end. The slide valve is attached to a rod provided at the lower ends with tappets, against which the ends of the sliding-block strike, thus reciprocating the valve rod. The levers from which the rod suspended are provided with spring arms for the desired degree of expansion.

M. FAYOL concludes that the absorption mospheric oxygen by coal-dust usually the rise in temperature to which spontaneous bustion is due. He finds that lignite is the low temperature other varieties of mediate tempe

ON-SPRING FOR FRET-SAWS.

appliance shown in the annexed en- aving will be found useful by those nt to rig up fret-saw machines, espe- here under-tension is required. The a Company introduced it for their v, to supersede a loose spiral spring 56), and it will be appreciated by those t a firm tension underneath the table



ose who want to utilise a sewing- stand for a fret-cutting machine, and hitherto puzzled to get a good under- By drilling another hole in the steel hifting the pin the tension could be r stronger and lighter springs can be . The bracket is screwed to the under- e table.

IEMISTRY OF SULPHITE OF SODA.

ollowing remarks on the study of the aistry of sulphite of soda are by Messrs. and Co., and are extracted from the *hic News*:—

on of Sulphite of Soda.—The method fol- our laboratories is the volumetric one on the reaction between iodine and s acid.

d Solution of Iodine.—In preparing the olution of iodine, we employ the pure ed iodine of commerce; numerous ex- having shown us that it is so nearly pure as to answer all technical require is the troublesome process of purifying is dispensed with. Of the above-men- ine, 12·7 grammes (195·99gr.) are weighed ferred to a litre flask, covered with cc. of cold distilled water, and to this rammes (385·8gr.) of iodide of potassium

Complete solution of the iodine in the potassium is the object aimed at, and to nis the flask should be rotated so as to e contents; as the solution proceeds, more to be added, in portions of about a time; finally, when the iodine is com- solved, the volume is made up to the the whole of the water were added at lete solution of the iodine could hardly

l Solution of Hyposulphite of Soda.—In the standard solution of iodine, a solu- yposulphite of soda of such a strength of it shall exactly discharge the colour of the standard iodine is requisite. ised hyposulphite of soda (easily obtained ce) is powdered and spread out in a thin filter paper. In a moderately dry room nary temperature, a few hours' exposure r paper is sufficient to eliminate the oisture always present in the hyposul- *te.*—The hyposulphite must not be dried .) Of the salt so prepared, 24·8 grammes are weighed out, transferred to a litre [illegible] flask, distilled [illegible], 10 [illegible] po [illegible] and [illegible] to one litre. The object of adding the bicarbonate of potash is to prevent the hyposulphite decomposing. So prepared, the solution will keep for months in a *dark* cupboard without change. The standard iodine prepared as we have recommended will also keep for many months unaltered.

Starch Paste Solution.—One gramme (15·4gr.) of starch is mixed into a paste with a little cold distilled water; 100 c.c. of water, quite boiling, is then poured upon the paste, with stirring. After cooling, the solution is ready for use.

The Actual Assay.—Weigh out 0·5 gramme (7·71gr.) of the sulphite to be tested on a watch-glass (the sample should be reduced to fine powder in a mortar previous to weighing). Into a wide beaker or dish 41cc. of the standard iodine is run from a burette. The watch-glass containing the weighed sulphite is now placed in the beaker containing the iodine solution, and the whole stirred with a glass rod until the sulphite is completely dissolved, which takes place almost immediately. The amount of iodine solution employed—viz., 41cc.—being a little more than the quantity actually required by 0·5 gramme of pure sulphite of soda, there will necessarily be an excess of iodine remaining in the beaker after the above operation is concluded; this excess is measured by running in the standard hyposulphite of soda already mentioned, drop by drop, from a burette. As the excess of the iodine is consumed by the standard hyposulphite, the colour of the solution becomes lighter. When the colour is only faintly yellow, a little starch paste is added, when the deep blue colouration of iodide of starch appears, and renders the end of the reaction more delicate. After adding the starch paste, continue to drop the hyposulphite in, stirring between each addition. When the end is reached (i.e., when the excess of iodine is consumed completely by the hypo.) the blue colour of the iodide of starch is lost, the fluid becoming colourless. Now read off the number of c.c. of hyposulphite employed, deduct this quantity from the 41 c.c. of iodine run into the beaker, and the remainder will be the iodine consumed by the 0·5 gramme of sulphite of soda weighed out. To obtain from this the percentage of crystallised sulphite of soda ($Na_2SO_3 7H_2O$) in the sample, multiply the number of c.c. of iodine consumed by 2·52 (we suppose 0·5 gramme of sulphite of soda to be used for the estimation).

Example:—0·5 gramme sulphite weighed out, transferred into 41cc. of iodine, required 2·1cc. of hyposulphite to discharge excess of iodine; therefore 41cc. − 2·1 = 38·9, and 38·9 × 2·52 = 97·03 (percentage of crystallised sulphite of soda present in sample).

The above modification of the iodimetric estimation of the sulphites was fully described by Messrs. Giles and Shearer in a paper read before the Society of Chemical Industry (*Soc. Chem. Ind. Jour.*, May, 1884), where the authors pointed out that the plan of dissolving the sulphites in water previous to titration led to low results. In addition to the error due to the above, the procedure of running in the iodine into the sulphite tends to an error in the same direction, so that an analysis conducted as described in Mr. Robinson's article would necessarily give the percentage of sulphite much too low.

In respect to the keeping qualities of sulphite of soda, we can indorse the remarks of your contributor upon the inferior quality and rapid deterioration of much of the sulphite at present in the market. The rapid deterioration alluded to only applies, however, to the low quality sulphite of foreign (German) manufacture. We have frequently analysed samples from the source named containing no more than 50 per cent. of $Na_2SO_3 7H_2O$. As the largest makers of pure sulphite of soda in the world, we can state that a commercially pure salt containing 98 per cent. of sulphite, as sent out by us, will keep for any length of time in a well-corked or stoppered bottle without undergoing any practical change.

It should be mentioned that low quality sulphites, in addition to other impurities, are always contaminated—frequently very grossly so—with hyposulphites, thus rendering them most objectionable for use in the developer.

The presence of hyposulphites in sulphites is easily detected by dissolving a quantity of the sample (two or three grammes) in distilled water, adding a considerable excess of hydrochloric acid, say 40cc., and boiling for ten minutes; the presence of hyposulphites is indicated by the fluid becoming turbid from the separation of finely divided sulphur. The testing for sulphates requires more care than is generally supposed. If no sulphate were originally present in the sulphite, it would certainly be formed by the action of the oxygen of the air, unless precautions were taken to exclude the latter, when the sulphite is brought into solution in presence of hydrochloric acid. The examination for sulphates should be conducted as follows. A small flask of about 200cc. capacity is fitted with an indiarubber stopper, the latter being pierced so as to carry a short length of glass tubing, drawn out to a fine point at one end; into this flask about 100cc. of distilled water and 20cc. of hydrochloric acid (free from sulphuric acid) are placed: the stopper, with drawn-out exit tube inserted, is placed over a lamp, and the contents briskly boiled for ten minutes, when the stopper is momentarily removed, about a gram of the sulphite dropped in and the stopper replaced. The boiling is continued until the whole of the sulphurous acid is expelled; fifteen minutes' boiling will usually be sufficient to attain this. The solution, free from sulphurous acid, may now be tested for sulphuric acid by means of chloride of barium solution; only a slight cloud should make its appearance upon dropping in the $BaCl_2$ if the sample is a good one.

We regret to have taken up so much of the valuable space of this journal; our excuse must be that from the character of the sulphites, the method of analysis employed, while not necessarily demanding a great expenditure of time, requires to be based upon thoroughly sound principles in order that results of technical value may be obtained.

SCIENTIFIC SYSTEMATIC METHOD IN ORDINARY MECHANICAL OCCUPATIONS.—III.

By PROF. COLEMAN SELLERS.

(*Concluded from page* 314.)

LET me now go back to the consideration of material used in boilers. During the latter part of Mayor Stokley's administration, say about 1880, he, at the instance of the city inspector of steam-engines and of the officers of an insurance company for inspection and insurance of steam boilers, appointed a commission to devise some fixed rules whereby uniformity of rating could be insured as to the pressure at which boilers may be worked. I had the honour of serving on that commission, and am thus enabled to tell you that we found a set of rules in force which gave to all boilers of the same diameter and the same thickness of metal the same pressure per square inch, regardless of the quality of the metal employed in construction and of the nature of the riveted seams. The ordinances passed by councils, at the suggestion of the commission, made it imperative that all the conditions that exist in each boiler as to nature of seams, thickness and quality of the metal used, should be considered, and the boilers rated accordingly, giving the greater latitude to good workmanship and good quality of material combined with judicious proportioning of the parts. At the time to which I allude, but a few years ago, the United States laws in regard to the testing of boilers used in the marine service called only for a knowledge of the tensile strength, and no notice was taken of the softness or ductility of the metal combined with great strength. I know a case in which a sheet had to be selected of higher tensile strength than could be obtained at the time, coupled with much ductility, to repair a boiler so that it would pass the inspectors under United States laws. A lower ultimate tensile strength with high ductility would have made a safer job of the repair.

We find it to our advantage to utilise the talent that comes from the technical schools, only guiding and holding in check the schoolmen until they have learned the lesson of the workshop practice. You must bear in mind that it has been asserted that the *Puritan*, the *Genesta*, and the *Pilgrim* were all designed by men who had a theoretical knowledge of boat building, and were not practical builders. The talent shown by the theorist who did save the cup for America in an international contest might be utilised to advantage in the workshops of the practical boat-builder. On the other hand, the record of failures and mistakes for the want of practical experience, or sufficiently extended knowledge in the endeavours of newly-fledged scientific experts, are many and lamentable, as all know who are obliged to utilise their talents. Scientific men, too, have been charged, often wrongfully, with retarding progress. Dr. Lardner is accused of having stated, in his early lectures delivered in America, that the ocean could not be successfully navigated by steam, mainly on account of the large quantity of coal required, as compared with the carrying capacity of the vessel. It was in 1840 that he lectured here, and he remained in America until 1849. The *Sirius* and the *Great Western* steamships arrived in New York on St. George's day, April, 23, 1838. Dr. Lardner's comments were made in England, at Bristol, August 25, 1837, before the Mechanical section of the British Association. His opinion was asked, and was published in the *Times*, August 27, 1837. He never expressed a doubt as to the practicability as has been stated. The substance of what he then said was that the marine engine, with its then state of efficiency, was not able to cross the Atlantic from England to New York profitably without the patronage of Government. The engines of his day burned 8lb. or more of coal for every hourly horse-power developed, while we can do the same work with 2lb. of coal per horse-power, and we desire Government subsidy to keep our ships afloat. Since the time that the *Great Western* steamed into New York harbour, what changes have been made in steam engines and in marine architecture. When in Scotland last year, I visited some of the noted ship-yards on the Clyde. In the yard of the Dennys, at Dumbarton, I was present at the trial of a model in the testing tank to determine the wave-line on the side of the ship. Certain side-wheel steamers were to be built, and it was advisable that the wave-line on the side of the ship, incident to the motion of the vessel, should be so fixed as to have the crest of a wave rise with certainty just where the paddle-wheel struck the water, and not compel the blade to reach down in the valley of the water for its hold in driving the ship forward. Theory had given a shape to produce this wave-line, and a model ship about 8ft. long, cast in paraffin, and worked up to the required lines on an expanse profiling or sculpturing machine was being tested, and record made of all the conditions that could be noted by trained experts. In the same buildings, there were employed, I should think, at least twenty men and women, doing the clerical work of the calculations involved in scientific ship-building.

In London, last year, I was present in the lecture room of the Royal Institution, in the room made celebrated by the exposition of the discoveries of Thomas Young, of Humphry Davy, of Michael Faraday, while each in turn presided over that Institution, and gave to the world, in that room, the result of their close scrutiny into the working of the laws that govern matter. The lecturer of the evening was treating of the motion of fluids, and one of his experiments was so striking that I venture to repeat it now, as it shows how much deeper we must go than the surface of what we see in search for exact truth. He produced a cubical block of wood, such as I now hold in my hand, suspended by a string attached to the centre of one of its faces. See, the block hangs like any other piece of inert matter, with its centre of gravity in line with the axis of the string. We see nothing unusual in the behaviour of the block. If I try to make it hang in any other position, the force that placed in position being removed, it falls back to its normal position. If I attempt to make the block stand on one of its edges, it falls over, and we know, after a few trials, that such position is one of unstable equilibrium, and not to be relied on as permanent. I have here, however, a block, also of wood, of the same size and shape as the first one; it, too, is attached to a string; to all appearance, it is a similar block. I hold it in such a position that the string is dependent from one of the vertical faces of the block, and not from the upper one. I hold the string and release the block, and it does not fall from this constrained position, but seems to hang to one side of the string, in what, to our senses, seems an abnormal position. I stand it on one edge, and it does not fall as did the first block. I might place it in other positions, and the effect would be as striking. Now, what makes one bit of wood act as we are accustomed to see matter act, and the other to act so differently? I will tell you. The first block was what it seemed to be, the second has motion inside of it, and that motion, under certain well-known laws, controlled the position of the block. See, I open the second block, which is hollow, and in the box is a brass top which has been and is yet spinning. The forces concerned in the rotation of the top were powerful enough to control the light form that simulated the block of wood.* The learned lecturer in London used this simple experiment to show what motion will do, and it was one of many experiments in the direction of showing the difficulties that attended the study of the motion of fluids, when motion within the fluid, not visible to the human eye, was exerting a controlling influence, and leading the mind of the observer away from the true facts of the case. I venture to show you this as illustrating the care that must be observed in seeking for truth. It requires a trained mind to follow the most direct road in any complicated investigation into the laws that govern matter, and the same training is needed by every mechanic in the orderly and systematic carrying out of his designs.

I have spoken of the inductive system of investigating the laws of the universe as practised now. Modern scientific advancement is measured by our knowledge of the laws that govern matter, and its progress is in proportion to the abandonment of empirical methods. All knowledge is based on the observation of facts. If we attempt to draw conclusions from too few facts, we may not be wrong in our conclusions, when we have to deal with cases involving the same facts, but we may err greatly when our formulated method is carried in practice far beyond the experiments upon which it was based in the first case. I will mention a noticeable example; We are probably indebted to no one more than Morin for his experiments on friction. No one has been able to controvert what he discovered in regard to the laws of friction, but cases occur in which there seems to be manifest disagreement with his laws, and these cases are always outside of the scope of his series of experiments. In other words, he did not carry his experiments far enough in the direction of velocity and in the direction of pressure, nor do we yet know all the conditions that obtain in the friction of different substances as we approach their destructive limit in use. As we extend our knowledge by still further experiments, we do not find any flaw in his expressed laws, so far as his light went, but we introduce other factors in the equation, factors that were of no moment in the experiments he tried, but which become the prime factors in the more severe requirements of application far beyond his in both directions. We are as yet, with all our information, but on the threshold of knowledge, but we are growing to be sure of one thing, that we have passed the time of empiricism, and to advance profitably we must pursue systematic rules of progress. In the competition of the world we cannot afford to make mistakes, while to avoid mistakes we must decide just what we want to do—the character of the material we have to use as well as the forces involved in the operation to be performed. We are to have a new bridge over the Schulykill at Market-street some time. We are wise enough to know that it will not do to have that structure built by rule of thumb, trusting to rebuild it in a better manner later. It is doing things wrong once, twice, and often many times before we stumble on what will barely serve our purpose that is costing so much money, and giving so little satisfaction, and retarding progress. We cannot walk a square on any of our cobble-paved streets which should serve the purpose of facilitating the traffic over the road-bed, but we wonder at the wonder at the want of knowledge shown by those who regulate our municipal matters and have permitted, and still permit, such structures to remain at a constant cost in detriment to the property hauled over them, and the discomfort of ourselves. Street railways in many cases have their tracks perched on the centre of a narrow street with so much curve or camber to the pavement that the rail-bed is as high or higher than the curb-stones on either side, and the slanting pavement on either side of the track is on such an incline and so roughly paved with huge round stones as to set at defiance all the laws of mechanics, that dictate a road of the least resistance as the most economical, both in wear and tear to the road itself, but to the conveyances that pass over it. The locomotive proposed by Oliver Evans in the beginning of this century was to have run on the country roads, but he, with his limited knowledge, even hinted at special roads made to offer less resistance. Our streets are paved to make the most resistance. The locomotive was useless until it found a road adapted to its purpose. The success of the locomotive depended on the condition of the road it travelled on. Great results followed in practice when a scientifically-constructed and well-laid road was ready for the locomotive. Let us have smooth, well-laid streets too.

Cable railroads have been in use in many cities for some years, their construction was experimental, and their present economy is problematical. I am not prepared to say just how scientifically they have been constructed in Chicago and the Far West, but here in our own city we are seeing a gigantic constructive experiment tried on the cut-and-try principle. Metallic conduits for the traction cable are put into place over miles of roads, the conduits being so formed so as to have little or no power of resistance against the crush of the frozen ground, and even so made as to present a shape most favourable to permitting the pavement to wedge the grip-slot shut. Wheels are put in to guide the ropes seemingly without any regard to strains that might have been known beforehand; or, if not known, should have been found out by careful experiment, and the citizens, who should be using the streets to their best profit and convenience, are kept off them by a constant succession of changes, involving tearing up, altering, replacing, to the discomfort of our fellow-citizens, and to the loss of the company owning the road. The public are less interested if this cut-and-try system is taking place in the private workshops, and the public cares very little about the stages of progress through which any finished product has passed in reaching the stage of use to the consumer. The public are warranted, however, in objecting to unsystematic and ill-advised engineering enterprises being conducted to their detriment and delay. There will be no end, however, to just such empirical engineering. The desire to save in the first cost, without considering the after result of such false economy, will be the rule perhaps for a longer time in the future than any one here is interested in, but it is the outgrowth of much evil in the methods of our schools. One of the first objects of education is, I think, to quicken the perception, to teach the habit of observing phenomena clearly and quickly, to instil the desire to trace effects to their causes, and to cultivate close and just reflection. The elements of geometry, physics, and mechanics should have the preference over many of the traditional studies of the primary and the grammar schools, and, what is more, the early introduction of such studies, presented to a child's mind in a practical form, as they can be, will prepare his mind for the more extended study of the higher branches of the same subjects in later years. As it is, the alphabet of science is not taught until the student is ready to read the subject in later life, when he should have grown up with a feeling that he always was in a measure familiar with the facts of the science.

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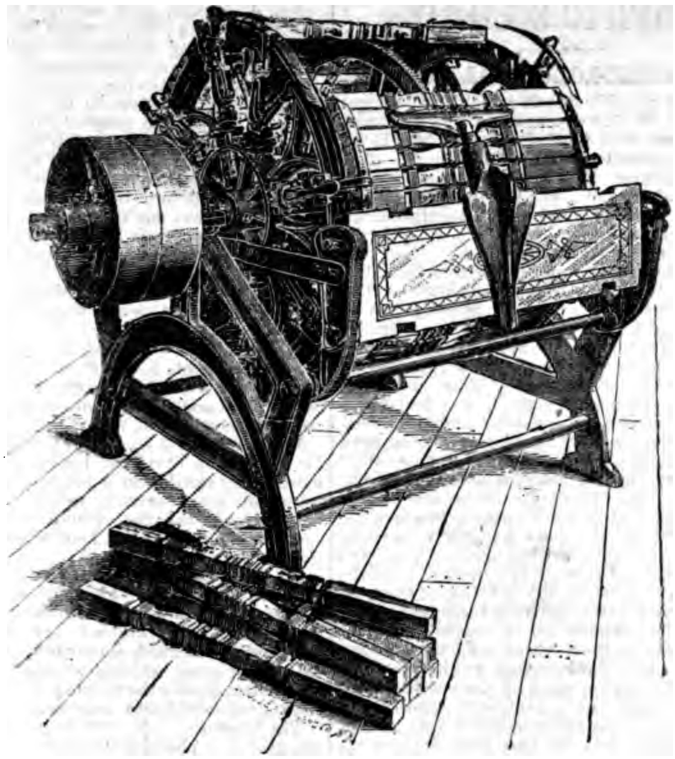
* The apparatus used consisted of two cubical blocks, each 6in. by 6in. by 6in., one solid, the other formed of wood 3-16in. thick; and in this box was a well-made gyroscope in a metal ring, loaned for the occasion by Messrs. Queen and Co., of Philadelphia. The attachment of the suspending cord was at the centre of the face of the block, close to one end of the axle of the gyroscope.

DECAY OF THE TEETH.

IN the introduction to his "Natural History of the Human Teeth, Explaining their Structure, Use, Formation, Growth, and Diseases," published in 1778, John Hunter indicated a good and clear line of delimitation between the province of the medical practitioner and that of the dentist. It may be worth while to reproduce his opinion for contemporary guidance:—"All the diseases of the teeth, which are common to them with the other parts of the body, should be put under the management of the physician or surgeon; but those which are peculiar to the teeth, and their connections, belong properly to the dentist." It follows from this that decay of the teeth is a malady which ought to be regarded as falling within the province of the medical practitioner, and we incline to think it deserves more general and closer attention than is commonly bestowed upon it. Hunter (whose works might, with those of Cullen and the older writers, be advantageously studied again by the generation of practitioners who have forgotten them, and even condescendingly read by that contemporary generation which has been so beneficently provided with newer and better light and leading), was of opinion that decay of the teeth had great significance as regards the state of health. He argued, and not unwisely, that if a part of the organism which is not subject to rapid decay after death dies during life, there must be something active to kill it, or, as he put it, "there is some operation going on which produces a change in the diseased part." And he deduced from the morbid anatomy of decayed the teeth that it is not due to external or accidental causes, but that the evil commences within: moreover, that "this disease and its consequences seem to be peculiar to youth and middle age: the shedding teeth are as subject to it, if not more so, than those intended to last through life, and we seldom or ever see any person whose teeth begin to rot after the age of fifty years." This last fact is notable. If a man can keep his teeth until after middle age, he may generally count on keeping them to the end. There seems to be some reason for thinking that decay of the teeth is commoner now than it used to be. Assuming this to be the fact, it would be interesting to inquire whether there is anything in our modern mode of life which has a tendency to cause the teeth to decay. The old-fashioned notion about eating sugar and acids and the like is exploded. Meanwhile it may be worth asking if want of vigour is not a cause of decay of the teeth, and if the want of vigour observable among certain classes of children and young persons is not due to the increasingly artificial character of the lives the young lead: with diminution of fresh air and exercise, and the aggravation of mental tasks and brain and nerve worry which characterises the educational and developmental stages of our modern life. The young people of America are particularly subject to decay of the teeth, and the young people of America are conspicuous for their advanced mental culture and the protective care bestowed upon them. They are fed and dressed like adults, and they are "forced," in an intellectual sense, to the serious depreciation of the organic materials of which the human body with its brain and nerves is composed, and of the vital energy with which it ought to be endowed.—*Lancet*.

AN IMPROVED TURNING LATHE

THIS lathe, shown in the engraving, is designed to turn work square or polygonal in [illegible] instead of round. The machine consists of wheels adjustably secured upon a central [illegible] The materials to be turned are placed [illegible] wheels, thereby forming a cylinder. [illegible] being revolved, one side of [illegible] desired shape. They ar[illegible] other side cut in like



SMITH'S IMPROVED TURNING LATHE.

/heels by a series of clamps or shoes, which stable radially to enable them to clamp ls of different thickness. Each clamp is by a lever, which is quick and powerful in n. A single movement of the lever will ɔw the clamp back out of the way, as shown ngraving, leaving a section of the machine all impediments, enabling the operator to aterials thereon or turn them over very ; and when in place, a single movement of r will securely clamp them to the machine : the clamp so that it cannot be thrown The machine has an adjustable middle for the pieces, upon which they are firmly eventing all vibration and permitting of the ork. The wheels are provided with adjust-ts, by means of which the pieces may be ɔctagon or any other number of sides. The : is so designed as to be easily and rapidly l, and will finish smooth, with clean, sharp rom 150 to 600 pieces in ten hours. This n has been patented, and the machines are anufactured by Messrs. D. C. and S. E. 227, West 5th-street, St. Paul, Minn.— : *American.*

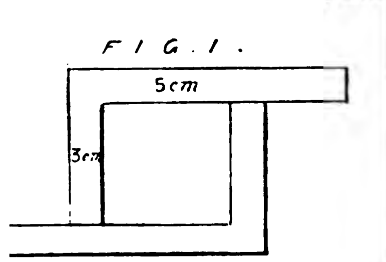
BEDDING MICROSCOPICAL OBJECTS.

following methods of imbedding objects e given in the *American Naturalist* from a source:—

ding in Paraffin—Clarifying Media.

-wood oil is recommended by Lee as a ıg medium on various grounds, the more nt of which are the following:—1. It as rapidly as clove oil. 2. It does not he object brittle or excessively hard. 3. It h better solvent of paraffin than clove oil; ce only a short paraffin bath is required. penetration of the paraffin is not only more

F I G . 1 .



nt also more thorough. Hell recommends which he finds can be used to greater ad- than chloroform, especially with large [illegible] objects should be [illegible]

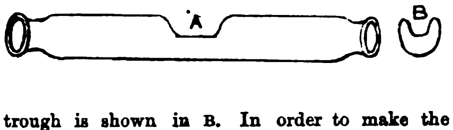
Imbedding Box.

A convenient box, Fig. 1, introduced by Dimmock, may be made of two pieces of type metal (or better of brass). As will be seen from the accompanying diagram, each piece of metal has the form of a carpenter's square. A convenient size will be found in pieces measuring 5cm. (long arm) by 3cm. (short arm) and 7mm. high. With such pieces a box may be constructed at any moment by simply placing them together on a plate of glass which has previously been wet with glycerine, and gently warmed. The area of the box will evidently vary according to the position given to the pieces, but the height can be varied only by using different sets of pieces. It is well to imbed in a thin layer of paraffin, so that the object, after cooling, may be cut out in small cubical or pyramidal blocks, which may be easily fixed, for cutting, to a larger block of hard paraffin, or better, to a block of wood saturated with paraffin.

Box and Warm Bath Combined.

Selenka has recently described a simple apparatus for imbedding small objects in a definite position. It is made by taking a thin glass tube, and heating one side at the middle until it becomes soft enough to bend easily. Then the mouth is applied to one end while stopping the other with the finger, and the air sucked out, causing the softened portion to bend inward, and thus forming a shallow trough, A, Fig. 2. A section of the trough is shown in B. In order to make the bottom of the trough flat, it is only necessary to place in the tube, before heating, a strip of glass, against which the infolding portion of the tube will flatten. One end of the cylinder is joined by rubber tubing with a T-shaped tube, one arm of which connects with a somewhat elevated litre glass of cold water, and the other arm with the hot water of the water-bath. The connection with the water reservoirs is through rubber tubing, which can be closed by pinch-cocks. The other end of the glass cylinder is also provided with a rubber tube through which the water flows into a vessel standing on the floor. The cylinder is fastened (by string or clamp) to the table of a dissecting microscope, with the trough at the centre. The hot water is then turned on, and allowed to flow slowly. The trough is next filled with melted paraffin by the aid of a hot pipette, and the object dropped in and oriented with a needle. As soon as the object is placed in the desired position the cold water is turned on, which as an immediate stiffening of the paraffin. hot water is shut up, and after a few moments the paraffin with the imbedded object can be removed from the trough. The trough should be washed with absolute alcohol before imbedding.

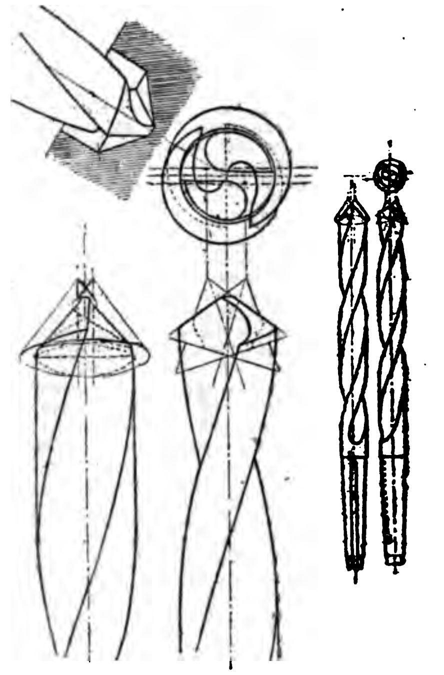
F I G . 2 .



TWIST DRILLS.—I.*

THE following paper is offered as an inquiry into the requirements of the cutting edges of twist drills, and as a suggestion of a mode of procedure by which a proper form for them may be determined. Each lip of a drill is required to cut a shaving from a metal surface, and should be in the shape of a wedge. The angle included between the faces of the wedge will be called the cutting angle, and that between the surface being cut and the adjacent face of the wedge the angle of clearance. In order to secure the greatest efficiency in cutting different metals, these angles should be varied, but on account of the inconvenience of having to keep a different set of drills for each metal, a compromise has been evolved which is reasonably efficient for them all. It is known that the best cutting angle for wrought iron is about 60° and for cast iron about 70°, the angle of clearance being from 3° to 5°; hence, if we take 65° as the cutting angle of a drill, it will answer for either metal.

The body of a twist drill is a cylinder, grooved on two opposite sides. The intersection of these grooves with the end of the drill form two lines, the straight portions of which should be parallel with each other and at a distance apart equal to about one-eighth of the diameter of the drill and leading from the circumference a little past the axis, then curving backward in a direction opposite to that of the rotation of the drill and again touching the circumference at a distance of rather more than a quadrant from the starting point, as shown by the accompanying drawing. If these grooves were parallel with the axis, it is evident that the cutting angles of the drill would be 90°, less the clearance, or, say, 85°. In order to reduce these angles to 65°, the amount required, the grooves are cut spirally, making the angle of the spiral about 20°, or its pitch about nine times the diameter of the drill. This makes the cutting angle correct only at the part of the lip furthest from the axis, while it will increase in magnitude from this point in to the point nearest to the axis; but, as the speed diminishes at the same time, this increase of the cutting angle is not objectionable. For brass, the cutting angle should be from 80° to 90°; therefore it is best either to use a flat drill or to alter the cutting angles of the twist drill by grinding off the lips by planes parallel to the axis and to each other. Another object in making the grooves spiral is the lifting or screwing out of the chips from the hole which is drilled. The distance between the parallel sides of the grooves at the axis gives the necessary strength to the centre or web, while the strength and stiffness of the drill are further increased by the metal adjoining the curved parts of the grooves. The cylindrical portions of the drill, which are left between the



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* A paper by WILLIAM H. THORNE, Philadelphia, read before the American Society of Mechanical Engineers.

grooves, should be backed-off from their forward edges, in order to diminish the rubbing surface and to prevent undue friction and sticking.

The angle of clearance of the lips is obtained by the shape to which the end surfaces of the drill are ground, and the straight part of the intersections of these end surfaces with the grooves forms the cutting edges. The most efficient shape for these end surfaces can best be determined by considering that the surface of the metal being cut is in the form of a hollow cone, truncated a certain amount, depending on the thickness of the web of the drill. The cutting edges of the drill will touch this hollow cone in straight lines. Now, imagine a portion of a conical surface to coincide with this hollow cone and then to be rotated about one of these straight lines through an angle of, perhaps, 5°. It is evident that this would produce a uniform and similar clearance throughout, and would form the most perfect clearance possible. It is the object, therefore, to approximate this in shaping the end of the drill. As the two cutting edges are straight lines, parallel to each other, but at a distance apart equal to the thickness of the web, and as each is produced by the intersection of a conical surface with one of the grooves of the drill, these conical surfaces must be selected so that their intersection with each other will produce a proper form of chisel point, and so that they will approximate as nearly as possible to the surface of the hollow cone.

The accompanying illustration represents on a scale of one quarter size a 2in. and ½in. drill as they should be ground by a well-designed machine, the complete conical surfaces and intersections being shown by fine lines. In these drills, the apices of the conical surfaces are moved away from the apex of the hollow cone a sufficient distance to produce, by the intersection of the surfaces, a proper form of chisel point; the axes are inclined so that the radius of curvature of the surface at the outer end of the cutting edge corresponds with that of the hollow cone; and these axes do not lie in the same plane but in parallel planes, at a distance apart greater than the thickness of the web of the drill, so that a tangent to the conical surface will make an angle of 5° with a tangent to the hollow cone at the outer end of the cutting edge.

(*To be concluded.*)

Artificial Perfumes.—Confectioners and manufacturers of liqueurs are in the habit of employing various artificial perfumes, which in chemical language are such bodies as amylic valerianate, amylic butyrate, ethylic butyrate, propylic ether, and caprylic alcohol. The odour and flavour of the apple, the pear, the pineapple, the strawberry, and the raspberry can thus be imitated. These imitations not only remove the necessity for the use of the natural fruits, but are far less expensive, and, besides having a perfect similitude with them, give the appropriate flavour in a more accentuated form. MM. Poincaré and Vallois have sought to ascertain whether these artificially prepared perfumes possess poisonous properties by injecting them under the skin of animals, as well as by introducing them into the stomach. Dogs and guineapigs, can withstand even large doses of these substances when injected under the skin; but these animals can be poisoned by sufficiently large doses, and then the symptoms set in rapidly. The most constant toxic symptom was great prostration, which was followed in a variable time by coma. These phenomena were less marked in the dog than the guinea-pig. All the animals were troubled with violent nasal irritation and sneezing, and distressed breathing was always evidenced by over-action of the respiratory muscles. An excessive secretion of mucus from the bronchial tubes was also noticed. Notwithstanding the gravity of the symptoms, the majority of the animals recovered. Chronic poisoning with the artificial perfumes was not followed by any characteristic effects, the chief morbid appearances being congestion, swelling, and ecchymoses of the gastro-intestinal mucous membrane. The practical outcome of these experiments is to sanction the use of infinitesimal doses such as are already employed for artificial flavouring of aliments.—*Lancet.*

Catalogues.—Messrs. Horne, Thornthwaite, and Wood, of the Strand and Cheapside, have issued a new catalogue of telescopes, in which there are some pages which will specially interest those who are desirous of silvering specula for themselves. We have also the thirtieth annual issue of Wood's catalogue of slides, magic lanterns, and dissolving view apparatus. If amateur and other lecturers or entertainers cannot find in this catalogue a suitable collection of slides for every conceivable occasion, they must, indeed, be hard to please.

M. ROTONDI finds that fats may be saponified by means of sodium chloride, by passing an electric current through the solution, and using suitable electrodes. The products obtained are soap, glycerol, and free chlorine.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this society was held on Wednesday evening, the 16th inst., at the Institution of Civil Engineers, Mr. R. H. Scott, F.R.S., president, in the chair.

Mr. J. Hartnup, Mr. A. W. Preston, Mr. R. Sheward, and Mr. W. B. Worthington, B.Sc., M.Inst.C.E., were balloted for and duly elected Fellows of the Society.

The following papers were read:—

(1) "On the Influence of Forests upon Climate," by Dr. A. Woeikof, Hon.Mem.R.M.Soc. The first step towards a scientific investigation of the influence of forests upon climate was taken by the establishment of the Bavarian Forest meteorological stations. This example was followed by Germany, France, Switzerland, Italy, and other countries. As a general result, it was found that during the warmer season the air and earth temperatures were lower in the forest as compared with contiguous woodless places: that their variations were less, and that the relative humidity was greater. Dr. Woeikof's discussion of this question shows that in the Western portions of the Old World extensive forests materially influence the temperature of neighbouring localities, and that the normal increase of temperature from the Atlantic Ocean towards the interior of the Continent is not only interrupted by their agency, but they cause the summer to be cooler in regions situated further in the interior than those nearer the sea. Hence, forests exert an influence on climate which does not cease at their borders, but is felt over a greater or less district, according to the size, kind, and positions of the forests. From this it naturally follows that man, by clearing forests in one place and planting others in another, may considerably affect the climate.

(2) "Report on the Phenological Observations for 1885," by the Rev. T. A. Preston, M.A., F.R.Met.Soc. The year has been a very dry one, and this has acted in such a manner on vegetation that, although the winter was mild, plants were very late in flowering, and lasted only a short time. The bloom was often profuse, and as bees and other insects could visit them, the crop of fruit was unusually great—the apples, for instance, being often spoilt in quality from the enormous number on the trees; whilst in the case of wild fruits the brilliant colour of the bushes when in fruit was quite as beautiful as when in bloom. But at the same time the drought acted very prejudicially, especially to root crops and bush fruit, as well as strawberries. In the case of the root crops, the seed had great difficulty in germinating, and the weak plants were at once overpowered by insect pests, so that the crops of turnips were generally complete failures. The insect pests also did much damage to bush fruit, while the drought prevented the strawberries from swelling. The corn did not suffer to any great extent, the dry season allowing the land to be prepared: and although the straw was often short, the yield was not unsatisfactory. A general absence of butterflies was noticed in some places. In the South of England the white butterflies were most abundant at one time, but the autumn butterflies were not so plentiful as usual.

(3) "Etudes sur les crépuscules rosés," by Prof. R. Ricco, of Palermo.

(4) "The Storm of October 15th, 1885, at Partenkirchen, Bavaria," by Col. M. F. Ward, F.R.Met.Soc. This was the most destructive storm which has occurred in this valley since the winter of 1821-22. The storm burst suddenly at 7 p.m., and lasted about half an hour; but in that short period nearly every house was unroofed, and it is computed that in one forest alone above 250,000 trees were laid prostrate.

ROYAL MICROSCOPICAL SOCIETY.

THE third meeting of the session was held on the 9th inst. at King's College, Strand, W.C., A. D. Michael, Esq., vice-president, in the chair.

Mr. Crisp said that since the last meeting a copy of the resolution of the society in condolence with the family of the late Dr. Carpenter had been forwarded to Mrs. Carpenter, and a letter in acknowledgment received from Dr. P. Herbert Carpenter, which he read.

Attention was also called to some slides presented by Dr. Morris, which were mounted in a highly refractive medium, which by some misconception was imagined to have the effect of increasing the aperture of the objective in proportion to the increase of refractive index, and which was described as a new theory for making objectives of low aperture perform as well as the modern wide-angled objective.

Mr. Swift's large photo-micrograph of the tongue of the blow-fly which had obtained the prize medal at the recent exhibition of the photographic society was exhibited.

Mr. J. Mayall, jun., said that this photograph was made on a plan for which he was partly responsible, having suggested it to Mr. M. Swift as more likely to produce good results than the ordinary method, in which the increase of size was obtained by increasing the distance of the plate from the eyepiece. The plan adopted in this case was to make an enlarged photograph from a small negative obtained by a paraffin lamp; by this process and by chemically intensifying the enlarged negative, the specimen before the meeting had been produced, and it was one of the best, if not the very best, he had ever seen. Mr. Swift was, of course, entirely responsible for the success with which the process had been carried out.

Mr. Crisp exhibited Vérick's apparatus for enabling four photographs to be taken of the same object.

Mr. J. Mayall, jun., said that the intention of this was to enable four different plates to be used, so as to give a different length of exposure to each, or to photograph different parts of the same object without loss of time.

Dr. Maddox said that at the request of his friend Dr. Mercer, of Syracuse, he had brought to the meeting for exhibition a series of photographs of inked surfaces covering pencil lines. A note descriptive of the photographs was read, and the specimens in illustration handed round for inspection.

Mr. Crisp said that a somewhat similar case was recorded last year, in which a person wanted to add some words to a bond which had been originally written with very pale ink; as the added words were written in much darker ink, he had to go all over the original writing to make it look alike. Examination with the microscope, however, at once showed where this had been done.

The Chairman said that anyone who examined Dr. Maddox's photographs would see that the marks of the graphite were perfectly plain, and there could be no doubt about them; but, as a rule, he confessed that he was not a great believer in the evidence afforded by the microscope in cases of forgery. So far as his experience went, he thought the results obtained in this way were by no means so reliable as could be desired.

Mr. Bennett said that when he attended the meetings of the American Society of Microscopists at Rochester as a deputation from their society, several papers were read on this subject, and he believed that the general opinions then expressed agreed with that just given by the chairman.

Dr. E. Crookshank read a paper "On the Cultivation of Bacteria," which he illustrated by numerous drawings, and by a series of preparations exhibited under a number of microscopes in the room. He also exhibited and described a collection of apparatus of the latest and most approved construction for the cultivation of bacteria and the preparation of the media employed.

Dr. Maddox felt sure that all present must have listened with great pleasure to the very interesting paper which they had just heard. With regard to the paper process, Dr. Miquel, of Paris, had pointed out that there was a certain objection to Koch's method in the cases of those organisms which required a long time for their growth, some of which it was known did not develop for at least twenty days, during which time it was most probable that they would be overspread by other organisms, and consequently the original cultivation would be lost. Dr. Hesse's arrangement for drawing air through a tube was one which he thought they would recognise. Many of the Fellows would recollect that some time ago he exhibited at one of their meeting an aëroscope or aspirator for this purpose, from which the German one differs only in the length of tubes. He thought the Germans were rather apt to run away with their ideas in this way; but though he did not at all object to anyone copying any of his own contrivances, he thought it ought not to be done without some kind of acknowledgment. He could only express his own thanks to Dr. Crookshank for the exhibition of this apparatus, and for the magnificent drawings with which he had illustrated the subject of his paper.

Mr. F. Cheshire said that reference had been made to *Bacillus Alrei*, and it might be interesting to know that even in the case of the bee itself the peculiar growth was found in the body of the larva. Undoubtedly, it did arrange itself in that particular lined way that had been mentioned.

The Chairman said they must all feel greatly indebted to Dr. Crookshank for his paper upon what was, perhaps, *the* microscopical subject of the day. It was especially gratifying to them to hear the subject dealt with by a gentleman who was not only such a thorough master of it, but who also possessed so fine a collection.

Mr. Crisp mentioned that Dr. Crookshank embodying his ideas on these subjects in which would appear shortly.

Mr. Robertson's note "On a Mode of Spinal Cord" was re [illegible] of the cord about spirit (10 over pro transferred to a 6 per cent. solution of bichromate of potash for six days, care being taken during the process of hardening to remove with a razor thin sections from the ends to allow the solution to thoroughly penetrate to the interior of each piece. The process of hardening is completed by transferring to weak spirit for two days, then to strong for two or three more days, when the cord can be kept till wanted for sections. Portions of the cord are stained before sections are made by soaking for twelve hours in a solution of good picrocarmine, washed in weak spirit, and soaked for a short time in absolute alcohol, which should be used to wet the razor in cutting. The sections are cleaned in oil of cloves, and mounted in dammar varnish or Canada balsam dissolved in benzole in the usual way. I have tried most of the methods recommended in the text-books for demonstrating the structure of the spinal cord, brain, ganglia, &c., and find that none of the methods recommended bring out the processes and cells or enable one to trace the cell process so well as the method of soaking in the picrocarmine before cutting; and there is also little risk of damaging the sections after they are cut, as they can be washed off from the razor to the slide, cleared with oil of cloves, and mounted in dammar varnish or balsam dissolved in benzole in the usual way. It is very difficult to procure good picrocarmine in this country. The best that I have met with I obtained ready made from MM. Rousseau and Son, Paris. The only objection to the bichromate of ammonia method is that the solution is liable to depart in the form of small specks amongst the nerve. Some of these specks are seen in the sections."

Mr. Meates's note "On a New Highly Refractive Medium for Mounting" was read, the substance employed being a mixture of one part arsenic to five, six, or seven parts of sulphur.

Mr. Cheshire read a paper "On the Pulvillus of the Bee," illustrating the subject by a drawing on the black board. He also called attention to a notch found upon the leg of the bee, and explained what he considered to be its use as opposed to the explanations given by some other observers.

Mr. Bennett said that it had been stated by some writers that this part of the bee was used for opening the anthers of flowers so as to get at the pollen. Could Mr. Cheshire say from his experience whether this was so?

Mr. Cheshire said he had no knowledge of the fact from his own observations.

Mr. Bennett said that it was quite certain that many of the Diptera did feed largely upon pollen, but he did not know if the same thing prevailed in the case of the Hymenoptera.

Mr. Cheshire said that in the case of the bee it certainly was so, as the stomach was always found to contain pollen. The queen, before mating, also fed upon it, but after she had mated she was fed with a peculiar glandular secretion by the workers. This was found to be a highly nitrogenous food, and under this diet the queen rapidly increased in weight from 1½ grain to 3¼ grains. The workers, however, all fed on pollen.

The Chairman said that the gradual raising of the Pulvillus, as described by Mr. Cheshire, was a tolerably widespread method amongst the Acari; in many instances it was so large in proportion to the size of the creature that it would probably be quite impossible to lift it off straight.

Mr. Cheshire asked if the form of pleating was generally observed in the case of the Acari?

The Chairman said it was not so in all cases, but in some the folding was much the same as in a closed fan, and the opening out was similar to the way in which such a fan might be opened out by vertical pressure.

Mr. Crisp read a circular which had been received from America, explaining the objects and scope of the Elizabeth Thompson endowment fund.

Mr. J. W. Groves exhibited some mounted sections cut by the large Barrett microtome, shown at the preceding meeting, and described in the last number of the Journal. The sections were not as thin as it was possible to cut them; but were exhibited to show how large good sections could be made with the machine.

Nine new Fellows were elected and proposed, and Prof. H. de Lecaze-Duthiers was also elected as an Honorary Fellow of the Society.

A Powerful Hæmostatic. — A curious and interesting discovery is reported to have been made in Columbia, which, if confirmed, will be valuable to surgeons. A shrub, which is called there "aliza," exudes a juice which is so powerful a hæmostatic that when a knife is smeared with it, and used for operating purposes, the largest vessels y be severed without any hæmorrhage. It is stated in the South American medical journal [illegible] hat hæmorrhage (epistaxis?) g the scent of th [illegible] ale [illegible]

SCIENTIFIC . NEWS.

THE Dun Echt Circular, No. 103, contains the elements and an ephemeris of Barnard's new comet calculated by Dr. H. Oppenheim from an observation made at Berlin on the 5th, and two others made at Dresden on the 7th and 10th. $T = 1886$, May 14·1430 Berlin M.T.; $\pi -$ ☊ 116° 31′ 57″; ☊ 66° 22′ 12″; i 94° 8′ 7″, mean equinox 1885; log. q 9·74184. The ephemeris for Berlin on the following midnights reads:

	R.A.			N. Dec.	
Dec. 26.	3h.	25m.	12s.	7°	19·8′
28.	3	20	23	7	37·5
30.	3	15	39	7	55·8

The brightness taken as unity on Dec. 5 will be 1·4 on Dec. 28.

The Dun Echt Circular, No. 104, contains an announcement that Mr. J. E. Gore, of Beltra, Ballysodare, Ireland, found at 9h. 20m. p.m., on the 13th, observing with a binocular, a reddish star about 6 mag. and about 20′ following χ (54) Orionis. Not finding it given by Harding, Lalande, Heis, or Birmingham, Mr. Gore suspects that it is either a "new star" or a remarkable variable. On Dec. 16 Dr. Copeland and Mr. L. Becker, at Dun Echt, found it of the 6½ mag., and of an orange-red colour. It has a very beautiful banded spectrum of the 3rd type, 7 dark bands being readily distinguished with the prism. The bright intervals seem full of bright lines, especially in the green and blue. The mean place for 1885 is—R.A., 5h. 48m. 59s., N. Dec., 20° 9·4′. It is not in the Bonn maps.

Mr. O. T. Sherman announces in the *American Journal of Science* the discovery of no fewer than fifteen bright lines in the spectrum of Gamma Cassiopeiæ, and seventeen in that of Beta Lyræ. Mr. Sherman states that he has found bright lines, sometimes in considerable number, in the spectra of many other stars—a discovery which will be deemed important when verified. The appearance of bright lines in stellar spectra is, however, readily assumed under certain conditions, and Mr. Sherman's observations require corroboration.

The death of Sir Frederick J. O. Evans, R.N., F.R.S., late hydrographer to the Admiralty, occurred on Sunday last. The deceased was in his 71st year. In conjunction with the late Archibald Smith, F.R.S., he published in 1869 the "Admiralty Manual for Ascertaining and Applying the Deviation of the Compass," which was translated by all maritime nations.

The death is announced of Mr. Edwin Ormond Brown, assistant chemist to the War Department at Woolwich Arsenal, where for thirty years he had been actively engaged in the development of the manufacture and utilisation of gun cotton and dynamite. Mr. Brown was in his 60th year.

With reference to a paragraph which appeared in this column, p. 297, "An Old Subscriber" and a member of the medical staff of the Paddington Hospital for Children informs us that Miss Prideaux could not have contracted diphtheria in the execution of her duties at the hospital, as a case of that disease has never been admitted since the hospital was opened.

The annual conversazione of the Amateur Mechanical Society was held the other evening in the rooms of the Society of British Artists, which were brilliantly illuminated by the Albo-carbon light. General Clark exhibited some splendid specimens of ornamental turning. Mr. Holtzapffel and Mr. Evans had each a good show of lathes, &c., Mr. E. R. Dale, F.S.Sc., exhibited his prize coil electric machine, and Mr. Lee showed the Lee-Chaster electro-motor (½h.p.) at work driving his planing attachment for lathes. It is hoped that the society will soon be in possession of a workshop, a library, and improved machinery. A new list of members and a number of the *Journal* will, it is hoped, be issued early next year.

At the meeting of the San Francisco Microscopical Society on Nov. 25, a discussion arose relative to the habits and life-history of the grain-weevil, *Sitophilus granarius*. Some interesting facts were mentioned, and the subject, which is of commercial as well as scientific interest, will probably be specially taken up at a future meeting. The secretary, Mr. A. H. Breckenfeld exhibited double-stained sections of the petiole of *Eucalyptus globulus* by polarised light. He also showed the very easily-constructed microtome by means of which the sections had been cut. In this, the object is imbedded in a plug of paraffin inserted in a short glass tube, which is sunk into a block of wood. The plug can be very gradually raised by means of a large, blunt-pointed "screw-eye," which enters the glass tube from beneath through the bottom of the block. Two glass slips are then cemented to the top of the block, on either side of the tube and flush with its top, and by means of a keen razor sliding over these smooth surfaces, very thin sections can be easily and quickly cut. The expense of the apparatus is, of course, merely nominal. A well-mounted slide of a species of *Cladophora*, one of the marine algæ, was shown by F. L. Howard. The specimen was found growing with other algæ on the piles of the Pacific Mail Dock, which is quite a good collecting ground for the cryptogamic botanist. Amongst the exhibits of the evening was one of Lord S. G. Osborne's diatomescopes, forwarded by Mr. Hinton, the manufacturer.

At a meeting of the Royal Physical Society, held last week in Edinburgh, Prof. Cossar Ewart contributed an interesting paper on "The Hatching of Herring in Deep Water." After referring to the importance of the herring fishery as a Scottish industry, the author pointed out that we are still ignorant of the habits, food, and migration of most of the food fishes, and knew still less of the spawn and the time of spawning, and had almost everything to learn as to the distribution of fish, and as to the most economical means of preserving those not required for immediate consumption. In 1810 only 90,000 barrels were cured, but in 1880 the number had reached the wonderful total of 1,480,000. The increase, however, had not been commensurate with the increase in the amount of netting. Since the introduction of cotton nets and large herring boats, the means of capturing had been increased enormously, but large numbers of immature fish had been sent into the market, often scarcely fit for food. A matter of even more vital importance, however, than the size of the fish captured was whether the off-shore shoals would disappear or diminish, as had been the case with the inshore shoals, if they were annually invaded with large fishing fleets? In this connection Prof. Ewart pointed out that if the eggs were capable of hatching in deep water—say, in from sixty to a hundred fathoms—almost any of the many gravel-coated banks of the North Sea might serve as spawning beds. After detailing various experiments, he said the only difference between the hatching of herring ova in deep and shallow water was one of time, and they might now safely conclude that if herring deposited their eggs in suitable ground in any depth of water not exceeding a hundred fathoms they would undergo development.

M. Joseph Bertrand was received as the successor of the late J. B. Dumas, in the perpetual secretaryship of the Academy of Sciences, in the presence of a large number of distinguished savants, many of them octogenarians, and amongst them the venerable Chevreul, who in a few months will complete his hundredth year. His features bear the marks of senility, but he is hale, and his intellect is scarcely impaired, while his hearing is excellent.

The Lucigen is the name of a new lighting apparatus, which produces an illuminating gas by forcing air through creasote. It is the invention of Messrs. Lyle and Hannay, and consists of a cylindrical vessel capable of containing 30 gallons of heavy hydrocarbon oil. Air under a moderate pressure is conducted to the cylinder, which is fitted with a special burner having two tubes, one within the other, leading up to it. The inner tube dips into the creasote, and the pressure of air on the latter forces it up the tube. A portion of the air finds its way to the burner through the annular space between the inner and outer tubes, and the air and oil combining at the burner form, when ignited by a match, a flame which gives a light that is useful for general working purposes over a radius of 150 to 200 yards. The proportions used to form the proper light are four of air to one of oil by volume. The Lucigen has been used at the Forth Bridge Works.

Dr. Dujardin Beaumetz believes he has record of at least one case of spontaneous hydrophobia, and Pasteur agrees with him, as rabbits inoculated with portions of the medulla oblongata of the patient exhibited the usual symptoms of poisoning by the virus of rabies. M. Pasteur is inundated with applications for treatment, from persons bitten by dogs, and recently, on one day, inoculated no fewer than forty persons with the attenuated virus.

A new fire-damp indicator has been devised by M. Lechien, of Mons. It consists of an indiarubber ring, the internal circumference of which is pierced with holes. This is allowed to become inflated in a suspected locality, and when it is placed round a safety lamp, a very slight compression sends the gas into the interior, and its character is indicated by the alteration produced in the flame.

The great gas-engine case, after sixteen days' battle in the Law Courts, has ended in judgment for the plaintiff, Mr. Justice Pearson deciding that in Dr. Otto's engines there is at the time of ignition, a mixture heterogeneous and not homogeneous, that it has exactly the effect claimed, and that there is no anticipation of Dr. Otto's discovery and invention — consequently that his patent of 1876 is valid and good.

Static electricity produced by a Carré machine has been used in Spain as a remedy for amblyopia (blunt, as opposed to clear, vision), produced by nicotine and hysteria. The susceptibility of the patient, especially in the case of women, should be carefully tested.

Dr. W. Otto, of the North German steamer *Ems*, has tried cocaine for sea-sickness with success.

Mr. Elliot Stock has just published a work entitled "Newton: his Friend: and his Niece," by the late Augustus de Morgan, edited by his wife and by his pupil A. C. Ranyard. It contains a good deal that will interest students of biographical history, but is especially noticeable because in it De Morgan clears the character of Newton from any stain which may be thought to attach to it from contemporary remarks on the relations between Charles Montague, Earl of Halifax, and Catherine Barton, Newton's niece. De Morgan gives good reasons for believing that Miss Barton and Lord Halifax were privately married.

USEFUL AND SCIENTIFIC NOTES.

Lantanin, a Peruvian Antipyretic.—A new antipyretic, which is said to be superior to quinine, has been found by Drs. Negrete and Buiza, of Peru, in a South American plant, Lantana Brazilieusi. According to *El Correo Farmacéutico*, the alkaloid lantanin has been administered to thirty-two patients suffering from fevers of different kinds and degrees, with satisfactory results. It is said also to be better borne by delicate stomachs than quinine. The dose recommended is one grain and a half every two hours, but as much as half a drachm may be given during the twenty-four hours.

Borax as an Internal Disinfectant.—In the *L'Union Médicale*, Dr. Cyon confirms the statement, made by Dumas in 1878, that borax is possessed of most valuable antiseptic powers. Independently of its value for the preservation of food, it is a great preventive of infectious diseases, and may be employed internally to ward off epidemics. It may be taken for months or years with impunity, and constitutes a valuable prophylactic. Dr. Cyon states that it is a remarkable fact that in all epidemics of cholera the workmen in boracic acid factories have always escaped the disease. The usual dose is five or six grammes (75 to 90 grains) daily, taken for an indefinite time.

Algin.—Algin is the residual product of the preparation of iodine from certain marine algæ by the wet method. It resembles albumen, with the exception that it is not coagulated by heat. It forms alginates with metals; the alkaline and earthy alkaline alginates are soluble, but the other salts are insoluble. The double alginates are easy of preparation, and almost all of them very soluble. Algin has some alimentary value; it may be used in place of gum arabic in the preparation of various dietetic and medicinal products.

LETTERS TO THE EDITOR.

◆

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆

TO "F.R.A.S."—STEINHEIL'S EYEPIECES —THE NEW COMETS.

[25136.]—IN reply to "F.R.A.S." (letter 25108), the aperture of the Rousdon equatoreal is $6\frac{4}{10}$in. The object-glass is by Merz, Munich, and the focal length 74in. Both Fabry's and Barnard's comets were picked up with a low-power eyepiece by Steinheil; power 27, diameter of field 1° 48'.

This is one of a set of specially-constructed low-power eyepieces by Steinheil, which have been kindly lent for trial here, and Mr. Peek has made a most careful trial of them in comparison with other ordinary low-power eyepieces. The one here mentioned appears peculiarly adapted for the examination of very faint nebulous objects, and is by its large field well suited for sweeping for comets.

The observations of the nucleus of Fabry's comet are a proof of the quality of the $4\frac{1}{8}$ o.g. used by "F.R.A.S.," as this nucleus is very small, not much above 12th magnitude, and I am not surprised he could not find Barnard's comet, for it is considerably fainter than Fabry's. It was observed here on December 8th, 9th, and 10th.

The observations Mr. Garbett wishes for (letter 25110) were in this instance impossible. A 10th magnitude star, though distinct enough in a telescope of this aperture, does not give a spectrum sufficiently bright for observation, while the comet was so faint and diffuse that the same remark applies with still greater force to such a nebulous object.

The comet *b* 1883 (Pons-Brooks), was observed here on October 4th of that year, passing nearly centrally over two 8th magnitude stars, when such was the tenuity of the cometic matter that they shone undimmed through the comet, the only effect (and that was very slight) being that the stars did not appear quite so neatly defined as when seen on the dark sky. **C. Grover**

(Assistant to C. E. Peek, M.A., F.R.A.S.).
Rousdon Observatory, Lyme Regis,
Dorset, Dec. 18.

THE NEW COMET.

[25137.]—I LEARN from Mr. Grover that the comparison of the star's spectra was not possible last week, neither comet nor star being bright enough to have spectra examined; but ever since powerful spectroscopes have existence, say, above 20 years, nearly every comet has been seen to pass before stars up to the 6th or 5th magnitude, without any observer being ready. That any part of any comet itself should be bright enough to afford a satisfactory spectrum was hardly credible till Dr. Huggins assures us it was done. But what can any information learnt that way be in comparison with what observations of this kind would yield? The effects on even weak star spectra of transmission through an additional hundred miles or two of our atmosphere are said to be obvious. Not less must be the effect of thousands of miles of comet gas.

Dec. 15. **E. L. G.**

STAR DISCS, &c.

[25138.]—I DESIRE to draw attention to the question whether, given a perfect parabolic mirror, the out and in focus discs as seen with an ordinary Huyghenian eyepiece, would be alike or different? It appears to me they would be different. In the eyepiece the spherical aberration is only lessened and not removed by the use of two lenses, and the result is the same as if a single lens were used with less aberration than ordinary. In considering the matter, then, I treat it as if the eyepiece were a single lens only. It seems to me that a lens upon which a converging beam impinges will differ in the amount of aberration from a lens with a diverging beam. When viewing the out focus disc of a star, we have a diverging beam. Suppose, in this position, the correction is perfect; on pushing in the lens to view in-focus disc, we have a converging beam, and what was a perfect correction in former case is no longer so. It is easy to see that when the focus of mirror coincides with centre of curvature of first convex surface of lens, the beam will pass first surface unaltered, and aberrations will only be produced at the second surface. Subject to correction, then, I submit that with a perfect mirror the in-focus disc will never be as sharp and well defined, nor the diffraction rings so dark, as on the out-focus disc, when viewed with ordinary eyepiece of convex lenses only.

In reply to 25112, I am not aware I asserted I saw Cassini's division with 2in., or the crape ring. I will try when Saturn is in my strip of sky; but I do not expect to see it. As for other evidence, Mr. Proctor says 2in. will show it. I stick to the imagination being required as well.

I was not aware that I had said alteration was needed in the adjustments of a reflector when perfect for whole aperture to make it perfect for an eccentric stop. I thought I took the other view.

Is there any suspicion of variability in the star centre of H IV 37? I have once or twice found it very plain; at most times, not to be seen at all.

Is there not a mistake in Webb *re* P 1 222? He calls it 6th mag., 15th 10th and 9th: the 6th mag. having 15th at 2·5". The 6th mag. is north of P 1 222, which is the 9th mag. star. I spent some time trying to reconcile the data with the stars; but could not. **Edwin Holmes.**

NEWTON AND ENDOWMENT.

[25139.]—IN a work written by the late Augustus De Morgan, and just now published ("Newton, his Friend, and his Niece"), occurs a passage which is deserving of the widest publicity, as showing how even a giant intellect like Newton's suffered deterioration after accepting office under the Crown.

"At the age of fifty, the high-priest of science found himself the inmate of a college, and, but for the generous patronage of a friend, he would have died within its walls. And where should a high-priest of science have lived and died? At the Mint? Very few sacrifices were made to science after Newton came to London. One year of his Cambridge life was worth more to his philosophical reputation and utility than all his long official career. If, after having piloted the country safely through the very difficult and, as some thought, impossible operation on the coinage, he had returned to the University with a handsome pension, and his mind free to make up again to the 'litigious lady,' he would, to use his own words, have taken 'another pull at the moon'; and we suspect Clairaut would have had to begin at the point from which Laplace afterwards began. Newton was removed, the high-priest of science was translated to the temple of Mammon, at the time when the Differential Calculus was, in the hands of Leibnitz and the Bernouillis, beginning to rise into higher stories. Had Newton remained at his post, coining nothing but ideas, the mathematical sciences might have gained a century of advance."

Stella.

MICROSCOPICAL—DRY MOUNTING—ZINC CEMENTS.

[25140.]—THE December number of the *Journal* of the Royal Microscopical Society devotes some space to the consideration of the best way to get rid of moisture in dry mounts. Various plans are suggested for overcoming the difficulty. In all of them there is a great deal of trouble, and the result is uncertain. I believe the best way to avoid moisture is to proceed as follows:—Melt some hard Canada balsam and fix the cover glass with it. There being no liquid to evaporate, no moisture can get into the cell. The balsam, when hard, can be coated with brown cement, and then white zinc or other cement applied over it.

With regard to white zinc, I have cemented a great number of specimens with it, and find that if the glass is clean and dry, there is no need of any further coating. I have had several failures with Brunswick black; but as some of my slides have not needed a second coating, I put them down to my own neglect of proper precautions.

Enal.

BERRY'S PATENT TOOL-HOLDER.

[25141.]—I HAVE seen numerous *articles* ab
tool-holders in the back numbers of this pa
The tool-holders described were certainly
designed, and some of them deserve sincere
It will, no doubt, interest your readers
description of a new form of tool-holde
have no doubt beats all its predecessors
with pleasure hear our able lathe-
it, in order to be able to defend it
known, as it is really worth know
Inclosed sketch will almost ex
as I am not very good at drawin
explanation will make it clearer
The tool-holder I have has
thick, with a head forged at th

in actual practice one or two important factors intervene which mar the result.

What I wanted to elicit was as to whether it had been done by any other and simpler method—i.e., without the overhead, change wheels, or spiral chuck, the overhead being used to drive the drill or fly-cutter only. Now, it can be done, and by a method perfectly refreshing in its simplicity; and at some early period I hope to communicate the means to the readers of the "E.M."; but before doing so I hope to forward to the Editor some specimens of such work for inspection. As it is my intention to submit my arrangement to Mr. Evans, it is possible the description may emanate from his more experienced pen.

A word as to the division plate. The method of correctly counting mentioned by "W. R. W," is very simple, and I shall certainly adopt it when necessary. Mr. Ashton's automatic counter is very ingenious; but where shall we arrive if we go on loading the mandrel, first with this apparatus, then with that, most of which are intended to supplant ordinary skill? We shall be having Mr. Evans announcing a lathe to do anything that it may be told to do by working the treadle, and then our charming occupation will be gone. **Tuebor.**

THEORY OF THE WIMSHURST MACHINE — POWER OF THE CONDUCTORS.

[25146.]—In the theory of this machine, published in "E. M." of the 11th inst., the power of the conductors over the working of the discs was but slightly alluded to, because that power cannot actively assist the functions of the plates, although it can actively paralyse them. If the machine were only two endless rows of electrophori, the conductors might gather the E. from each electrophorus as it passed, but could do no more. The electrophori would propagate, by induction from such charge as one or more held, other charges more or less near to the strength of the inducing charge, but never equalling it, much less exceeding it; but when the charges of many sectors or electrophori are repelled into the space of one, that one has an increased charge, and propagates a proportionally increased charge in others. This repelling of the electricity into a smaller space may be looked on as an electrical dam in the charging segment held back by another electrical dam in the discharging segment, and if one dam be run off, both must go. The conductors can run off the dam of the discharging segment, and, theoretically, should be able to carry away the power of the machine. Practically we find this unmistakably true. Any one having a machine can satisfy himself in five minutes. The machine working with parted terminals, and giving its long sparks from condensers, will be found to have its discs highly charged before and *after passing the collecting rakes.* There can be no mistake about this. The knuckle applied to the plate will make the fact apparent to eye and touch. The conductors are taking a part of the E. only, and there is a vast amount dammed up somehow. Now bring the terminals together, or connect the conductors with the ground—the dam of E. runs off. The rows of electrophori are left to work on the charges they held—and what work will they do? Place the knuckle to the plate *before the plate comes to the rake*, and see how much E. it is carrying to that rake. If there be any E. it must show. The electrophori without the electrical dam cannot even keep up their charges.

Thus the Wimshurst as now constructed is found to be essentially a high-pressure machine, and dependent for its power on resistance in the external circuit. It may be that electricians will turn their attention to this matter of conductors when they appreciate the situation. The conductors should only carry off the E. produced after the discs are charged until the limit is reached. Practically, that limit is soon reached; but considering there is a power which rises faster than the resistance, the question is of interest, "What is the limit?"

I thank Mr. Wimshurst for his kind advice, although it has been anticipated. I have made four machines, and I bought a fifth, a "Tudsbury," for no other reason than comparison. The machine I described in twelve lines I spent three months over. I made for it eight conductors and four sets of neutralisers; I cut six glass discs and 240 sectors. If any one has spoken precipitately, I am not that one. I did not call the machine unsatisfactory. I did not say it was rarely self-exciting in this climate without reference to work other than my own, and I did not say it in a depreciatory sense, it being really no trouble to me to excite it if the atmosphere be dry enough for it to work at all (not always the case).

What I wrote about was quite a different matter from the merits or demerits of the machine—namely, the theory of its working apart from self-excitement.

I shall be glad now to see that theory fairly tackled and broken down, if such can be done by showing me any inconsistency in it; but I expect to be referred to some practical experiments with the machine itself for proof, and I hope to be spared any further facetious guesses as to my probable state of mind had I followed somebody's lines, the said lines being merely a mechanical repetition not calculated to help a search to which I have given much patient attention for twelve months.

Mr. Wimshurst ought to remember that the cause of one is the cause of all in this case. There can be no vested interest in misdirection. I have alluded to his opinions with respect, and it is painful to me to show anyone the false position he can place himself in by a hypothesis of inexperience based upon conjecture.

Roscommon. **F. Taaffe.**

THE FERROUS OXALATE DEVELOPER.

[25147.]—I have received many private letters from your correspondents on this subject. Most of these speak in high praise of this developer. Some few there are who fail to get a clear solution on mixing the ferrous sulphate solution with the potassic oxalate. Specially to aid these, I inclose this present: If a deposit is produced at the time of mixing the two solutions, it depends on one of two causes. (A) The solutions are not *saturated.* (B) The solutions are saturate, but the oxalate has to be added to the iron solution, instead of adding the iron solution to the oxalate. A correspondent hailing from York states that his solutions, which, when freshly made, gave perfectly clear mixtures, now yield a precipitate on admixture.

This evidently depends on the fact that, water having been added to the stock bottles, they have not been shaken up, so as to insure solution of the fresh salt. The solution of ferrous sulphate, if made from nice bright clean crystals of ferrous sulphate, will keep clear in corked bottles for months; and the addition of 3 or 4 grains of copper sulphate to each pint of iron solution will increase its keeping qualities very much.

I shall be very happy to write a few letters on the gelatine process, if the same would be acceptable to your readers. **S. Bottone.**

The Limes, Stanley-road, Carshalton.

GASOLINE GAS.

[25148.]—With reference to Mr. Wright's letter (25092) in your issue of December 11th, I should like to state my experience with gasoline gas as applied to gas engines.

I had a small gas-engine made from Dorrington's castings, which I wished to use to drive a 15ft. boat during last summer. As I did not wish to incur any needless expense, I got one of Fletcher's generators (his smallest size), and attached to my engine a small bellows, made on the model of that of an organ, the safety-valve of which opened at a pressure of about 3in. of water. To save trouble, I made the bellows of sufficient size to supply rather more air at each stroke than I require gas for each charge of the engine, and drove the bellows by means of a grooved pulley and band at the same speed as the engine. What air I did not require to carburet was blown off at the safety-valve. The bellows was placed close to the engine, but the generator for safety was placed in the bow of the boat, the air from the bellows being conveyed to it along one side of the boat, and from the generator to the engine along the other side.

I found the apparatus to work admirably, and had no difficulty in starting my engine in a minute, as all required was to open the two cocks on the generator, turn the engine by hand till the gas-bag was full, when, on applying a light to the igniting jet, all was ready to start, and stopping was quite as easy.

I found on trial that half a gallon of gasoline ran the engine (cylinder 4in. by 7in.) at a speed of 200 a minute for about three hours, and my only trouble was from the excessive heat given out by this gas—I should think nearly double the amount coal gas would give, and which I intend to get rid of in a new engine by means of a water jacket.

My gas apparatus did not cost more than £2, and was all that could be desired. **Drake.**

ON THE SEASONING OF TIMBER.

[25149.]—There are many proposed methods of expediting the seasoning of timber, and I should like to make a few remarks on the same subject; also to suggest another method which I believe, if properly worked out, would be of great use to the wood-working community generally.

Nature herself supplies three drying agents, viz. —1, Frosts; 2, Sharp dry winds; 3, Heat of the sun. It is a well-known fact to timber dealers, whose interest it is to keep sound seasoned stock, that by far the most potent and useful of these is
—(1), frosts; next (2) sharp dry win
of all (3) solar heat.

The solar rays bake the outside
parts of the substance of the wood are
one degree of heat and parts to ano
differences of degrees of heat imply
pansions, and to these are due the su
shakes so detrimental to the value of

Strong dry winds are very good, a
act by evaporation. A company has
for the artificial seasoning of timbe
after the sap, &c., has been extracted
timber is dried by warm, dry-air cu
promoters claim that by this process
improved in quality. I am inclined
doubt whether the whole of the sap
tracted by steam, for, look how the s
place in the wood. Under normal
the moisture in a tree is absorbed by
passes up the tree by the wood. In di
plants of several years growth, the wa
the alburnum or young wood, which
at the outside. Hence the prepondera
the less dense exterior zone. The
tains the requisite salts in solution.
competent authorities that all the salt
the liquid state by the root are n
water, and that the root gives off acid
as carbonic acid gas (CO_2) to dissolve
if such salts be deposited in the solid
tissues of the wood, it is very eviden
be dissolved out by steam. For the
the sap by this process, then, I woul
steam to be mixed with carbonic aci
can now so cheaply and readily be obt

Sharp frosts are held by practica
more efficiently and expeditiously as
than either of the above-named natu
and for these reasons. Wood, like
bodies, contracts by reducing the
Water does the same until it freez
expands in bulk in the proportion of
the contraction of the wood and the
the water on solidification, both consp
as it were, the moisture.

A sharp frost has the advantage ov
acting uniformly, and thus avoiding
equalities of expansion. In support
I may add, does not usually cause che
in wood. This statement regarding u
expansion requires qualification, for
that all wood expands slightly more
tion than across the fibres.

My idea, then, to expedite seasoning
the planks to the action of sharp frost
readily be obtained artificially in need,
allow the wood to remain seasoning u
in an erect position. This position is
of the utmost importance practicall
reason is obvious. The natural cha
moisture is through the wood from
the leaves, &c., whilst the stem is
position.

Another important factor to obtain
ing work is to allow the wood to rema
drying a short time after being pla
woods, however old, will shrink after b
Thus, oak was taken from an old buildi
had been upwards of 200 years, and on
shrank.

Charlotte-street, Hull. **Ernest H**

FUSING-POINT OF ALUMIN

[25150.]—Mr. W. J. Grey asks if I
covered any connection between the f
and heat conductivity of a metal. He
forgetful (I do not for a moment suggest
ignorant) of Tyndall's now universall
theory that heat is merely another name
cular motion? I see, from the table he
letter 25135), that he has adopted Wiede
Franz's ratios of heat conductivity, wi
and Person's fusing-points—perhaps a sc
method of comparison to either authors;
is more than doubted now if any pyro
invented can give us reliable figured d
tions of the latter point above 700° C.
the former, I certainly think the way
and F. procured the conduction results
cation, by means of the thermo-pile, of
and Despretz's method of heating by a
the metallic assay-bar, sustaining therm
proportional distances from the source
open to serious objections, on the gro
impossibility of obtaining *precisely*
amount of heat from the flickering
spirit-lamp applied to different bars
even to the same bar at different
observation. A much more reliable i
molecular conductivity would, as it
have been realised by heating the end
filed to a point, with the point of t
pyrocone; and, by employing differ
this method would have shown the f
the same time. With regard to
of aluminium, quoted by
and Johnson's results, it

Moon's hourly motion in declination—		″
10m. var. at 19h.		44·78
,, ,, 20h.		43·78
		2)88·56
Hourly motion at ☌		4·428

Semi-diameter—			
		′	″
At midnight		15	56·4
Correction for parallax	7·5′ +		
	27		
	525		
	150		
	2·025		2·02
Semi-diameter at ☌		15′	58·42″
Reduced to minutes		15·974′	

Then, after the diagram is completed, by Mr. Pearson's method, it is necessary to compute the time of immerson and emersion, thus:

	h.	m.
For immersion—		
Hour angle at ☌	23	13·1
,, ,, immersion	22	12·2
	1	0·9
Local mean time of ☌	3	9·5
,, ,, immersion	2	8·6
For emersion—	h.	m.
Hour angle at emersion	23	31·6
,, ,, ☌	23	13·1
		18·5
Local mean time of ☌	3	9·5
,, ,, ,, emersion	3	28·0

FIGURES REQUIRED TO BE MADE IN COMPUTING AN OCCULTATION BY MR. WOODSIDE'S METHOD.

	h.	m.
Washington mean time of ☌	14	45·5
Difference of longitude		24·0
Local mean time of ☌	3	9·5
Washington hour angle	1	10·9
Difference of longitude		24·0
Local hour angle	23	13·1
Log. ρ sin. ϕ'	9·82626	
,, cos. star's declination	9·98225	
,, 100	2·	
x = 64·35 div.	1·80851	

The above figures required by my method can be made in two minutes, and if x is taken from a table, in *one minute or less*. The scale is computed once for all, and is *invariable* for all computations for the place; and the moon's semi-diameter is always equal to 27·23 divisions of the scale.

The quantities Y, x', and y' are found in the *American Nautical Almanac* complete for use, and of course need not be taken out on paper. Also by my method, the diagram exhibits at once the times of immersion and emersion without another figure. **Chas. L. Woodside.**

Boston, Mass., U.S., Nov. 19.

COMPOUND LOCOMOTIVES.

[25153.]—WITH regard to the controversy in your columns *re* the Compound Locomotives, would you allow me to say a few words about them? I think the idea a good one, and without doubt they are economical. Most of your correspondents seem to have got the idea that compounding requires condensing. Now, this idea is decidedly erroneous, and no more necessary than expansion valve, and I should say that what gives rise to the idea is that all steamers having compound engines condense. But why do steamers condense? Is it because they are compound? Decidedly not. They have condensers in order to supply fresh water to the boilers. If they had not, the said boilers would have to be supplied with salt water. This depositing salt would corrode the boilers, whereas by condensing fresh water is supplied. Then look at paddle steamers: they have not compound engines, yet they condense for the same reason.

Again, if those correspondents were at the Inventories, they might have noticed that a large percentage of the engines on exhibition were compounded; and yet, if I remember rightly, not a single one of them had condensers. I think these arguments ought to be conclusive.

W. P. Steell.

WE understand that Messrs. Blakey, Emmott, and Co. have obtained the contract for supplying the Midland Railway Company with batteries and other apparatus during the ensuing year.

REPLIES TO QUERIES.

◆

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[57360.] — **Chronometer Balance.**—In anyone but "Wen's" experience, dirt causes a watch to gain; often, largely. The same effect is caused by the watch being put together more stiffly, as our friend curiously hath it. Reason simple enough. In either case the power is weaker, and the balance (in clock, the pendulum) is not urged to its full vibration, thereby doing it in less time. Moral: "Those in glass houses," &c.—A. E. BANNISTER, 18, Bernard-street, Southampton.

[57740.]—**Free Reeds—Tuning.**—I am pleased to observe a little so-called professional information creeping into "our" columns, and no doubt the gentleman who replied to this query is satisfied that he has faithfully described the wonderful and long talked-of tuning apparatus. I wish, however, to supplement the remarks on p. 322, by informing the querist that there are many reed-organ factories (to my knowledge) who do not use the tuning bellows. If a reed-organ maker buys his reeds (and there are many such), he will, or does not, require this mysterious piece of machinery. The chief use of the tuning-bellows is for the purpose of filing reeds up to pitch; but, in no true sense of the word, are the reeds tuned, either "rough" or "fine," in the apparatus described on p. 322. Had I understood previously that the querist required to know how to construct the rough affair recently brought to light, I should have sent sufficient information in the first place. I did not reply to the last query asked on the subject, because another correspondent (who assumed to hold a higher position than myself) was also requested to reply, and I am always willing to give place to correspondents who think themselves infallible in such matters, in case the querist may possibly be misled. I am extremely sorry to inform the original querist that this great stumbling block stood in my way of helping him out of his difficulty. As I shall not give the subject up altogether, I hope to have the opportunity of relieving the querist by giving definite and minute details on the construction of a tuning apparatus which will be worthy of the title. If this reply is inserted, I shall then conclude that the Editor is willing to grant me the necessary space to describe a tuning appliance, by the aid of which reeds may be filed to pitch, rough tuned, and partly voiced. The operation of "fine tuning" is the finishing touch to the reeds.—G. FRYER.

[57774.]—**Coupler to Harmonium.**—Octave couplers to harmoniums are not very fashionable, and their application not to be much recommended; such arrangements are detrimental to the "touch." The advantage of the application of an octave coupler, either to the harmonium or American organ, is to increase the power and volume of tone, but is always accompanied by injury to the touch on the keys. The querist may not, perhaps, be aware of the improvements (recently applied to pipe-organs) made to obviate, and, to a great extent, prevent the previous necessity of a heavy touch on the keys. In the recently-improved pipe-organs the touch is rendered almost equal in lightness to that of a pianoforte. To attach, or apply an octave coupler to a harmonium is not a wise undertaking, and the effect gained by its application to the instrument (considering the great disadvantage attending it) is not worth the amount of time and patience required to make a successful job of it. Take good advice, and let your harmonium remain as it is.—G. FRYER.

[57813.] — **Gramme Dynamo — Magnetic North and South.**—In order to give the opinion which Mr. Eaves asks of me (p. 322), it is absolutely necessary to go back to some very abstract first principles. The question is, Should we, upon true scientific principles, call the end of a bar magnet which turns to the north, N. or S.? As a matter of fact, we in England always call it N., and the French writers call it S.: the question is whether we should consider that the magnetic pole is endowed with a specific, actual quality—an absolute northness or southness. Now the French school continues to cling to and teach the exploded theory of two magnetic fluids—austral and boreal magnetisms—that is to say, real northness and southness. Then we have the notion that the earth itself is a magnet, identical in nature and condition with a steel bar; the result is that the two poles, pointing in the same direction of the earth and bar, as the one attracts the other, must needs be charged with opposite kinds of magnetism. Now the French are never satisfied with anything, however practically convenient, which is opposed to their ideal of correctness (the correctness of the ideal is of no consequence). We more easy-going and practical-minded English call the end of the bar which points north, the north pole, N. The French say, no; its magnetic properties are the same as those of the south pole of the earth, its magnetism is austral, it must, therefore, be the south pole of the bar, and we will call it S. This argument convinces Mr. Eaves, and he uses the French terminology; now he invites my opinion. Well, I have two, and will give them. First, as the real use of names is to identify objects, if a person writes for English readers he should call the north-pointing N., if for French readers he should call it S.; in other words, he should do at Rome as the Romans do, and speak the "language understanded of the people" he addresses. But now for the abstract opinion: we must now go back to the absolute—it is a matter of pure truth. Well, in the universe there is neither up nor down, right nor left—there is no actual north or south, east or west. These are purely local matters, related to specific data. In magnetism, also, there is no absolute northness or southness; no actual difference between the condition of the N. pole and the S. pole: it is purely a function of each individual particle—identical in state at both poles, identical in arrangement even. The directivity manifested is not a result of the property of the magnet, still less of any different properties of its two poles. It comes into existence only as a consequence of the mutual reaction of two magnets; it is a result of their uniting into one system, a consequence of the conductivity of each for the lines of force of the other. Therefore, I should say that there is no true scientific reason for preferring either N. or S.; that it was common sense to call the end of the compass needle N. which pointed north, and natural to retain that name generally for magnets, and the French idea is a kind of affectation of a purism, and, moreover, involves adhesion to an untrue theory of magnetism. I may add that while it is convenient to think of the earth as a bar magnet, we have no evidence that it is so. Its magnetism may be a temporary phenomenon, a product of electrical currents dependent upon its diurnal rotation in the sun's rays: in this case the magnetic directivity would not be caused by any polarity of the earth, but by the relation of the compass to the direction of these currents; there is, in fact, much to be said in favour of this idea.—SIGMA.

[57863.] — **Boiler.** — In reply to "Belgian," page 323, I may just observe that I cannot lay my hand upon the No. alluded to, being very busy just now. It is certainly curious to note that we, having filed a specification of our invention for filling boilers on July 3, 1884, No. 9706, "Invicta," towards the latter part of the year, gave a drawing and a description so precisely similar in every respect, that it was apparent to us that he derived his inspiration from us; and as a proof that I am right, I challenge him to publish his real name, which he carefully keeps a secret. The plan, as used upon my boiler just now, is a copper ball or chamber, standing, say, 6in. above top of boiler at one side of same; from the bottom of this chamber a pipe goes vertically down into the supply (in this instance a bucket of water, so that its action can be witnessed); a branch pipe from this leads into the boiler near its bottom; in this branch is a valve opening into boiler, and below said branch is another valve opening upwards; a small steampipe, with a stopcock upon it, leads into the top of the chamber, which is also provided with a small cock, so as to blow out the air when necessary. The action is thusly: Turn on the steam, and allow it to blow through for a little, then shut both the cocks: the steam in the chamber will quickly condense, and it will be nearly filled with water. If the steamcock be now again turned on, the said water will by its gravity flow into boiler, and, of course, when the steamcock is shut the same operation goes on as required.—A., Liverpool.

[57998.]—**Turning Coal.**—If the querist means cannel coal, I believe he will find directions in Holtzapffel's Vol. I. Perhaps someone who has that work will answer the query.—T. J.

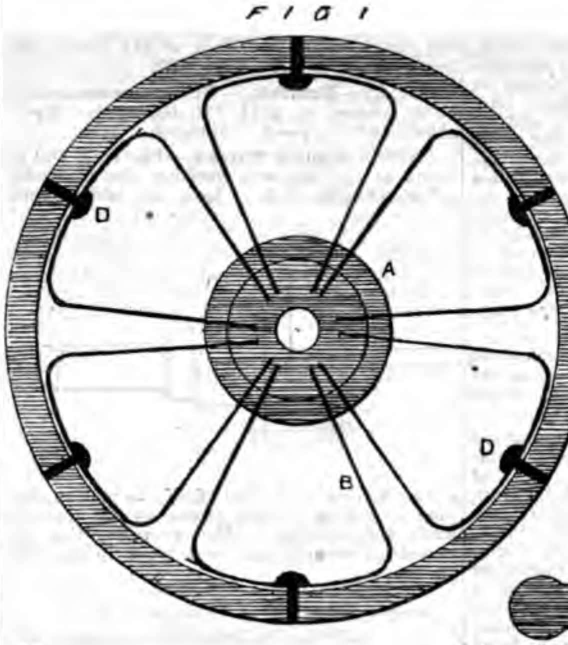
[58013.]—**Metal Moulds for Vulcanite**—Plaster of Paris moulds are generally used; but iron or copper would do, and even lead.—E. G.

[58016.]—**Wheel Flange Depth.**—The subject of the depth of flanges for railway wheels has frequently been discussed by engineers: but there seems to be little inclination to alter the present rule of thumb, which gives a depth of 1¼in. to 1½in. As a matter of experience, that seems to be sufficient. There is far more danger in tight gauge than in want of flange depth, for if the space between the metals is less than it ought to be, flange friction is intensified, and the tendency to mount the rails is increased; but, still, the gauge must not be loose, as it is important to prevent oscillation or swaying as much as possible.—NUL-DOR.

[58017.] — **Carpet-beating Machine.** - there such a machine in [illegible] or do[illegible] querist want someone to i[illegible] him? There is a machine [illegible] which the carpet passes [illegible] over a steam-heated coil, number of sticks, worked by tappets on another roll, knock the dust out of it, while a revolving brush cleans the underside. Is that what the querist means ?—S. R.

[58119.]—**Wheel.**—I give three different ways of making waggon or truck wheels. In making wheels of this description, the only pattern required is the centre boss, as shown at Fig. 3 : A is boss, B is print for wrought arms, C is guide-plug for centre core. Fig. 2 is sectional view of boss, A showing top and bottom facings, B showing core prints. Fig. 1 is view of wheel complete, with either wrought arms or steel. Fig 4 is one set of arms, usually ½in. by 3½in. broad, with ends to go into the metal of boss, 2in., and to be nicked at the ends a little. Fig. 5 is a bending-block, with wrought iron in the centre, standing out 3in. by 1½in. square, to rest in swage block. Fig. 6 is side view of block, showing ledge for arm to rest; only portion of block shown. In moulding wheels of this type, it is best to cast a circular plate with a hole in the centre, about 15in. diam.; bed it level, then soften the centre and put facing sand, and bed the boss so that the bottom of the arms is level with the top of the plate; then drop a frame, about 3in. larger than the boss each side. Make joint on top of arms, ram top part, loosen pattern stake box, and lift off. Be sure to keep the stakes clear of the arms. Next rap the frame, and lift it off so that the arms will go into boss. It is best, before laying arms in, to have a light ring and centre it from boss; then drop the arms in, then you are sure of their being the right diameter. Another system is to level a small bed, and bed the boss-pattern in the centre; level with the bottom of the arms, and proceed as before. Another system of bossing is chills for top and bottom in place of sand, having a gate in, and a core print top and bottom. Next is a truck wheel or waggon wheel with round arms. Sketches show wheels with eight arms in each. They can either be made with pattern for rim, or made as flywheels are made, with a sweep, as shown at Fig. 1; Fig. 2 is a loose piece to go on outside of rim, as shown at Fig. 5 (B); Fig. 3 is guide peg (Fig. 5), showing how moulded, having a joint at top of ring A A; C is boss; D, little bosses for arms to go into, both in rim and centre boss; Fig. 7 is showing boss being moulded and jointed at A A, centre of arms and pattern divided at B centre of hollow. The best system is to take a box according to size of boss, put 3in. of core sand in, then bed the boss pattern, make joint at A, putting parting sand on, lay on next part of pattern, ram up to next A, make joint as before, put in plug C, and ram up, having a cast-iron grid ring to lift it by; rap the box, take off and rap the pattern at end of arms, and lift off; finish black, and dry in stove; then, after the rim is rammed up, dig a hole in the

FIG 1



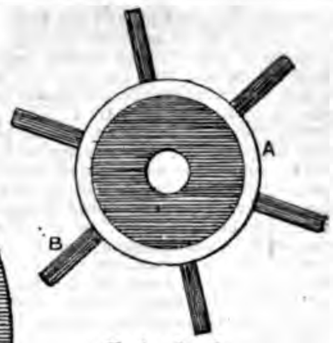


FIG 2

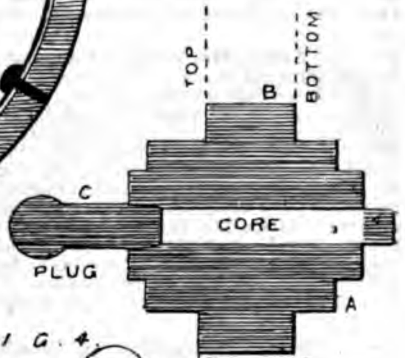
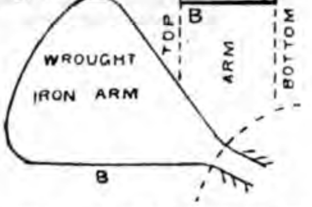


FIG. 4.



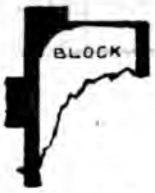


FIG 6

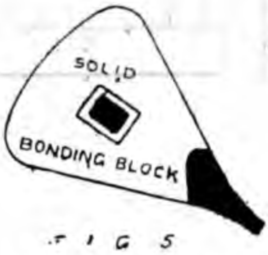


FIG 5

FIG 5

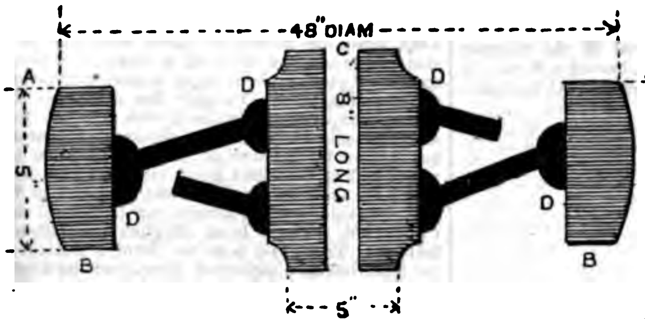


FIG 1

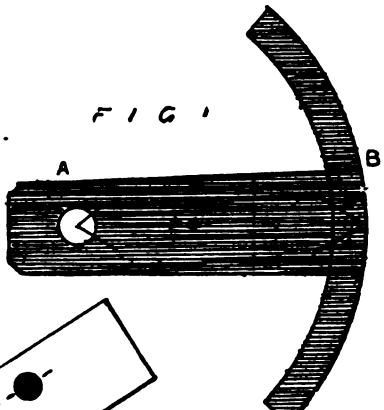


FIG. 3.

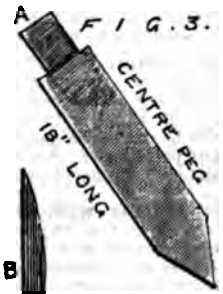
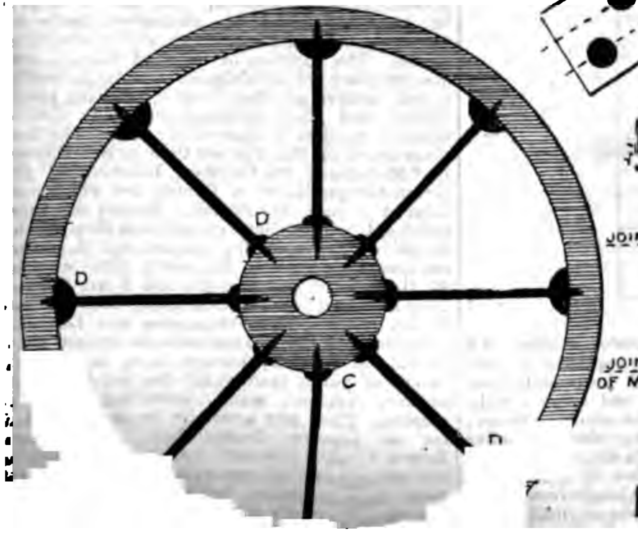


FIG. 2

FIG. 8.

FIG. 6.



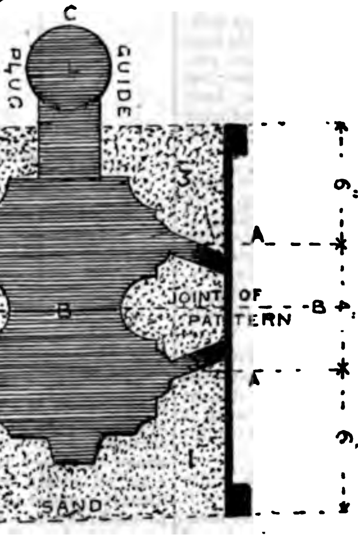


FIG 7

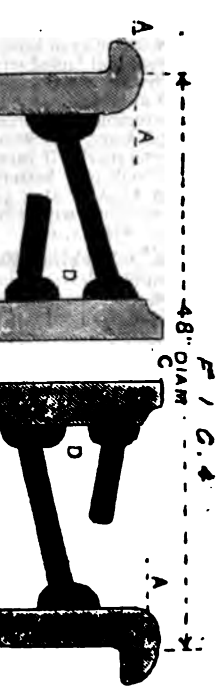


FIG. 4.

middle for boss, mould, and set from top of ring, arms of boss to be as shown in Fig. 8, and in rim as shown in Fig. 6, they coming into the metal, about 2in. in boss and 1in. in rim. By moulding on this principle there is no difficulty in putting the arms in, by laying the part 1 in its place; then, putting four arms in, lay on middle part, and put other four arms in; next put top on, having centre core in, cover rim weight, and make runner up, cast ring first and let go cold, so that contraction does not break the rim. This system will do for either flywheels, pulleys, or any kind of truck wheels where wrought-iron arms are required. In Figs. 5 and 4 I have shown part of arm in top of one and bottom of other, as they are not opposite to each other in boss; if large, cover with loam, ring instead of moulding box, as flywheels are.—SAND RAT.

[58024.]—**Set Boilers.**—This querist cannot do better than refer to Mr. Fletcher's catalogue, and look specially at his radial split burners.—NUN. DOR.

[58032.]—**Automatic Firing of Furnace.**—Automatic firing of steam-boiler furnaces is one of those things which is so far good in itself that it continues in use, but makes no great headway, because the advantages and the economy are not sufficiently great. It must be more than 30 years ago that I first saw automatic firing in the boilers at the Bank of England, where they had the hopper arrangement; but automatic or not, a steam boiler must have an attendant, and he may as well put the coals on, as stand and watch the machine. Automatic firing would be of most value on board ship; but I do not remember any mention of its having been adopted on board steam vessels.—NUN. DOR.

[58033.]—**Steam Navigation on Canals.**—The objections are that steam propulsion washes the banks down and creates too much disturbance in the water.—S. R.

[58034.]—**Firebrick Fireplaces.**—The querist had better procure fire lumps such as are used by furnace builders, and chip them to fit; but, if he cannot, then let him get some Stourbridge fireclay, mix well with water until of the consistency of soft putty, and work that into the places, leaving it to dry before starting the fire. I believe a little salt added to the clay is an improvement.—NUN. DOR.

[58036.] — **Patent Compound Duplex Engine.**—Will this querist give more particulars of so wonderful an engine? At least, he has heard of it, because he gives it a name. The question then is, where did he hear of it?—S. R.

[58167.]—**Sanitary.**—Thanks for replies. What is the value (as a manure) of the refuse as compared with, say, stable manure; and is the urea of any value in it, or is it injurious to the plants? Should it be put in the garden direct, or is it best dried and pulverised? Are there any crops that it suits better than others?—SEMI-DETACHED.

[58192.]—**Coils with Bare Wire.**—I have made several in this way in days when I could obtain no covered wire or other appliances. In fact, I made an induction coil before even that of Hearden or Rhumkorff, and without knowing that I had produced a novelty. It was made of fine copper wire, obtained by unwinding a lot of French plated toy chains; each layer was separated with a strip of silk, and the wire turns had fine sewing silk laid on between them, and the whole saturated with linseed oil boiled with resin. It gave violent shocks from one terminal with one Smee cell, and without a condenser, so that it had tension sufficient to complete its circuit through the table legs, floor, and body, and would, no doubt, have produced good sparks, if furnished with condenser and with a sufficient battery. A patent has been taken in America also, years ago, for producing electro-magnets with bare wire, avoiding actual contacts.—SIGMA.

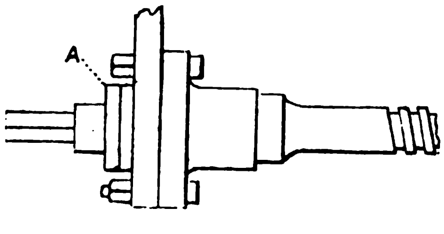
[58199.]—**Backing Plates.**—Well made gelatino-bromide plates seldom require backing. Dry collodion and other thin plates require backing, if exposed to very strong contrasts. For backing these, a little burnt sienna made into a paste with water and a little gum will be found as good as anything. It may be removed with a sponge dipped in cold water, care being taken not to wet the sensitive surface.—S. BOTTONE.

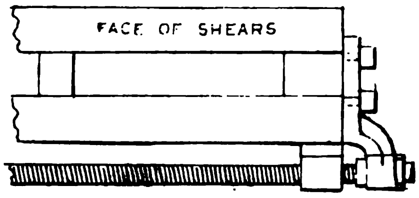
[58202.]—**Photo. Lens.**—TO MR. BOTTONE.—Sellers of lenses always quote the shortest focal length, and this is obtained from the most distant light-giving object, viz., the sun. The distance is generally measured from the centre of the combination to the ground glass.—S. BOTTONE.

[58202.]—**Photo. Lens.**—If your lens is really a "Dallmeyer," then the description of lens will probably be engraved on it; all those I have mentioned are landscape lenses. Another way to tell which lens it is, is by the focus. For a 2in. diam. lens the back focus of a rapid rectilinear is 15in.; of a wide-angle rectilinear, 7½in.; of a wide-angle landscape, 10in. You can find the focus by fitting your lens into a camera temporarily and measuring the distance from the back of the lens to the focussing glass.—B.SC., Plymouth.

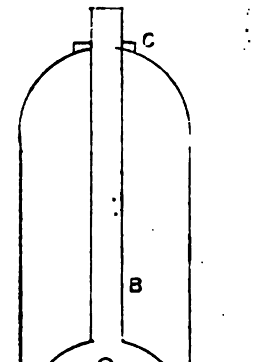
[58209.] — **Erratum.** — In my communication anent wheels, on page 324, the words "fired" should be "tired."—A., Liverpool.

[58239.]—**Faulty Thread.**—The fault will be found at the jam-nuts forming the adjustable collar on bracket at A. I have very seldom found a true bearing to be had there; so took another plan by putting a back centre on end of screw-shaft, and adjusted it there, providing that the end of screw-shaft had been faced up true (the bracket I used was bolted on to end of shears) with a steel screw and two jam-nuts. Perhaps this sketch will help.—D. B. S.





[58242.]—**Boiler.**—In reply to "H. R. W." page 308, I may premise that this boiler was constructed for a steam tricycle, which will account for the high-pressure it was tested to—viz., 220lb. per square inch. Being much occupied, I merely send a sketch of same, not drawn to scale, as I have the boiler coated about 3in. deep with "Bell's asbestos." The copper, where I can get at it, is No. 14, or, by rule, $\frac{3}{32}$. The copper used weighs about 75lb. The shell has a flange at A $1\frac{1}{8}$ broad; on top is an iron ring $\frac{3}{16}$ thick. Next comes a ring of sheet asbestos! then the part marked B, the chimney tube of which is 2in. diameter, having a thread cut upon a sufficiently thickened part at C to take a large brass nut, washer, and asbestos washer. All this arrangement is apparently requisite in order to thoroughly braze in the 14 horizontal water tubes, seven in one direction and seven at right angles, and 1in. in diameter. This also has a flange; then comes another asbestos ring; then a similar flange to copper firebox; and lastly, another iron ring, all firmly screwed together by $\frac{5}{16}$ bolts and nuts $1\frac{1}{4}$ asunder all round. The height from flange to crown is 24in. The firebox was originally made to contain $\frac{3}{4}$in. of water all round; but this was found not to answer, and I cut it out and lengthened it from $4\frac{1}{2}$in. to 71in. As I have before stated, coal alone clogs the spaces between the water



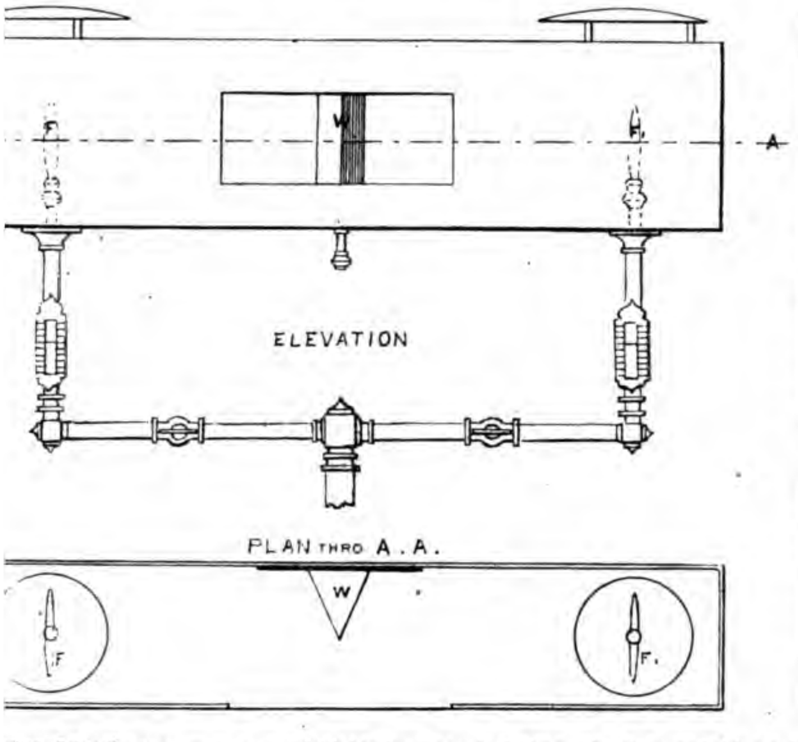
tubes, but works well when half-
Having set it up upon brickwork
with a similar-sized pipe, almost 20ft
side of my house, it requires attentio
rises with great rapidity; it takes, sa
of water as its normal charge. The
is 4in. by 2½in.; an ordinary spri
safety-valve, a Bourdon pressur
stitute its fittings. If any further i
wanted, I shall be glad to give it if w
bilities.—A., Liverpool.

[58246.]—**Microscopical Exa**
Yeast.—It is not quite clear from t
a "Young Brewer" requires, whethe
of the microscopical character of "y
practical instruction in microscopi
tion. If it be the latter, he would
half an hour from an experience
than from all that could be written
ject. I give, however, as much as
within the limits of a paragraph on
of this organism. The yeast fungus, Sa
cerevisiæ, sometimes inconvenient
Torula by Pasteur and others, is
elliptical cells, consisting of a thin
containing a granular protoplasm.
general, one or two vacuoles are
cells are variable in size, accor
stage of development, those that
averaging about 8·0μ (1·0μ =
0·00003937 (nearly $\frac{1}{25000}$th inch);
normally by gemmation, putting fo
wonderful rapidity, and form long
necklace-like chains. When nutriti
they form endogenous spores, term
then develop to "yeast cells," an
usually reproduce by gemmation.
multiplying the cells look plump, d
protoplasm, which is generally gra
out, and the vacuole, or sometimes
small. When the life cycle of the ce
and degeneration commences, it ha
shrunken or wrinkled appearance, t
comes clearer, less granular, and th
larges conspicuously, nearly filling t
The protoplasm may be separated
wall by bursting the latter, through p
cover-glass of a preparation made
manner. The cells sometimes elong
perhaps three, times their short diam
form a true mycelium—i.e., filament
of "high" and "low" fermentation
said to be specifically distinct; clearl
believe this to be an error, the diffe
ing merely on the temperature of
It has been said that yeast is but th
form of Penicillium glaucum (c
mould), or other of the higher aërial
This, again, is clearly an error, re
many other asserted cases of a tran
species, or pleomorphism do, in impur
or contaminations. Pasteur has d
assertion experimentally: he it was a
showed conclusively that the diseases
due to contaminations of foreign
yeast; he has described their variou
sufficient accuracy for practical pu
most valuable work, "Etudes sur la
Paris, 1876. (There is an English t
believe.) True yeast does not form
the fluid, but is distributed througho
While fermentation and multiplicatio
are active, they are in constant moti
their varying specific gravity, from pa
gas generated being attached to many
a pellicle forming is always an indic
presence of contaminations. This cla
but little understood; the atmosphe
numerous, both in the open air and
houses. The function of many of t
obscure; they are certainly not zymot
stated, neither are they "septic," ca
faction, and their development in
nutrient medium is exceedingly slo
observations on this class are those by
in "Medullelser fra Carlsberg Labo
fortunately published in Danish, but
tains a résumé in French. He h
articles, I believe, but have not seen
Botanische Zeitung. The characters
ent species are given in the useful li
W. B. Grove, "The Bacteria and Y
They are also referred to in the most re
of Dr. Klein, "Micro-Organisms a
"Bacteria," or the schizomycetes, bot
bacilli, and (generic) bacteria occur
vations of yeast, than which they a
smaller, seldom much exceedin
breadth. They may generally be di
far as concerns fermentation. "
Brewer" will, however, find a de
the characters of true yeast, an
usual contaminations, better suited
pose than anything else, in Pasteur's
mentioned. It need scarcely be [illegible]
practically acquai[illegible] with t
work with the
or medium powe

he objects are comparatively large.—

Plaster Casts.—" Jason " can obtain lished surface to plaster casts by boil- a strong solution of common curd soap owing casts to dry, and afterwards rub- ghtly with a piece of clean flannel.— MA.

Gas Burners.—" F. P." will find an for testing the consumption of gas rtised in your columns; but for accu- the light given, no such simple and d has as yet been devised. " F. P." ows the means adopted at gasworks, ly apparatus is necessary to arrive at accurate results. The comparative burners, however, may be done very using two of the above instruments of plaster of Paris or other white he accompanying sketch illustrates a



riter devised some years ago, which o satisfy the most sceptical as to the f one burner over another, many persons the impression that the light must be the same amount of gas is passing, rse is by no means the case. A A is a a movable front, blacked on the inside. e bottom two pipes are led and con- the consumption indicators. Perfora- de all round the pipe and covered with he purpose of supplying air to the tlets are made at the top and covered prevent extraneous light from getting . W is the wedge of plaster, so fixed nd actuated from below. A small cur- own, is used when testings are made day; but this is not required when t. The wedge in elevation is shown e side than the other for the purpose n; but it must be moved so that the equally illuminated and the apex of invisible. Now, suppose two burners is required to determine the compara- y are used and each burner passing antity of gas, then if the light from l, both sides of the wedge, placed cen- en the two, will be equally illuminated. ver, gives more light than the other, will require to be moved nearer the until a point is reached when the light w, as light varies as the square of the follows that if d = distance of apex of larger light, and d_1 = distance from $^{2}_{2}$ = efficiency of the lesser compared rger light. Thus, let the distance burners be 30in., and let d = 16in., in. Then $\frac{14^2}{16^2} = \cdot 7656$, or, in other ight given from the one flame is only rs that given by the other. A pressure s-bag are useful adjuncts to the appa- he advantages of governor burners are strated.—T. T. W.

get authentic information from the MECHANIC concerning the value of the Leclanché"? If he takes the trouble to look, he will find it stated over and over again that it has no value. Why, then, should any one waste his time in working out the information to show that it is useless in any specific case? He might get a momentary light in a small lamp, and the best thing he can do is to try one for himself: then he will get authentic, if not satisfactory, information.—SIGMA.

[58262.] — **Microscopical Objectives.** — " Homoios " has apparently rather confused notions on this subject. It is by no means clear that an objective made of topaz would "be infinitely superior in all optical qualities to one of glass," still less, that "no dry lens is to be compared to an immersion." As a matter of fact, a carefully-corrected lens of glass would be superior to an uncorrected one of topaz; and to correct one of topaz for both form and colour, glass would have to form a part of the combination, and this would probably entail more labour without any better results as regards form, while it might be simply impossible to correct the colour altogether. Again, it is only for lenses of really high power that the immersion principle is available, while more than nine-tenths of all microscopical investigations are made with lenses of moderate and low lower. It is a very common error to suppose that the higher the power of an objective the more useful it is.—GAMMA SIGMA.

[58264.]—**Oboe.**—As no one has answered this I will do what I can. It is a melodic instrument, and rapid passages are ineffective; tone particularly fine: fingering differs essentially from clarionet. Unlike the last-named, which is a transposing instrument, the oboe plays on same key as piano or violin; it has double reed, the clarionet has single reed. Compass B natural, below G clef, to about D above complete chromatic scale. Requires so little wind that performer is obliged to hold his breath (this is very tiresome on the muscles of mouth). Tone depends principally on the lips being in good condition—that is, not fatigued. Can be heard in any first-rate orchestra.—JASON.

[58267.]—**Guttapercha for Boots.**—Guttapercha for boot jobbing wholesale comes in at 1s. to 1s. 6d. per lb. The thin cut soles one sees in the shops are not used in the trade. A jobber will put on 5 to 8 pairs of soles in one heat (about half an hour). He uses the gutta soft, covers the sole with same, using his thumbs only by pressing the sole on a smooth stone all unevenness is taken out. The edges are trimmed with a hot knife. After it is hard it is trimmed with a knife spokeshave and emery paper. If it is for leather boots, the solution must be of a good sort, otherwise you will fail. The same care is not needed in gutta or rubber boots. I myself used a mixture of my own for jobbing, composed of old guttapercha and a certain brand of guttapercha. I found this better than anything I could buy, as I could alter it for summer or winter work. I used also a mixture of guttapercha instead of ebonite for batteries.—LEAR.

[58270.] — **Volumetric Analysis.** — As ehling's solution is very unstable, the following modification is preferable. Solution I. Dissolve 34·639 grames of $CuSO_4 \cdot 5H_2O$ in distilled water, and make up to 500 cb.c. Solution II. Dissolve 173 grammes of $C_4H_4KNaO_6 . 4H_2O$ (Rochelle salt) in 100cc. of soda ley (strength 400 grammes of NaOH in 1 litre), and make up to 500cc. with distilled water. These solutions are kept separately and mixed in equal volumes when a test is made.

5 cb.c. of No. 1 } mixed =
5 cb.c. of No. 2 }

10cc. equals	·05	gram.	Dextrose, lævulose, or invert sugar.
" "	·0475	"	Sucrose (after inversion).
" "	·07143	"	Lactose.
" "	·0807	"	Maltose.

The following method of use is sufficiently accurate for technical purposes, though when more accurate results are desired, it is necessary to adopt another method. Measure off 5cb.c. of each solution, mix and dilute with about an equal volume of water; boil (the liquid should on boiling show no signs of precipitation); now run into the boiling liquid from a burette the sugar solution (which should contain about 1 per cent. of the sugar to be estimated), boiling after each addition; when the blue colour disappears, filter off a few drops of the hot solution; acidify with acetic acid, and add a drop of dilute solution of K_4FeCy_6, which will strike a brownish-red colour as long as copper remains in the solution. When all the copper is precipitated by the sugar solution, read off on the burette the number of cb.c.'s used, and calculate out the result. $\frac{N}{10}$ $K_2Mn_2O_8$ decinormal potassic permanganate contains 3·16gr. of the pure salt in 1,000cb.c. of water; therefore, 1cc. contains ·00316gr. $K_2Mn_2O_8$ and 1cc. is equivalent to ·0056gr. Fe, 20cc. equal 20 × ·0056 = ·112gr. Fe, and so on. With Clarke's soap solution it is necessary to adhere to the directions given, using the table for calculating out the results. You cannot use water in place of alcohol in the preparation of the soap solution.—DEXTROSE.

[58274.]—**Regenerative Gas Fires.**—There is now in the market a gas-stove very much upon the lines suggested by "B. Sc." It is much better for the purpose of heating apartments than any of the Bunsen stoves so generally used. It is free from objectionable odour, in consequence of the perfect combustion, gives off the whole of the radiant heat of the flame, and abstracts the heat from the products of combustion, utilising this heat for raising the temperature of air that supports the combustion. The flame burns under a hood in which is ample room for combustion. The heat radiated is thrown into room by means of a reflector. The products of combustion pass through a number of iron chambers, which abstract the heat and themselves become red hot. Attached to these chambers and extending down back of stove are a number of iron gills; these become hot by conduction. The air for combustion is admitted at the bottom of stove, and in ascending to the flame is brought into contact with the gills, and thus becomes highly heated before reaching the flame. The flame, after being lighted some nine or ten minutes, becomes most brilliant, and radiates intense heat. To tone down this light a screen of ruby cone and bull's eyes is placed in front of flame.—T. G. MARSH.

[58281.]—**Burke and Holmes Cell.**—A description of a modification was given in last week's "E. M." The Burke and Holmes cell usually consists of a containing vessel with a porous pot with carbon inside, and a zinc plate each side of the porous pot. The solution is the same as that given in the "Nitrate of Soda Battery." Five cells ought to light well an 8-volt 5-c.p. lamp for a long time, but the duration depends on the quantity of solution, &c. It does fume, the same as an ordinary Bunsen, though perhaps not quite so bad, hence the lid.—P. C. Hornsey.

[58283.] — **Carriage Wheels.** — If the fore wheels were of the same size as the hind, of what pattern would the body be which would allow the fore part to take the front wheel under it as is usual in the act of turning the coach.—A., Liverpool.

[58289.]—**Re-silvering Lamp Reflectors.**—As the querist may find it difficult to procure cyanide of potassium, let him try the following: Powder one part nitrate of silver, one part common salt, and eight parts of cream of tartar; mix, and make into a paste with water when required. Having thoroughly cleaned the surface of the reflector, rub the paste on with a piece of clean cork, and when all parts are well covered with the silver film, wash in distilled water and dry in sawdust. Bring up the polish with jewellers' chalk or rouge, applied with a soft brush. This film will not last very long, but it is easily and cheaply renewed.—NUN. DOR.

[58297.]—**Guttapercha Boots.**—As this query reads, the boots are made of guttapercha, and there should consequently be no difficulty in repairing them, as it is only necessary to warm the two surfaces up nearly to melting point, and press together. I suppose, however, the question really refers to sticking guttapercha soles on leather boots. The only way is to thoroughly clean the surface of the leather sole, and the best way to do that is to rasp all dirt off and bring up a fresh surface of leather. Dress that well with solution of guttapercha in bisulphide of carbon, and allow it to dry. Then warm both surfaces thoroughly, and press together in such a way as to exclude air. Trim off, when quite cold, and put a few nails along the edge of the sole at the waist of the boot. —S. R.

[58303.]—**Forge.**—You can scarcely erect one cheaper than an ordinary circular portable one. Mine, when new, 18in. diameter, cost, say, 50s., and doubtless could be had much cheaper as second-hand. All that you would then require would be a sheet-iron hood into chimney. If you have an ordinary bellows (and a fan, unless driven by power, is an infernal humbug), you will have to build a hearth outside of your fireplace, or you will be sadly restricted as to length and dimensions of the job in hand. I opine that I could easily weld, say, 2in. square iron with my fire.—A., Liverpool.

[58305.]—**Organ Blowing.**—The querist cannot do better than purchase a small gas-engine, which would undoubtedly be far superior to the clumsy arrangement he refers to. Gas-engines are not very expensive nowadays.—G. FRYER.

[58307.]—**Frosting Glass.**—Why not wash over the surface of the glass with hydrofluoric acid, which may be obtained in guttapercha bottles from any of the London chemists, rinsing off the excess of acid with plenty of water? Wear a pair of india-rubber gloves when using the acid, and be very careful that it does not touch the skin, as it is exceedingly corrosive.—DEXTROSE.

[58309.]—**Slide Valve.**—Yes, you can relieve pressure on valve by partly "balancing" it. There are a great many ways of doing this; but the general is to have a short cylinder on back of valve, with a ring inside pressed against the cover of chest, which is planed for this purpose. The ring must be a good fit, but movable, and pressed out by springs. A small pipe is fixed to valve-chest cover to carry off any slight leakage that gets inside the ring. You will understand the valve is relieved to the extent of the internal area of ring pressure. In many cases the arrangement is fixed to cover, and back of valve planed.—T. C., Bristol.

[58311.]—**Electrical.**—The Leclanché cells are not very suitable for this purpose. The bichromate solution attacks iron violently.—S. BOTTONE.

[58311.]—**Electrical Lamplighter.**—A short piece of fine platinum wire will light a benzoline lamp, but do not use Leclanché cells. The best is a small bichromate, with the zinc mounted on a spring, so as to be pressed into the liquid and then withdrawn by the spring as soon as the effect is obtained. Iron would be acted on by the solution.—SIGMA.

[58312.]—**Electro-Motor.**—Wind the armature with about ½lb. of No. 18 cotton-covered copper wire, and the fields with about 3lb. No. 16. This motor, worked by six quart bichromates, should drive a sewing-machine easily.—S. BOTTONE.

[58313.]—**Fan.**—"B. L." will not get any fan to give an air pressure of 5lb. square inch. He will get a Root's or Baker blower to give a pressure of about 3lb. square inch maximum; but for a pressure of 5lb. I think he will find nothing available except a blowing cylinder. It may perhaps be simpler to use two Root's or Baker blowers in succession on the same air-pipe, the second one taking the high-pressure air from the first and delivering it at a still higher pressure, as is commonly done with condensing pumps for obtaining very high pressures.—998.

[58315.]—**Electric Bells in Series.**—As at present arranged, one is a vibrator, and the other two single-stroke, so that if the first one is "cut out," the others will only strike once, unless the push is worked continually. By far the best way out of the difficulty is to put a relay and local cell to each bell, making them all vibrators. For instance, if you are using 5 cells now, use two for working the line, and one for each of the bells. They could be connected in "multiple arc"; but I find, from years' experience it is most unsatisfactory. Truly, they ring, but not one-hundredth part so loud as when connected singly to a cell. I have tried one vibrator, and the rest single stroke. Also the "shunt" system adopted for the call bells used by the telephone companies; but nothing, after all, equals the relay. The "multiple arc" arrangement I think would be all right if the armature did not have to be set so close to the magnet cores—that is, the hammer of the bell has so very little stroke. I do not quite understand how you stop the 2nd or 3rd bell ringing. Perhaps you would say how this is effected.—G. J. J.

[58316.]—**Dynamo.**—TO MR. BOTTONE.—The amount of wire is correct. The reason that you do not obtain much current when driving the motor is because the interruptions which take place in the current twice at each revolution of the motor, prevent the field magnets from getting fairly magnetised. A shunt of about 1ft. of No. 30 iron wire connecting the free brush to the free terminal, the current being taken off the brushes to work the motor, would remedy this. This dynamo ought to light six 10's in parallel, connected from free brush to free terminal.—S. BOTTONE.

[58320.]—**Cube Inches in Sphere.**—Cube the diameter, and divide by $\frac{\pi}{6} = 0{\cdot}5236$. Thus, 12½ cubed 1953⅛ multiply × ·5236 = 1022·65 cube inches. —T. C., Bristol.

[58320.]—**Cubic Inches in Sphere.**—Solidity of sphere is found by following formula:—$\frac{\pi}{6} d^3$, or $0{\cdot}5236\ d^3$. In this case $d = 12\frac{1}{2}$; $d^3 = 12\frac{1}{2} \times 12\frac{1}{2} \times 12\frac{1}{2} = 1953\frac{1}{8}$ cub. in., which, multiplied by 0·5236, gives gross 971 cub. in. If you want contents of spherical vessel, you must of course take inside diameter in the formula; in this case it will be 12½ less twice the thickness of the shell.—BELGIAN.

[58323.]—**Bookcase.**—The druggist will no doubt supply you with what you want, and tell you how to use it.—BELGIAN.

[58325.]—**Storage Battery.**—In such a case, where space and weight are apparently of little moment, it would be foolish to attempt to make one of those complicated affairs, the only justification for which is the expectation of getting much work out of small size and weight. (N.B.—I say the expectation; the proof we have yet to expect.) The only really trustworthy thing is the old Planté, which any one can make. All that is necessary is sheets of lead hung in sulphuric acid and water: to work 20 volt lamps you will want 12 cells in series. Their size is a mere matter of convenience and cost; it would be good economy to make them large now, because lead is very cheap. They simply require "forming" by repeated reversing at increasing intervals until they work well, and then working them regularly in one direction. They will work for years and go on improving; 3lb. lead will be best, now it is so cheap, but 2lb., or even less, will serve. Don't bother with any mess of red lead, which promises much at first, only to disappoint and annoy.—SIGMA.

[58326.]—**Party-Walls.**—If "A.'s" premises are in London, Westminster, or the limits of the Bills of Mortality, he will probably find what he wants in the Party-Wall Act, 14 Geo. III. cap. 78.—B.Sc., Plymouth.

[58327.]—**Painting Magic-Lantern Slides.**—"S." can easily be referred to "some course of information," in the articles by "Sable," published in Vol. XII., I think, and reprinted in handy form by Mr. Hughes, now of Mortimer-road, Kingsland, N. Perhaps the querist will find sufficient in No. 946, p. 226.—T. J.

[58327.]—**Painting Magic-Lantern Slides.**—Groom's "Transparent Painting on Glass," price 1s., would be of use. Specially prepared colours are quite unnecessary. Ordinary 4d. tubes are good; but transparent or semi-transparent colours must be selected. Ivory black, carmine, crimson lake, prussian blue, indigo, madder brown, burnt and raw sienna, vandyke brown, verdigris, and gamboge, are all suitable. Roberson's medium or megilp is used for thinning; but of this do as little as possible, as the colours are apt to run. Use a very small sable brush for outline, and camel-hair for masses. Clean the glass thoroughly, and don't touch with the fingers.—B.Sc., Plymouth.

[58327.]—**Painting Magic-Lantern Slides.**—Paint the lantern slides with ordinary water-colours, and when dry give them a coat of Canada balsam, and cover with another glass, as if they were intended for the microscope; or mix your colours with turpentine instead of water, but be careful they do not get too crumbly. The transparent colours are sienna, asphaltum, dragon's blood, carmine, rose pink, chemical brown, all the lakes, gamboge, and all the greens. The semi-transparent colours are umber, Vandyke brown, chrome red, emerald green, Brunswick green, ultramarine, indigo, and verdigris. You can order a book on "Magic-Lantern Slide Painting" at any bookseller's for a shilling.—P. H. S.

[58327.]—**Painting Magic-Lantern Slides.**—Special colours are used for painting slides, and all the colours and other requisites, along with a book on the subject, can be had from any artist's colourman; but it would be a hopeless task and a waste of time for "S." to try and paint slides unless he has considerable artistic ability as well as experience in painting both in oil and water colours. Another thing: no information contained in books, or printed directions, are of any use in this art. Practical information by an experienced hand is
absolutely necessary, the mechanical
being so great in working the colours so
the true shading and clearness so ne
steady, good slide.—DENS.

[58328.]—**Electric Light.**—A sma
capable of lighting five 10-candle lamp
this work well with your engine.—S. Bo

[58328.]—**Electric Lamp.**—A
engine, provided it works steadily, is
100-c.p. light. A small dynamo of th
power would be necessary. Ten gas-b
slightly in excess of 100-candle-light;
candescent lamps of 10-c.p. each co
arranged as to give light where it
required.—BOBADIL.

[58328.]—**Otto Gas Engine for
Light.**—Procure a small dynamo to
20-c.p. lamps. Use an efficient form
and lamps, or your engine will have mo
can manage. Be sure and have a f
dynamo, or there will be an unpleasant p
the lights at every explosion which occ
engine, every other revolution.—JOHN H
JUN.

[58330.]—**Sawing Metal.**—Treat th
turning tool, and lubricate for the same
you would if turning.—T. C., Bristol.

[58330.]—**Testing for Metals.**—Th
and best method of testing metals and a
sublimation with the blowpipe, alumi
and carbon slip. If "J. B." will obtain
named articles and practise with the bl
may soon learn to distinguish the metal
in the alloys by their sublimates on
aluminium plate. Not only qualitative
a close approximation to quantity may b
by the exercise of a little ingenuity an
ance. I think "J. B." will find full i
how to obtain sublimates before the b
back numbers; if not, write again.
the many queries asking for infor
coils and condensers for same, it may int
readers to know a simple way of testing
of "tinfoil." Some time since I purch
respectable firm a quantity of "tinfo
condenser of intensity coil. A few
wards, while experimenting with the
tried a fragment of the foil on carbon
plate, when, to my surprise, I immed
copious sublimate of litharge and red
plate, and very little white efflorescen
assay. This indicated that the foil whi
sold to me for *tin* contained a large
lead; and I have no doubt that ther
siderable quantity now in the market
for *tinfoil* which is nothing else than
out between two coverings of tin; thus
are deceived and robbed. If I have
purchase tinfoil again, I shall take m
apparatus in my pocket. Could not pe
this for tinfoil be proceeded against
The above episode will illustrate to th
"Ours" how useful is a knowledge of
analysis," even in every-day life.—B. C

[58331.]—**Tempering Milling**
Hope you have not square corners to k
not too sharp a bottom of teeth.
cherry red when hardening, and don't
of water till quite cold. You must
rest. They will fly sometimes.—T. C.,

[58332.]—**Double Cone Pulleys.**—
you have a screw-cutting lathe. If
screw from surfacing slide and bolt a st
of flat iron to bed of lathe, and let it ru
facing slide between two guide-pins f
Set bar to angle required, throw leadi
gear, and there you are. Set the tool f
with tap of the hammer, unless you
complication.—T. C., Bristol.

[58333.]—**Soapsuds in Turning.**—
rust the work if you use soft-soap, or co
—T. C., Bristol.

[58336.]—**Screw-cutting.**—If anyth
thread, you will find it cut much swee
move the top slide a little so as to let
one side at a time until last cut.—T. C.,

[58336.]—**Screw-cutting.**—If "Belg
328, refers to cutting V-threads in slide
a comb of several teeth, it ought to be
level of the centres, parallel to the wo
to be shifted sideways at all; but it is
to attempt to bring up the full thread i
as the tool will surely bite at the finish;
when approaching this stage, you shoul
hand with an ordinary chaser.—A., Liv

[58337.]—**Keyways.**—You could cut
a hammer and chisel while you were fi
unless you had a lot to do. Drills for
flat-ended or concave, and you might
slide-rest and drill in lathe. Make dri
stiff, with a cutting edge at
Bristol.

[58338.]—**Surface**
advise 100 super. feet.

enser? Won't cost so much. Diameter of p, 10in. If single-acting brake, horse-power not bear a fixed proportion to load on engine, rises with the load, as friction of engine only itly increases with load.—T. C., Bristol.

8339.]—**Legal.**—To make a deed of gift of kind valid, complete possession must be given ie time of executing the deed. A stamp of 10s. quired. For the wording of the deed consult licitor, as the real estate will have to be debed, and the personal inventoried. — B.Sc., mouth.

8341.] — **Archereau's Arc Lamp.** — It is e possible to run this lamp with 20 Bunsen , which will give a good light for three or four rs. If you can afford 30 cells, the effect would nuch better. A good light requires both quan- and E.M.F. The greater the E.M.F. the ger will be the spark, and the greater the quan- the broader the arc. Carbon rods ¼in. diam. be large enough. Substitute sulphuric acid salt solution in outer cell. With bichromate orous and sulphuric acid in outer cell, the e of the battery is very little diminished and es are avoided.—BOBADIL.

58344.]—**The Richardson Arc Lamp.**—To . BOTTONE.—I do not know this lamp.—S. TTONE.

58350.]—**Electric Lighting.**—The resistance he lamp being $\frac{100}{1\cdot5} = 66\cdot6$ ohms, the resist- to be used in series, in order to obtain the e current with 110 volts, will be 6·6 ohms. Use ed iron wire coils of No. 20 B.W.G. About will be required.—W. HITCHCOCK.

8350.]—**Electric Lighting.**—You cannot ce the E.M.F. of a machine by introducing tance. This can only be done by decreasing d or wrapping armature with thicker wire. some 110-volt lamps.—JOHN H. HINDLE,

8350.]—**Electric Lighting.**—I do not under- d this query. Have the lamps a resistance of ohms each? How many do you want to use? t is the resistance of the dynamo itself? If want to use only one lamp of 100 ohms resist- on a dynamo having an E.M.F. of 110 volts, you say that the lamp requires 1·5 ampère, you will not be able to light it properly, and insertion of resistances will only make matters e.—S. BOTTONE.

8354.]—**Steam Cock.**—You can only grind it hen it leaks. Do not use emery, but I can mmend a piece of hard coke smashed fine and with water. Ease the plug with file if a lder is formed. I like the asbestos packed s.—T. C., Bristol.

8357.] — **Vine Pruning.** — I recommend rtus" to get a very handy shilling manual on -growing by Pearson, of Nottingham, which s all necessary information about pruning s, having worked by its direction for 13 years. e wants a more expensive book get Thompson's ne Culture." I always stop my fruit-bearing aches at the fourth leaf from the bunch by hing off point with the finger-nails, otherwise vine will run to wood instead of bearing fruit. . A.

8361.]—**Lathe.**—You can certainly run a ular saw on centres, dead or otherwise. When n, turn them up afresh. I don't believe in run- g circular saws on centres, unless for short porary jobs. Saw spindles ought to be mounted good long bearings, as the speed is great, and tion on points causes great heat very soon.— LGIAN.

58362.]—**Steam-Pressure Gauge.**—How small ou want to make it? I made one recently 1in. meter to indicate to 20lb. It consists of a small on ¼in. diameter, and the rod from it working inst the end of an L lever; the lower end of long is an arc (toothed) and works on a pinion. A table piece of watchspring presses against the , and steam, or rather water, in the siphon sses against a thin indiarubber diaphragm.— C., Bristol.

58363.]—**Recovering Oil.**—This might be e with carbon bisulphide.—S. BOTTONE.

58364.]—**Firebrick Fireplaces.**—Fill up the uired space with broken firebricks, using as a ent a thick mortar made of dry fireclay and p-boilers' solution of silicate of soda. This ent dries as hard as firebrick, and stands the quite as well.—998.

58364.] — **Firebrick Fireplaces.** — "Save d" should get some fireclay, mix it with a e water till it is of proper consistency to work. ld it to the pattern he requires, and dry slowly a few days before it is put into the grate. But not chip a couple of ready-made fire-bricks to I have done this, and found ments.—H. A.

[58364.]—**Firebrick Fireplaces.**—I believe you can do what you want with fireclay made into a paste with soluble glass (silicate of soda). I reduced my grate in the following way, and find it answer admirably: I bought two fire-tiles, 2in. thick and about 9in. square, and had them chipped to fit the ends of the grate (they are very hard). I then made a paper pattern of the shape of the bottom of grate, and had it cut out in sheet iron. This I place over the grating at bottom of grate, put the tiles in position, fill the grate full with lumps of coal, put paper, wood, and cinders on top of coal, light, and let burn downwards. Fire keeps in for hours without being touched, and must have saved cost of alteration many times. Fire-tiles 6d. each, chipping 10d., sheet iron 6d., total 2s. 4d. Sheet iron burns itself quite clean if reversed every day.—D. G.

[58367.]—**Heating Passage.** — I successfully heat a very cold passage and keep frost from greenhouse plants with a lux-calor gas stove. This kind of stove requires no flue, and is equally adapted for burning kerosene or any mineral oil.—HAYLING ISLAND.

[58369.]—**Ammonium Bichromate.**—Sesquioxide of chromium is left. This is called "magic tee."—S. BOTTONE.

[58372.]—**Wimshurst's Influence Machine.** —"G. H. R. V." should fasten the glasses to the bosses with a little of the Rockhill tricycle cement, and if they are larger than 12in. diameter a small plate of vulcanised fibre should be screwed on in addition. Let the glasses run as close together as possible. The bottoms of the two Leyden jars are connected together, and the bottom of the second two jars are similarly connected. These connections are then united by means of a short length of wire which can readily be detached if desired. —J. W.

[58376.] — **Electricity for Amateurs.** — To MR. BOTTONE.—Take sulphuric acid sp. gr. 1·845, 12oz.; nitric acid, sp. gr. 1·45, 4oz.; paper, ½oz. I do not know the name of the tool. I had it made for me.—S. BOTTONE.

[58377.] — **Grinding - in Safety - Valves.** — Pumice powder answers well for quick grinding of brass articles, and I finish same with dust scraped from a piece of "dry" setstone.—A., Liverpool.

[58377.]—**Safety-Valves.**—Grind them in with grindstone dust or cokedust and water. Give them a twist and a lift continually, and keep grit off the wings.—T. C., Bristol.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

57768.	Organ-Accordion, p. 150.
57770.	Engine, 150.
57775.	The Telephone and the Ear, 150.
57786.	Something Worth Knowing, 151.
57797.	Cane Sugar, 151.
57798.	Crystallisation (Practical), 151.
57804.	Watch Movement, 151.
57821.	Storage Battery, 151.

57993.	Telescopic, p. 229.
58021.	Geometry, 229.
58030.	Albatross Head, 230.

A SERIES of Arctic relics of strange interest has been brought home by Captain Fairweather, of the whaler *Terra Nova*, of Dundee, and transmitted to the Admiralty by Mr. Leigh Smith. These relics consist of various documents in a cylindrical tin case, which had been deposited by several of the Franklin Search Expeditions thirty years ago, and a statement left by Sir Allen Young when at Beechey Island in 1875. Captain Fairweather states that he picked up the documents in Prince Regent's Inlet. He is of opinion that the natives have cleared out Beechey Island depot of everything that would be of service to man in those regions.

THE Mexican Government are about to establish a meteorological station among their highest mountains at an elevation of nearly 20,000ft. above the sea level. Access to such a place must be always precarious and frequently impossible for a long time together. Hence it is necessary to make exceptional provisional for rendering the instruments almost independent of human attention and supervision. The necessary apparatus is being constructed, and, as far as possible, all the instruments are being made to go for a year without stopping.

QUERIES.

[58380.]—**Koumiss.**—Can any of "ours" kindly give me simple instruction for making koumiss in small quantities for home use? I understand it is a very health-giving and medicinal beverage, and should like to know what it is good for and the method of using it?—J. H. M.

[58381.]—**Legal.**—Will Mr. Wetherfield give me the following information? A man marries a woman. Before he marries, the woman makes a settlement on herself and her daughter, and heirs, if any. The woman and the daughter die without any issue; but the woman has brothers and sisters. What position would the husband stand in with regard to the property? The woman picks for her trustee one of the clerks out of the office of the lawyer that got out the settlement deed. Since then the business has been taken out of this lawyer's hands. He refuses to give up the settlement deed, as he says the said trustee wishes him to hold it. Can he be made to give it up? The daughter is 22 years of age. Could she, with her mother, do away with the settlement deed if they thought fit? The daughter is unmarried. Would that settlement affect the property being sold if the mother, with the daughter's consent, wished to sell it? If a man makes a will, is he compelled to leave his wife anything? Can she make any claim on his own personal estate if he leaves it to his own relatives?—QUITE IN A FOG.

[58382.]—**Brewing License.**—Will some of "Ours" kindly answer the following? I occupy a house, which is assessed under £10 rateable value, and wish to brew beer for own use. Can the Excise charge me duty on the malt if I take a 9s. license, or shall I be compelled to get a 6s. license and pay the duty on malt? I might state that the house is my own property, and is worth, with the workshop and outbuildings, £15 a year.—J. F. W.

[58383.]—**Brass Boiler.** — Can any reader kindly inform me how to braze a small brass boiler, 8in. by 4in., the brass being 1-16in. thick?—G. H.

[58384.] – **Magneto Machine.**—To MR. BOTTONE.—Many thanks to Mr. Bottone for answering my query, 58165; but as I have not "Ganot's Physics," nor near a good library, I cannot get the information, and would like him to say what kind of commutator I ought to use? There was a slight error in my query, it should have been 28 instead of 24 wire. Any hints as to improvements would be gladly received by—W. H. M.

[58385.]—**Polishing Hard-wood Bobbins.** — I have some hard-wood bobbins to polish. Can any of our readers tell me what to use to give them a smooth face? I shall want to do them quickly in the lathe; they are but common things.—A. B. C.

[58386.]—**Air-Gun Valves.**—How are the valves of air-guns constructed?—AMATEUR.

[58387.]—**Magic Lantern.** — I have two portrait lenses—one a quarter-plate of 4¼in. focus, the other a half-plate of 6½in. focus. Which would be best to use in constructing a lantern to give a 15ft. disc, and how far from the lens should the lantern slide be, and how far the 4in. condenser from the slide?—MAGIC.

[58388.]—**Big Drum.**—Would any of the readers of "E. M." kindly tell me how to repair drum pellet? There has been a hole 3in. long made in one of the pellets, and would like to know if cement would do, or what would be the best way to repair it?—MUSIC.

[58389.]—**Spectroscope.**—Will "F.R.A.S.," or some other correspondent, kindly say if the "amateur's spectroscope," described in Vol. XX. of the ENGLISH MECHANIC, is of sufficient power to show lines in the spectra of bright stars? If so, what is the smallest telescopic aperture that can be used for this purpose?—ALCHEMIST.

[58390.]—**Silver Solution.**—Some time ago I made some silver-plating solution, and put it in a pine-box lined out with pitch. It worked all right till the pitch got dissolved with the silver solution. How am I to remedy it?—AMATEUR PLATER.

[58391.]—**Arc Lamp.** — Will some of your correspondents give sketch of 500-candle arc lamp, with details? Will No. 57956, on p. 304, Dec. 11, work satisfactorily? If so, what size for 500 candle-power?—LIGHT.

[58392.]—**Tires.**—Would some kind reader tell me the easiest method of bevelling large tire? We bevel them now with the striking hammer, which is great trouble and likewise hard work.—VILLAGE BLACKSMITH.

[58393.]—**Lead Wire Spirals.** — Can any fellow reader inform me the quickest method to wind lead wire in a spiral form as close as possible, not more than 1-16in. bore up the centre? Average thickness of wire 18 B.W.G. I want to make it in 10ft. or 12ft. lengths, and very speedily.—J. H. B.

[58394.]—**Casting.**—To "SAND RAT."—I shall be glad if you will kindly explain your mode of venting a steam-jacketed cylinder, the cylinder to be bushed? Do you consider bushing first-class work?—CILINDRO.

[58395.]—**Chemical.** — Will some of our friendly chemists kindly inform me where I am to get a correct table of the atomic weights? I have compared five different tables, but can get little satisfaction from them—for instance, in "Bayley's Chemist's Pocket-book" the atomic weight of antimony is 122·0, and in "Jones's Practical Chemistry" it is given as 120·0.—R. MELDRUM.

[58396.]—**Legal.**—A cottager becomes a tenant under an agreement to give a quarter's notice or pay a quarter's rent. Such notice not having been given, can the said tenant go out and take away all his goods at the end of any one quarter, paying rent up to that date only? The landlord proposes to lay hands on the furniture as the only possible security for the forfeited quarter's rent. It is pleaded that he can take no such steps until the end of the quarter, by which time it is plain that he will have to console himself by taking possession of the empty cottage, deteriorated by three months' emptiness in the dead of winter.—O. J. L.

[58397.]—**Light.**—In a recent examination, the following question was asked: The sun has risen 30 degrees above the horizon, and you see its image on a pool. What is the angle of reflection and incidence? Give a sketch. If one of "ours" would kindly answer this for me, I would feel much obliged.—OPTICIAN.

[58398.]—**Legal.**—Will Mr. Wetherfield kindly answer? My father died some time ago, leaving property, and a little money, for the benefit of my mother whilst she lived, after her death to be equally divided between his two only children—myself and my older unmarried sister. Mother died two months ago, and my sister has also died since, leaving no will. Can I claim her share as well as my own?—ENQUIRER.

[58399.]—**Preservation of Fruit.**—We made an attempt at preserving grapes, by packing them closely in tins in a solution of sugar, boracic acid, and salicylic acid severally, soldering on the lids, leaving only a small hole open: then placing them in a water bath, and as soon as the water in the bath boils the small hole is also soldered. On examination of the contents of the tins after three months, they were all bad. Can any kind reader give us any enlightenment upon this subject? We have lots of fruit, and could do a profitable trade if we could only succeed in preserving them.—CAPE COLONY.

[58400.]—**Distillation of Volatile Oils.**—Can any reader of the "E. M." give a description of the distillation of volatile oil from leaves—e g., oil of eucalyptus?—CAPE COLONY.

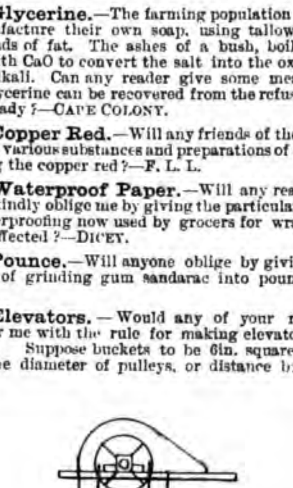
[58401.]—**Glycerine.**—The farming population in this colony manufacture their own soap, using tallow, lard, and other kinds of fat. The ashes of a bush, boiled for some time with CaO to convert the salt into the oxide, is used as the alkali. Can any reader give some means by which the glycerine can be recovered from the refuse after the soap is ready?—CAPE COLONY.

[58402.]—**Copper Red.**—Will any friends of the blowpipe give the various substances and preparations of copper for producing the copper red?—F. L. L.

[58403.]—**Waterproof Paper.**—Will any reader of the "E. M." kindly oblige me by giving the particulars as to how the waterproofing now used by grocers for wrapping butter in is effected?—DICEY.

[58404.]—**Pounce.**—Will anyone oblige by giving the best method of grinding gum sandarac into pounce?—DICEY.

[58405.]—**Elevators.**—Would any of your readers kindly favour me with the rule for making elevators for lifting grain. Suppose buckets to be 6in. square, what should be the diameter of pulleys, or distance between legs? Should buckets be square, and what distance should be from centre to centre of bucket when on belt? What should be the angle of cord marked X in Fig.?—YOUNG MILLWRIGHT.



[58406.]—**Transmitter.**—Will any electrical friend instruct me how to make a transmitter for Bell's telephone receivers? I cannot find one described in last fifteen months' "E. M."—MECHANIC.

[58407.]—**To Mr. Bottone.**—I am making a 12-cell Bunsen battery with flat cells; carbons, 5½in. by 3in. by ¼in.; bent zinc, 12in. by 3½in. How many c.-p. lamps may I expect to light with it, and how long will it keep in action? Also, I have a small hand dynamo; it will make a 5 c.-p. lamp red, also a 10 c.-p. the same; but cannot get any light from it. The size of armature is 2¼in. by 1⅞in. Will you please say how I can remedy?—W. S.

[58408.]—**Dead Black for Metal.**—I have tried the recipe for obtaining a matt or dead black—viz., by applying a mixture of the solutions of nitrate of silver and nitrate of copper to the metal (which has been thoroughly cleansed), and then heating evenly before a fire; but have been unable to obtain the desired result. Perhaps one of "ours" may know something else that is requisite in the manipulation, or another recipe for the same purpose. As this is a matter of interest to photographic amateurs, any information will, I am sure, be welcomed.—D. C.

[58409.]—**Bunsen Burner Lighted Automatically.**—Wishing to have this done by electricity (circuit closed by hand of clock), I would ask some of our practical electricians kindly to supply the following particulars: (1) which would answer better—heated platinum wire or induction spark? (2) If the latter, what would be the dimensions (length and size of wire, &c.) of the smallest coil capable of supplying such spark? (3) How prevent light travelling down at once to interior jet, which it generally does if first rush of gas be lighted? (4) Would current from four quart Leclanché cells already employed for the house bells be sufficient for all? A sketch of best arrangement would oblige—MARK MANSFIELD.

[58410.]—**Heating Large Room.**—I have a room 48ft. by 18ft., with three large windows and one fireplace, which is not sufficient to keep up the necessary temperature in winter? Would a small hot-water apparatus, heated by gas, be feasible, and, if so, how best utilise the present fireplace to carry off products of combustion? A sketch, with dimensions of boiler, pipes, &c., would greatly oblige—M. M.

[58411.]—**Flageolet.**—Will some kind reader tell me the cause of the instrument squeaking, or giving an incorrect sound at times, and, after a time, returning to its right tone? I fancy that the water collects in the mouthpiece and flows into the small aperature. I think there may be other causes that I don't know.—WHISTLE.

[58412.]—**Regulator for Incubator.**—Will some kind reader sketch a regulator for incubator? I have seen Hearson's, but am at a loss to know what liquid is used by him. I want it to raise small lids to allow air to get at the eggs when the heat rises to 110 degrees. I am informed that two metals can be obtained, one of which will expand in heat and the other will contract, or shorten, in the same amount of heat. If such is the case, and if two metals of such nature can be procured, I can get out of the difficulty, if they will extend and shorten to the extent of about ⅛in. in 15in. length. I can regulate my lever so that 2 drachms will raise the lids.—ONE IN A FIX.

[58413.]—**Bricks.**—Having seen the answer to the burning of bricks (58204), I beg to ask the correspondent if he can give me the information that I require, with respect to the burning of shale bricks? It is rather black in colour. Also what kind of kiln required and the cheapest way of burning them?—J. INGHAM.

[58414.]—**Emery Wheels.**—Is it physically possible for a silicate emery wheel to expand after it has been put upon the spindle?—A. F. B.

[58415.]—**Lubricant.**—To "S. R."—I thank him for having kindly answered my query (57853), and beg him to explain the manner in which the lard is to be washed.—E. P. G.

[58416.]—**Vaseline.**—I should feel obliged by any of your correspondents giving the properties and characteristics of vaseline. I have two specimens that are similar in external appearance; but, on testing their optical densities, a great difference crops up. The refractive index of one was 1·515, while that of the other was only 1·487. Can these both be true vaselines? and, if one only is pure, which?—ABACUS.

[58417.]—**Tarpaulin.**—Can any correspondent inform me how to dress tarpaulins so as not to crack and may be soft to stand the weather, as I am in a fix with them, as they get hard and stiff?—M.

[58418.]—**Sugar in Beer Worts.**—What is the utmost amount of sugar in beer worts from malt shown by Fehling's test? According to the Somerset House authorities it is never more than 52 per cent.; but in a case recently tried at Stourbridge, a practical brewer and the county analyst said: the former that he had known it as high as 58, the latter that copper reducing power could not be relied upon as a test for added sugar.—HORDEUM SICCUS.

[58419.]—**Rust in Pipes.**—Will P. J. Davies, or other reader, kindly tell me how to prevent iron circulating pipe (to bath boiler) from rusting? I use rain water, but the water is always discoloured after been heated.—PLUMBER.

[58420.]—**Leclanche Battery.**—Would Mr. William Wright, or any other reader, kindly give me some information respecting the construction of Swan's modified Leclanche batteries, as mentioned in last week's issue?—AMATEUR ELECTRICIAN.

[58421.]—**Violin.**—I have a violin with a leopard's head in place of the scroll. It bears a small ticket (Fredk. Foster, maker, London, 1820). The back is excellently varnished, and the front and sides well finished. It is not new, but appears to be of the age shown by the ticket. The neck is channelled for about ½in. where it joins the finger board, so that you can pass a wire right along to the nut underneath the fingerboard. Is it likely to be genuine? The tone is excellent.—J. L.

[58422.]—**Cassegrain and Gregorian Telescopes.**—Will some correspondent be kind enough to tell me how to make the small mirrors for these telescopes? I have all the back numbers, but cannot find what I want. Are they worked a number at a time as small lenses, and figured afterwards? Do the best makers still mount them on an arm? Is there any other way of boring the hole in the big mirror than with a revolving tube, and, if the hole is cut before working, does it hinder the polishing at all? Is the eyepiece furnished with rackwork?—J. L.

[58423.]—**Square Threads.**—Would any kind reader give rules for shaping tools for square thread screw-cutting and hints for the process in general? I want to make taps for screwing bronze nuts for my slide rest. Which proportions ought to be observed for the taps, length, diam., shape and size of grooves, &c.?—BELGIAN.

[58424.]—**Milling-cutter's Arbors.**—How should the rings be made which are placed both sides of cutters in order to keep these in the proper place on the arbors? Are they forged, or would pieces of tubing, with proper inside bore, do?—BELGIAN.

[58425.]—**Slide-rest Angular Adjustment.**—I wish to divide circular base plate of longitudinal slide into degrees. How should I proceed in order to do the thing accurately, and how should I mark the divisions to make them clear and sharp?—BELGIAN.

[58426.]—**Westcott Chuck Fitting.**—I have a 6in. four-jaw Westcott chuck, fitted on a face-plate, but wish to screw it direct on lathe nose, in order to have more rigidity. How should I chuck it reversed for the purpose of boring and screw-cutting hole at back quite true and firm?—BELGIAN.

[58427.]—**Twist Drills.**—Can these be used in a ratchet brace without fear of breaking them, or should old fashioned drills be used in preference?—BELGIAN.

[58428.]—**Laurent's Polarimeter.**—What is the new optical modification which has been applied to Laurent's polarimeter by Mr. Thomas Bayley? A description and sketch would much oblige—DEXTROSE.

[58429.]—**Petroleum Spirit.**—What is petroleum spirit, now used as a solvent for fats and essential oils in plant analysis? Where is it obtainable, and about what is its price?—DEXTROSE.

[58430.]—**Micro. Mounting.**—Having stained some pathological specimens with Hoffman's violet and mounted them in glycerine jelly, I find after a time the dye diffuses into the glycerine. Is there any method of preventing this?—DEXTROSE.

[58431.]—**Molasses.**—What is the process for separating raffinose from molasses? Is it true that this body occurs in quantity in the molasses from sugars prepared by the strontia process?—DEXTROSE.

[58432.]—**Canvas Canoe.**—I made one last summer from directions obtained from a book. Length, 12ft.; breadth, 2ft. 6in.; depth, 1ft.; made of strips of r[illegible] covered with heavy canvas. When finished I added a [illegible] deep false keel. She weighs about 1cwt. I find she is very cranky and tiresome to paddle in. The slightest movement causes her to roll greatly. Could any reader suggest a remedy?—C. J. BROWN.

[58433.]—**Analysis of Perspiration (Sweat).**—Of what is the above composed?—JASON.

[58434.]—**Glaze on Plaster Casts.**—What is mixed with the plaster to give the above?—JASON.

[58435.]—**Waste Amalgam.**—Amongst other materials for filling teeth, I use amalgam, and as there is frequently a little left over after each operation, I have in course of time, accumulated about eight ounces of waste, which, roughly stated, is composed of silver, tin, and mercury, with, perhaps, a trace of gold, platinum, or copper. Will any of our readers kindly tell me how I can recover the precious metal, more particularly the silver, which will, at least, constitute fully one-third of the bulk?—DENTIST.

[58436.]—**Ten Acres.**—Suppose I have a field containing ten acres, in a complete circle. I want to let one acre for a horse to graze on, tied by a rope, that rope to be tied up to the edge of the circle. I want to know what length the rope will be? Please answer it in plain figures, showing how the same should be worked as simple as possible.—A. Z.

[58437.]—**Resistance.**—To MR. EAVES.—Would you kindly inform me whether you have ever tested the resistance of a dynamo armature while running with a bridge and coils? I cannot do so, nor any other electrician of my acquaintance.—P. C., Hornsey.

[58438.]—**To W. H. Eaves.**—Will you kindly send sketch of board containing resistance wire and studs? I don't quite understand their positions, and how much No. 30 wire should I employ? Thin copper wire or iron wire should I use for trial in place of lamps?—ELECTRA.

[58439.]—**To J. H. Hindle, Jun.**—I hope you will send drawings and description of your lamp for factory use. I am badly in want of one, which I could do myself if I were only guided.—PARCH.

[58440.]—**G.N.R. Engines.**—Wanted, dimensions of the latest G.N.R. coupled engines, with 6½ft. wheels, [illegible] class.—G.

[58441.]—**H.-P. of Engine.**—Will any of our readers tell me the horse-power of a high-pres. engine? Size of cylinder, 16in.; length of stroke, 2½ft.; number of rev. 70 per min.; boiler pressure, from 45lb. to 60lb. By so doing will oblige, especially if they explain me the ru[illegible]—ENGINE DRIVER.

[58442.]—**Thermostatic.**—I have a greenhouse which is heated by hot-water pipes, the boiler for which is necessarily some distance away. Not being able to get about very well, I want to know if there is any plan by which I can ascertain the heat of the greenhouse without going outside in a wet and dark night, say some kind of tell-tale in the boiler house?—STOKER.

[58443.]—**Compression of Gas.**—Will any correspondent oblige with sketch and description of pump used for compressing gas to the high degree of density in which it is sold in iron bottles?—H. J. JACKSON.

[58444.]—**Surface - Condensing Marine Engines.**—Would any of your readers be kind enough to give me some information about these, as I wish to take charge of a small one? What I want to know is, What cocks or valves should be opened or shut before starting or when stopped? What is the use of the valve in the air-pump delivery overboard? Why is air-pump delivery carried overboard? How is surface-condensing engine "blown through"? What valves or cocks are sometimes or always placed on or about the condenser, and what is their use? How can I tell the proper quantity of water passing into condenser so as to regulate the sluice valve in circulating suction? Does the donkey-pump draw from both condenser and sea? The bilge pump being worked off air-pump, how is it that it can be worked constantly, as I cannot see how it can find enough water to pump? Boiler: How often should tubes be swept, and how often is it necessary to get up furnace tube to clean out combustion chambers? How much blowing-off is necessary, and how is the water regulated? What are principal things to attend to while working? Any further hints or information would be thankfully received, and I trust some correspondent will take note of these queries and answer them, as the information would be of much service to me.—YOUNG ENGINEER.

[58445.]—**Electric Light for Bicycle.**—Is there any accumulator that would supply a five candle-power Swan lamp for about an hour and a half—to light a bicycle? I intend carrying accumulator in my pocket. How is it charged?—AN AMATEUR ELECTRICIAN.

[58446.]—**Astronomical.**—How many times in succession was Aldebaran occulted by the moon during the recent series, and how often does a similar series of occultations of this star take place?—COPERNICUS.

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The English Mechanic

AND WORLD OF SCIENCE AND ART

FRIDAY, JANUARY 1, 1886.

THE PROGRESS OF ASTRONOMY IN 1885.

THE year which has just closed has, perhaps, been a rather more than usually eventful one for the astronomer; as will be seen when we come to enumerate the discoveries which have been made, the discussions which have arisen, and the theories which have been propounded during it.

The attempt to introduce a change in the astronomical day has, so far, apparently met with but scant success. The latest disputants of weight who have dealt with this question are Professor Newcomb, who deprecates the alteration, and Professor von Oppolzer, who is in favour of it. The adverse views of these eminent men will be found set forth at length on pp. 122 and 295 respectively of Vol. XLV. of the R.A.S. *Monthly Notices.*

The Annular Solar Eclipse of March 16th was successfully observed and photographed at numerous stations in the United States. The times of contacts, &c., were accurately determined, but no addition to our knowledge of the physical constitution either of the Sun or of the Moon was made on that occasion. Professor Young, employing the spectroscope, failed wholly to detect the slightest trace of a lunar atmosphere. The sole record, up to the time we write, of any observations made of the Total Solar Eclipse of Sept. 8th, reaches us from Mr. C. R. Marten, of Wellington, New Zealand, who noted an unsteadiness or quivering of the Corona, a long ray of which proceeded from the lower right quadrant of the moon, while a large equatorial protuberance was also perceptible. The red prominences seem to have been remarkable for their number, extent, and brilliance. Determinations of the solar temperature, derived by Professor Ericsson from observation and experiment, and by Hirn from theoretical considerations, place it at 1,700,404° Cent., and 2,000,000° Cent. respectively. The remarkable fore- and after-glows still persist as we write; whence it would almost seem either that we were travelling through some region of space enormously rich in meteoric matter, or that we were carrying such an envelope with us in our journey.

A circular (No. 99) issued from the Observatory of the Earl of Crawford on Nov. 21st (inviting attention to the fact that nearly two periods of Biela's missing comet had elapsed since the meteoric shower of Nov., 27, 1872) set observers on the *qui vive* on the last-mentioned night, wherever the sky was sufficiently clear. In the result, observations of the very fine meteoric display which actually occurred combined to show that, so far from the radiant of the meteors seen being a point, it formed really an elliptical area of some 10° by 6°.

In connection with meteoric astronomy, perhaps this is the place to mention that, towards the end of the year 1884, that very eminent observer in this department of Astronomical Science, Mr. W. F. Denning, of Bristol, astonished his confrères by the definite announcement that certain visibly active meteoric radiant points remained sensibly stationary for months—a statement so very startling, and so opposed to all that we know of the nature and movements of these visitants from space, that it would probably never have been listened to but for the position of the author, and his claim to speak *ex cathedrâ* on the subject. Mr. R. A. [illegible] subsequently showed that [illegible] main really stationary [illegible] stated by Mr. Denning, the meteors seeming to issue from it *must* travel with a velocity of 200 or 300 miles per second at the very least. To this Mr. Denning rejoins that nothing in the smallest degree approaching to such a rate of motion has ever been observed, and so the matter rests.

A sedulous, but (of course) wholly ineffectual, search was made for the mythical planet "Vulcan" at the time of its computed spring node by Mr. T. W. Backhouse, of Sunderland.

During the eastern elongation of Mercury in July last, Mr. Ballot saw, or believed that he saw, certain definite white markings on the limb of the planet. So far, though, his observations remain uncorroborated.

Professor Bakhuyzen has made a redetermination of the rotation period of Mars, which he finally fixes at 24h. 37m. 22·66s. ± ·0132s. This is 0·05s. in defect of the period assigned by Mr. Proctor as the result of his latest researches in 1873.

Nine more planetoids which have been discovered between Mars and Jupiter by certain astromoners who have apparently nothing better to do, bring the number of these bodies now recognised up to 253.

Some remarkable observations of physical change on the surface of Jupiter have been made by Professor Hough with the great 18·5in. achromatic of the Dearborn Observatory at Chicago, by Professor Young, and by other observers also in this country, who have noted that the famous red spot, which has persisted so long upon that planet, assumed the form of an elliptical ring, only, however, to close up again subsequently, and resume its normal appearance. Another red spot has also formed upon the face of the planet. Professor Hough, from a series of observations made between September, 1879, and June, 1885, finds that Jupiter's mean period of rotation is 9h. 55m. 37·40s. On every single occasion on which transits of Satellites III. and IV. have been recorded, they have invariably crossed the face of the planet as dark spots.

M. Trouvelot, of Meudon, asserts that Saturn's rings have undergone, and continue to undergo, changes quite patent to the observer furnished with sufficient optical means.

From his observations of the two satellites, Oberon and Titania, made during the oppositions from 1881 to 1884, Prof. Asaph Hall finds the mass of Uranus $= \frac{1}{22682 \pm 27}$. This is slightly less than that derived by him from previous observations, albeit a very little larger than the value deduced by Prof. Holden.

Prof. Hall has further determined the mass of Neptune to be $\frac{1}{19092}$, from observations of its solitary satellite. The periodic time of the satellite itself he finds to be 5·876339 mean solar days.

Five comets have appeared during 1885; or rather, perhaps, if we include Encke's (which was, however, first picked up by Professor Young, in December, 1884), six have been visible. The first one actually discovered during the year was found by Barnard, at Nashville, U.S., on July 7th. The second apparition was a return of Tuttle's Comet, a body originally seen first by Méchain in 1790, but subsequently lost until 1858, when it was rediscovered at Harvard, U.S., by Professor H. P. Tuttle. It has a period of about 13·6 years. It seems only to have been seen at Nice on August 9th. The third comet of 1885 was found by Brooks, on August 31st; the fourth by M. Fabry, in Paris, on December 1st; and, finally, the fifth by Barnard, again at Nashville on December 3rd. One and all of these objects were of the most inconspicuous character possible.

By far the most startling and "sensational" astronomical occurrence during the year which has just closed was the appearance, in August last, of a new star in the midst, and close to the nucleus of, that most familiar of nebulæ 31 M Andromedæ. The first public announcement of its apparition was made in the Dun Echt Circular, No. 97, which contained the intimation that Dr. Hartwig (at Dorpat) had found a starlike nucleus in the Nebula. The telegram from Kiel, containing this news, was dated Aug. 31. The star was, however, detected by Mr. I. W. Ward on Aug. 19, and, as a correspondent informed Mr. Maunder that he examined the nebula on the previous night (that of Aug. 18) and perceived nothing unusual about it, the time of the outburst is brought within very narrow limits indeed. When at its brightest it was probably of a magnitude between the 7th and 8th, but by Sept. 7, when it came under the rigorous photometrical scrutiny of Professor Pritchard, at Oxford, it had degraded to the 8·25th mag. By the end of the month it had faded to the 10th mag., and continued to grow fainter until it is now invisible. Examined with various forms of spectroscope by Mr. Maunder, at Greenwich, it was found to present a spectrum practically confined between D and F, precisely representing that of the Nebula itself, though, of course, a little brighter. Faint and uncertain traces of two or three bright lines were believed to have been perceived, but they were too dubious to admit of any measurement. This most mysterious body (if body it was, in any legitimate sense of that term) presented a sharply defined stellar disc up to the time of its extinction.

Moreover, on December 13th yet another star blazed up in the sky where previously a seeming void had existed; for on the night referred to Mr. J. E. Gore, observing the heavens with an ordinary field-glass found a 6th mag. reddish star some 20′ following χ^1 Orionis. It presents a very remarkable banded spectrum of the IIIrd type, exhibiting both dark bands and bright lines.

In speaking last year of the progress of Stellar Photometry during the preceding one (ENGLISH MECHANIC, Vol. XL. p. 377), we referred to the accordance existing between the magnitudes of a very large number of stars as determined by the wholly different methods employed at Harvard, U.S., by Professor Pickering, and by Professor Pritchard at Oxford. Since then a comparison has been instituted by Professor Pickering between his own deduced magnitudes and those derived from measures, or estimations, of a number of other astronomers, with the result of the discovery of some remarkable discrepancies between the Oxford magnitudes of a good many bright stars and those obtained at Harvard. As a possible explanation of (at least a part of) this discrepancy, Professor Pickering says: "The result derived from the Wedge Photometer should theoretically be affected by the brightness of the background, and this effect appears actually to occur in the present instance." Upon the publication of these words, Professor Pritchard, with that zeal and scrupulous regard for accuracy which has characterised his whole investigation of the problem, set on foot an elaborate series of experiments to determine the effect of moonlight on the point of extinction of any particular star. Selecting Polaris as the standard one, Professor Pritchard gives the results embodied in the following little table:

Moon's Age.	Mean Wedge reading for Extinction.	Number of Extinctions.
Days.	Inches.	
0 to 7	4·77	1050
7 to 14	4·76	1125
14 to 21	4·74	1675
21 to 28	4·75	1275

Showing as the result of no less than 5,125 extinctions made at the most varying periods of a lunation, that no sensible difference whatever in the magnitude of a star takes place from the character of the background on which it is superposed.

On the other hand, Prof. Pritchard regards the Harvard estimations of stellar magnitude as, to a certain extent, less trustworthy on account of the fewness of measures (those on three successive nights only) whence the means were derived. However the discrepancies may be finally reconciled, it is impossible to withhold the fullest meed of praise from both the American and English astronomers for the noble and useful work performed under their direction.

Celestial photography has been by no means behind in the astronomical race, some notable advances in its application having been made. Foremost among them stand the astonishing photographic ecliptic charts, made under the direction of Admiral Mouchez, at the Paris Observatory, by the aid of the splendid 13·39in. objective, constructed by MM. Paul and Prosper Henry. With this magnificent piece of apparatus stars of the 16th magnitude have been successfully registered on the plate. Mr. Common's achievements in stellar and nebular photography will be within the cognisance of a large proportion of our readers. Dr. Huggins's method, by the aid of which he believes he has succeeded in photographing the Corona of the uneclipsed sun, is being pursued by Mr. Woods at the Cape Observatory. The results have yet to be made public. In connection with this, it may not be without interest to mention that Signor Tacchini, of the Collegio Romano, at the beginning of July last succeeded in observing (what he supposed was) the Solar Corona from the summit of Mount Etna.

There is nothing of material importance to chronicle in connection with the instrumental appliances of astronomy. Mr. Grubb is, we believe, at work upon the new 28in. object glass of the South East Equatoreal at Greenwich, and the MM. Henry have just completed the 30in. one for the observatory at Nice. The great Lick objective remains *in nubibus*. A rather warm discussion has taken place between two astronomers of eminence, one on each side of the Atlantic, as to the relative merits of large and small telescopes for the observation of planetary detail. As a curious practical contribution to the solution of this vexed question, it may be mentioned that Barnard, in observing the comet, discovered by himself in 1884, found it much easier to see with a 5in. telescope than with a 6in. one!

A remarkable contribution to our knowledge of that heretofore obscure subject, the apparent enlargement of celestial objects and constellations as they approach the horizon, has been made by M. Paul Stroobant, who has traced this most familiar of illusions to definite psychical and physiological causes. He finds that the human eye itself has a tendency to increase the seeming distance of a pair of points on a level with it, as compared with their apparent separation when seen right overhead. In other words, he ascertained that two artificial stars on the wall of a darkened room, when only 6½in. apart, appeared separated by identically the same interval as the same pair on the ceiling when that interval amounted to 8in. To this visual peculiarity, and to the haze close to the horizon, M. Stroobant shows the seeming enlargement of bodies near the horizon to be wholly due.

During 1885 M. Folie has been appointed Director of the Royal Observatory at Brussels, in lieu of M. Houzeau resigned, while Prof. Holden has accepted the headship of the Lick Observatory. We trust that he may live for many years after the famous object-glass of the projected great Equatoreal there is completed.

The bibliography of astronomy need not detain us long. Albeit the observations and experiments of which it embodies the results belong to past dates, the publication of Professor Langley's "Researches on Solar Heat" did not take place until last year—a remark which also applies to the very useful and valuable "Catalogue of Known and Suspected Variable Stars," by Mr. J. E. Gore, the papers constituting which were read before the Royal Irish Academy during 1884. A work of very marked ability and interest, by Miss A. M. Clerke, was published during the autumn, entitled, "A Popular History of Astronomy during the Nineteenth Century." Characterised by a large amount of painstaking research and elegance of diction, it is unfortunately disfigured by puffery of one of the most notorious of the South Kensington advertising fraternity. Finally, in his "Story of the Heavens," the Irish Astronomer-Royal, Dr. Ball, exhibits all that wealth of learning and charm of exposition which so eminently distinguish him.

Death has, happily, been less busy among astronomers than during some formers years which we have had to chronicle. *Facile princeps* among the departed was that single-hearted and lovable man of science the Rev. Prebendary Webb, whose loss was mourned as that of a personal friend by scores and hundreds who never beheld his face. A somewhat voluminous writer, his reputation may well be suffered to rest upon his "Celestial Objects for Common Telescopes," which has probably inspired more amateur astronomy than any single work in the English language. Mr. Hartnup was Assistant-Secretary of the Royal Astronomical Society in the beginning of its career, and was later better known as the head of the Liverpool Observatory. Mr. Ladd came in contact with astronomers chiefly as a maker of spectroscopic and polariscopic apparatus, while Mr. Sidebotham will probably be best remembered as one of Mr. Nasmyth's coadjutors in his lunar work.

REVIEWS.

The Dyeing of Textile Fabrics. By. J. J. HUMMEL, F.C.S. London, Paris, New York, and Melbourne: Cassell and Co.

THIS work is one of the manuals of technology issued by the Messrs. Cassell, and is written by the professor and director of the dyeing department of the Yorkshire College, as a manual for the teacher and student, and also to supply the practical dyer with explanations of the scientific principles involved in the operations of his art. In rather more than 500 pages Mr. Hummel has contrived to give a complete account of the art of dyeing, bringing the information down to the latest date, and has thus produced a work which should be of much value to the student and those who wish to pursue investigations of an elaborate kind in any branch of the art. The subjects are not treated exhaustively; but, as a rule, sufficient space is devoted to them to give clear ideas of the outlines of the study, and to guide the investigator in his labours. For instance, it is not possible to exhaust the subject of cotton in twelve pages; but Mr. Hummel imparts a great deal of information in that space, as he does also in the pages devoted to flax, jute, and china grass. Wool and silk have necessarily a rather long chapter each, and then we come to the practical portion of the book, which commences naturally with the operations preliminary to dyeing—cotton and linen bleaching, wool steeping and scouring, silk stripping and soupling. Water, in its application to dyeing, is the next branch, and then the author proceeds to explain to the reader the theories of dyeing—the chemical and the mechanical. In the former it is supposed that animal fibres attract certain colouring matters by reason of chemical affinity, and that in the process of dyeing they actually combine with the soluble colouring matter to produce an insoluble coloured compound. Cotton does not become dyed, because it has no affinity for such colouring matters. This theory, or rather hypothesis, will scarcely bear examination, because there is no proof of chemical combination. Those who hold the mechanical theory explain the facts by supposing the animal fibres to have become dyed by reason of a purely physical attraction, by means of which the colouring matter penetrates the substance of the fibre and remains there in an unchanged condition. There is much to be said for and against both hypotheses, and good work is to be done by those who, having special knowledge, would undertake an investigation into the actions which go on in the dyeing bath. This book will supply them with all the practical details they require, as it also furnishes the worker with such technical information as he needs to understand the *rationale* of the processes he adopts.

Practical Instruction in the Art of Letter Engraving. By G. T. WHELPLEY. New York: John Wiley and Sons; London: Trübner and Co.

THE art of engraving is one that can be acquired only by constant practice; and artistic feeling is necessary to produce a result which will be agreeable alike to the workman and the critic; but almost any one can acquire sufficient proficiency with the graver to ornament metal goods with letters and simple designs; and according to the author, who writes from an American point of view, a good "letter engraver" will always find his services in demand, and gain a comfortable livelihood. Be that as it may, the instruction given in this little volume—gleanings of several experienced workmen—is all that can be desired; for, unlike many so-called practical treatises, it does really describe with sufficient minuteness all the details of the engraver's work. Mr. Whelpley commences with a paragraph on the principles of letter engraving, which, after some remarks on the formation of letters of different styles, is followed by "elementary lessons on the drawing of letters" and "sloping letters to a proper angle." The selection and preparation of tools commence the practical work, and the author's instructions are made very clear by means of diagrams. The improved square bent graver is superior to all others, he says, and a dark straw is the lowest temper to which it should be reduced for ordinary use without a second trial, as a tool with such temper is applied only to easy-cutting metal. Mr. Whelpley recommends pale straw for general work, and a good straw-colour for cutting the tough metals. To harden he dips the point of the cherry-red graver into a ladle of red-hot lead and then quenches in water, by which treatment the tool never becomes too hard or brittle. The methods of setting out the work and cutting the lines are fully described by means of letter-press and engravings, and there are several good examples of inscriptions, monograms, &c. Altogether it is a useful manual for those who desire to acquire some proficiency in the art of letter engraving.

List of Tests. By HANS M. WILDER. New York: P. W. Bedford; London: E. and F. N. Spon.

THIS work has been designed especially for the convenient reference of chemists, ph macists, and scientists, the tests (rea being arranged in alphabetical orde ing to the names of the ori of subjects gives the would be improved by p

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
14	B.A.C. 830	6	7 9 p.m.	Dark	73	75	8 11 p.m.	Bright	327	343
16	θ¹ Tauri	4½	3 56 ,,	Dark	106	66	4 58 ,,	Bright	282	244
16	Tauri	4½	3 58 ,,	Dark	86	45	4 56 ,,	Bright	302	264
16	75 Tauri	6	†4 33 ,,	N. by W.	194	155				
16	B.A.C. 1391	5	4 58 ,,	Dark	131	93	5 57 ,,	Bright	257	224
16	80 Tauri	6	†5 5 ,,	S. by E.	14	337				
16	81 Tauri	5½	†5 20 ,,	S. by E.	14	338				
16	85 Tauri	6	†5 55 ,,	S. by E.	14	340				
16	Aldebaran	1	7 48 ,,	Dark	137	122	8 49 ,,	Bright	247	248
17	117 Tauri	6	3 38 ,,	Dark	73	33	4 28 ,,	Bright	305	264
17	130 Tauri	6	12 54 ,,	Dark	88	124	1 59 a.m.	Bright	270	310
18	26 Geminorum	5½	8 37 ,,	Dark	73	43	9 44 p.m.	Bright	288	271
20	1 Cancri	6	2 3 a.m.	Dark*	32	61	2 49 a.m.	Bright	303	338
22	37 Sextantis	6	‡7 16 p.m.	Bright	69	33	8 7 p.m.	Dark	262	224
24	B.A.C. 4043	6½	3 40 a.m.	Bright	100	100	4 40 a.m.	Dark	210	222

* But apparently bright. ‡ Star not yet risen.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	*III*	*Tr E*	12	10	p.m.	14	I	Sh I	2	31	a.m.	23	I	Sh E	1	10	A.M.
2	*II*	*Sh I*	7	14	a.m.	14	I	Tr I	3	42	,,	23	I	Tr E	2	15	,,
4	IV	Ec R	1	13	11,,	14	I	Sh E	4	48	,,	23	III	Sh I	4	7	,,
4	II	Ec D	1	29	22,,	14	I	Tr E	5	57	,,	23	*III*	*Sh E*	7	15	,,
4	II	Oc R	6	44	,,	14	I	Ec D	11	53	3PM	23	I	Oc R	11	33	P.M.
5	I	Sh I	6	10	,,	15	I	Oc R	3	16	a.m.	26	*III*	*Oc D*	10	43	,,
5	III	Ec D	6	29	20,,	15	*I*	*Sh E*	11	17	p.m.	27	III	Oc R	1	27	A.M.
5	*I*	*Tr I*	7	23	,,	15	III	Sh I	12	9	,,	27	II	Sh I	4	10	,,
6	II	Tr E	1	46	,,	15	I	Tr E	12	25	,,	27	II	Tr I	6	21	,,
6	I	Ec D	3	31	50,,	16	III	Sh E	3	17	a.m.	27	*II*	*Sh E*	7	0	,,
6	I	Oc R	6	58	,,	16	III	Tr I	4	59	,,	28	I	Sh I	6	18	,,
6	I	Sh I	12	38	p.m.	16	*III*	*Tr E*	7	45	,,	28	*I*	*Tr I*	7	21	,,
7	I	Tr I	1	51	a.m.	18	II	Ec D	6	39	30,,	28	*II*	*Ec D*	10	32	4PM
7	I	Sh E	2	55	,,	20	II	Sh I	1	37	,,	28	IV	Sh I	11	39	,,
7	I	Tr E	4	6	,,	20	II	Tr I	3	56	,,	29	IV	Sh E	2	21	A.M.
8	I	Oc R	1	26	,,	20	II	Sh E	4	27	,,	29	II	Oc R	3	23	,,
8	*III*	*Sh E*	11	20	p.m.	20	II	Tr E	6	41	,,	29	I	Ec D	3	39	5,,
9	III	Tr I	1	11	a.m.	20	*I*	*Ec D*	7	17	50,,	29	*I*	*Oc R*	6	54	,,
9	III	Tr E	4	0	,,	21	I	Sh I	4	25	,,	29	I	Sh I	12	47	P.M.
11	II	Ec D	4	4	21,,	21	I	Tr I	5	32	,,	30	I	Tr I	1	49	A.M.
12	IV	Sh I	5	39	,,	21	I	Sh E	6	42	,,	30	I	Sh E	3	4	,,
12	*I*	*Sh I*	8	3	,,	21	*I*	*Tr E*	7	47	,,	30	I	Tr E	4	4	,,
12	*II*	*Sh I*	11	4	p.m.	21	II	Oc R	12	58	p.m.	30	*I*	*Ec D*	10	7	23PM
13	II	Tr I	1	29	a.m.	22	I	Ec D	1	46	3AM	30	*II*	*Tr E*	10	17	,,
13	II	Sh E	1	54	,,	22	I	Oc R	5	6	,,	31	I	Oc R	1	21	A.M.
13	II	Tr E	4	15	,,	22	*I*	*Sh I*	10	53	p.m.	31	*I*	*Tr E*	10	30	P.M.
13	I	Ec D	5	24	49,,	22	I	Tr I	12	0	,,						

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight, or by Jupiter's proximity to the horizon.

one knows who has watched the Moon through a long night, she travels from West to East in the sky; and consequently, in passing over such stars as lie in her path, her Eastern limb occults them and they reappear at her Western one. The "Angle from N. Point," means the arc included between the star when in contact, and that point of the Moon's limb cut by a circle passing through the North Pole and her centre. The "Angle from Vertex" is measured from the point where a circle through the Zenith and the Moon's centre cuts her limb. The former is employed with the Equatoreal—the latter with the Altazimuth. It must be carefully noted that these angles are measured round the Moon's circumference to the right (i.e. in the direction in which the hands of a watch travel), and that they start from the real South point, and bottom of her limb respectively as seen by the naked eye, the Huyghenian eyepiece of course inverting everything, and converting these into the seeming top or North as the case may be: from which seeming top, or North, are the angles given in the table measured. In the case of "Near Approaches," however, we give, under the head of "Moon's Limb," the *true* part of the Moon's limb—in points of the compass—which approaches nearest to the star. And we do so for this reason: that the Moon is so (relatively) near the Earth that she may just clear a star as seen from Greenwich, which she will pass over as seen from some other parts of England. Suppose, for example, that as viewed from the Royal Observatory, her South limb *just* passes North of a given star, then it is quite obvious that the Moon will cover the star if she be observed in Yorkshire. Or if her North limb just cleared a star as seen from Greenwich, she would hide it to a Brighton observer or one in the Isle of Wight. As we have said above it is the Eastern or advancing limb of the Moon at at which Stars disappear, and as from New Moon to Full Moon this is dark, occultations between these phases occur at these dark limb and reappearances at the bright one; a condition of things precisely reversed between Full Moon and New again.

Mercury

Is a Morning Star during the whole of January, attaining his greatest Elongation from the Sun (23° 21′) West at 2 a.m. on the 9th. His very considerable South Declination immersing him in the mists of the winter horizon places him in a most unfavourable position for the observer. His diamete
is only 4·8″ when the year opens, i
to 6·6″ by the end of the month; but e
his disc, if visible, is a most insi
object.

Day of Month.	Right Ascension.		Declination South.		So
	h.	m.	°	′	h.
1	17	16·0	20	21·1	10
6	17	29·7	21	14·5	10
11	17	51·2	22	10·6	10
16	18	17·4	22	52·9	10
21	18	46·5	23	12·2	10
26	19	17·6	23	3·3	10
31	19	49·8	22	23·0	11

The path indicated above extends
part of the Southern portion of Ophiu
nearly across Sagittarius; but the on
any size which the planet will
is μ Sagitarii, about 1½° South of whic
be found on the morning of the 14th.

Venus

Is an Evening Star throughout the M
is a beautiful telescopic object. She
greatest brilliancy on the 13th, and a
date, when the sky is perfectly clea
detected in daylight with the naked
anyone who knows precisely where to
her. The diameter of her charming
increases from 33·4″ on the first day of
Year to 52·6″ by the end of the Month.

Day of Month.	Right Ascension.		Declination South.		So
	h.	m.	°	′	h.
1	21	53·3	13	9·5	3
6	22	6·3	11	14·0	3
11	22	17·0	9	21·0	2
16	22	25·3	7	33·9	2
21	22	30·5	5	56·7	2
26	22	32·4	4	33·7	2
31	22	30·5	3	30·0	1

The path indicated by the above E
lies wholly in a barren region in Aqua

Mars,

Viewed with reference to his South
Morning Star; but he rises about
p.m. on January, and soon after 8h.
the 31st, so that he can be fairly wel
Midnight, especially towards the En
Month. He is, however, still a comp
insignificant and disappointing
especially in a small telescope, his dia
creasing merely from 10·5″ on the 1st t
the last day of the Month.

Day of Month.	Right Ascension.		Declination North.		So
	h.	m.	°	′	h.
1	11	34·7	5	54·0 ,,	4
6	11	39·2	5	33·6 ,,	4
11	11	42·9	5	18·7 ,,	4
16	11	45·7	5	9·7 ,,	4
21	11	47·5	5	7·2 ,,	3
26	11	48·2	5	11·5 ,,	3
31	11	47·8	5	22·9 ,,	3

Hence it will be seen that Mars *desc*
short arc in the confines of Leo and *Virg*
void region of the sky.

Jupiter

Is also a Morning Star; but rises later
than Mars, and, save at the end of the
is scarcely in a position for observ
after Midnight. His equatorial
which is 35″ at
creases to 38.8″ b
will be better p
month or two.

Jupiter.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	12 22·0	0 57·1	5 38·8 a.m.
6	12 23·0	1 2·2	5 20·1 „
11	12 23·7	1 5·1	5 1·2 „
16	12 24·1	1 6·3	4 42·0 „
21	12 24·3	1 5·7	4 22·4 „
26	12 24·1	1 3·2	4 2·6 „
31	12 23·7	0 58·9	3 42·5 „

The very short pendulum-like path indicated by the above Ephemeris lies between γ and η Virginis; but nearer to the latter Star.

Saturn

Is an Evening Star during the entire Month, and is altogether admirably placed for the observer, to whom we must reiterate our advice to lose no opportunity of scrutinising and drawing the planet during its present most favourable apparition. The Equatorial diameter of the ball decreases quite imperceptibly from 18·6″ at the beginning of January to 18·0″ by the end of the Month.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	6 19·0	22 32·3	11 32·8 p.m.
6	6 17·2	22 33·6	11 11·4 „
11	6 15·6	22 35·0	10 50·1 „
16	6 14·0	22 36·2	10 28·9 „
21	6 12·5	22 37·4	10 7·7 „
26	6 11·1	22 38·6	9 46·7 „
31	6 9·9	22 39·7	9 25·8 „

The slow retrograde arc thus described by Saturn lies approximately on a line joining ν and η Geminorum, and is performed in the direction of the last-named star, pretty close to which the planet will be found at the end of the Month. At Noon, on the 10th, Saturn and μ Geminorum will be in conjunction, and on that and the previous night will probably be inseparable, as viewed with the naked eye.

Approximate Times of the Greatest Eastern Elongations of Saturn's Five Inner Satellites.

Day of Month	Name of Satellite.	Time.	Day of Month	Name of Satellite.	Time.	Day of Month	Name of Satellite.	Time.
		Hour.			Hour.			Hour.
2	Mimas	4·8 a.m.	9	Mimas	5·6 p.m.	22	Mimas	10·2 p.m.
3	Mimas	3·4 „	9	Rhea	7·7 p.m.	23	Tethys	3·0 a.m.
4	Mimas	2·1 „	9	Tethys	9·9 „	23	Enceladus	4·2 „
4	Tethys	6·1 „	10	Enceladus	8·3 „	23	Mimas	8·9 p.m.
4	Rhea	7·4 „	11	Tethys	7·2 „	24	Mimas	7·5 „
4	Mimas	12·7 p.m.	11	Dione	9·3 „	24	Tethys	12·3 „
5	Mimas	11.2 „	12	Enceladus	5·2 a.m.	25	Mimas	6·1 „
6	Tethys	3·4 a.m.	14	Enceladus	11·0 p.m.	25	Enceladus	10·0 „
6	Enceladus	5·7 p.m.	16	Enceladus	7·8 a.m.	26	Tethys	9·6 „
6	Mimas	9·8 „	18	Rhea	8·4 p.m.	27	Enceladus	6·9 a.m.
7	Mimas	8·4 „	20	Dione	2·2 a.m.	27	Rhea	9·0 p.m.
7	Tethys	12·7 „	21	Tethys	5·7 „	28	Tethys	6·9 „
8	Enceladus	2·5 a.m.	21	Enceladus	7·3 p.m.	29	Enceladus	12·6 „
8	Mimas	7·0 p.m.	21	Mimas	11·6 „	30	Dione	12·9 „
9	Dione	3·6 a.m.	22	Dione	7·9 „			

The table above furnishes the approximate times at which the five inner satellites of aturn will be at their greatest elongations ast of the planet, and is given for the purpose enabling the student to identify them. an is so prominent an object as to be visible the smallest instrument, while Iapetus ribes so large an orbit as to be easily tifiable; notably when at its brightest of the Planet. Hyperion can only be he very largest instruments. of this table is only tentative, lad to hear from our Astro- of use. ing r Saturn's visibility. If in the negative we shall discontinue it, as the considerable space it occupies may then be more profitably employed.

Uranus

Does not rise until after midnight, so that we must defer any ephemeris of him.

Neptune

May be well seen during all the early part of the night, but of course comes pretty early to the meridian towards the end of January. He will, however, as we have so repeatedly insisted, merely present the appearance of a 7–8th magnitude Star, shining, though, with a comparatively steady light. It requires a power of at least 300 to raise a disc upon it.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 24·5	16 50·0	8 38·8 p.m.
6	3 24·1	16 49·1	8 18·8 „
11	3 23·9	16 48·3	7 58·8 „
16	3 23·7	16 47·8	7 39·0 „
21	3 23·5	16 47·6	7 19·2 „
26	3 23·4	16 47·5	6 59·5 „
31	3 23·3	16 47·6	6 39·7 „

Shooting Stars

Should be watched for during the first three nights of January; and may be again looked for from the 15th to the 19th inclusive.

Greenwich Mean Time of Southing of Seventeen of the Principal Fixed Stars on the Night of January 1st, 1886.

Star.	Souths.			
	h.	m.	s.	
α Andromedæ	5	17	22·77	p.m.
α Cassiopeiæ	5	48	51·13	„
Polaris	6	32	12·91	„
α Arietis	7	15	19·15	„
α Ceti	8	10	44·47	„
α Persei	8	30	34·17	„
γ' Eridani	9	6	58·85	„
Aldebaran	9	43	33·26	„
Capella...	10	22	20·81	„
Rigel	10	23	7·55	„
α Leporis	10	41	43·16	„
α Orionis	11	2	57·53	„
γ Geminorum	11	44	58·21	„
Sirius	11	53	56·70	„
Castor	12	41	1·03	„
Procyon	12	47	0·42	„
Pollux	12	51	59·97	„

Were the stars rigidly and absolutely "fixed," any given one would South 3m. 55·91s. (or 235·91s.) sooner every day, as indicated by a clock set to show Mean Time. This is so nearly true with a large proportion of them that for our purpose we may assume it to be accurately so; and to find the Greenwich Mean Time of Transit of either of the Stars in the above List for any other night in January we have only to multiply 235·91s. by the number of days which have elapsed since the beginning of the month (i.e. by the day of the month – 1), and subtract the result from the time given in our table. Thus: At what hour will Capella South at Greenwich on the night of January 11th, 1886? 11 – 1 = 10, and 10 × 235·91s. = 2359·10s., or 39m. 19·10s. If, then, from 10h. 22m. 20·81s. we take 39m. 19·10s. we obtain 9h. 43m. 1·71s. as the Greenwich Mean Time of Southing of Capella on the night of January 11th. This differs only 0·04s. from the actual instant of Transit, a quantity wholly inappreciable. In the case of Polaris, however, the discrepancy would have been somewhat greater; though so slowly does that star cross a wire that it might for our purpose be neglected. Suppose now, though, that we wish to ascertain the Local Mean Time of Southing of one of the stars in our table. This we may do by subtracting 9·8565s. for every hour of Longitude (and proportional parts of minutes and seconds) when our Station is West of Greenwich, and adding that quantity when our Longitude is East. For example, at what hour will Sirius South in Dublin on the night of January 1st? Dublin is 25m. 22s. West of Greenwich, so, as in the case given under the head of "the Sun" above, we say 60m. : 25m. 22sec. : : 9·8565 : 4·17s., and subtracting this quantity according to the precept (Dublin being West) from 11h. 53m. 56·70s. we finally obtain 11h. 53m. 52·53s. as the instant in Dublin Mean Time when Sirius will be on the Meridian of the Observatory of that City. Had we been dealing with Yarmouth or Canterbury the quantity found must, of course, have been added to the time given in our table.

TAYLOR'S IMPROVEMENTS IN VICES AND JAW CHUCKS.

THE improvements in vices and in jawed chucks shown in the annexed engravings have been patented by Mr. G. B. Taylor, of Birmingham. The object of the invention is to so construct the vice that when an article is held between the jaws it is pressed down upon the surface of the vice or chuck uniformly, at the same time that it is tightened between the jaws. This is accomplished by making that face of each jaw to which the plate is attached an inclined surface, either flat, as shown, or curved; the upper edge of the A surface, being nearer to the opposite jaw than its lower edge, B; also making that face of each plate which is attached to the inclined surface of the jaw to correspond with it and be free to slide thereon in the direction of its inclination for a certain limited distance. The other surfaces of the plates are made as usual. The plates may be fastened to the jaws by pins, the heads of which may be let into the plates as usual, in which case the holes in the plates are slotted and the pins screwed into the jaws, but preferably, the patentee so bores the holes for the pins, D, that their heads may be at the back of each jaw, and in this case the holes in the jaws are slotted and the other ends of the pins screwed into the plates as shown, by this means cutting away less of the toothed surface of the plate than by the first-mentioned method. Between the underside of the head of each of the pins and the shoulder formed by the bottom of the hole cut in the jaws for the reception of the pin head, is placed a small spiral spring, E, for the purpose of producing an elastic pressure between the inclined faces of the jaws and jaw plates, the object of which is to prevent dust, &c., from entering between the faces, and to still allow a free sliding movement between them. Or instead of using pins for the purpose of attaching the plates to the jaws, the plates may be dovetailed within or upon the jaws, or may be attached thereto by other suitable means. By means of these improvements any article gripped between the jaws of a vice or chuck made as above described will by its pressure upon the above described inclined surfaces cause the plates, and with them the article itself, to move downwards until the said article comes into uniform contact with the face of the vice or chuck, or in contact with pieces of metal placed upon the face of the vice or chuck for that purpose. When the article is released from the jaws, the springs beneath the jaw plates cause the plates to move upwards again to their original position. In Figs. 1 and 2 the improvements are shown attached to a vice, previously patented by Mr. Taylor, but all the above described improvements may be applied to any existing vice or jawed chuck, and in the case of vices having their jaws pivoted at the back on a

FIG. 1.

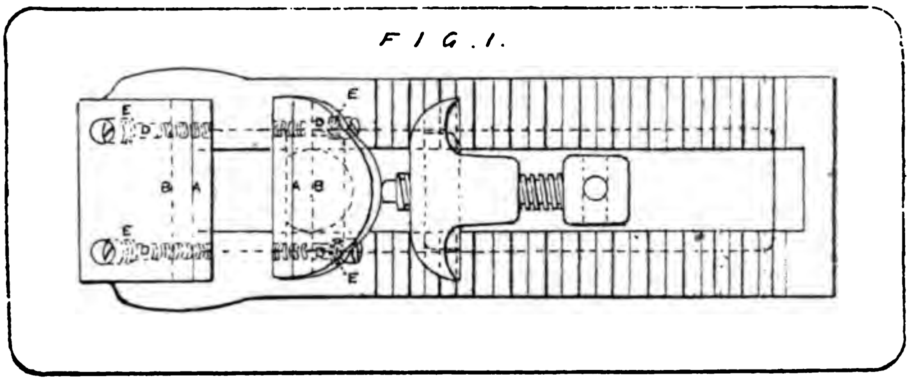
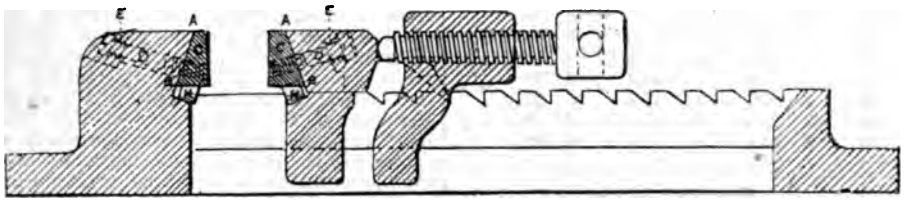


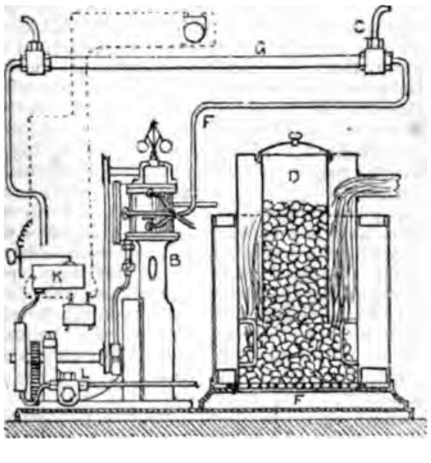
FIG. 2.



horizontal pivot above the level of the jaws, springs, as H, may be used to slightly raise the front of the jaws themselves from the surface of the vice, so that on gripping an article the jaws will move slightly downwards and carry the article with them, thus obtaining the same result as by the sliding jaw plates previously described, which in this case need not be used.

PIFRE'S DOMESTIC MOTOR.

THE annexed diagram of the Pifre steam-engine will show that it much resembles the Davey "safe" steam motor which we illustrated on p. 532, last volume. M. A. Pifre set out to construct a motor that should be capable of being used everywhere, be easy to set in motion, and keep in repair without special knowledge. M. Pifre's idea is that since the steam-engine, raised to its highest power, has centralised motive power to the profit of the greatest enterprises of our epoch, it might become its province to likewise act as a domestic motor. As the chief defect of small steam-engines is that they require more care and watchfulness than are demanded by large ones, M. Pifre has changed the usual mode of producing steam and converting it into work, and has devised an apparatus which is capable of running automatically for several hours without any supervision on the part of its owner.



Hence the characteristic name of "Automotor" that has been bestowed upon it. The generator and motor are united upon the same base, and the condenser is located wherever most convenient. The generator has some resemblance to a hot-air stove, but one that has been changed internally in such a way as to produce an abundance of steam. The fire is lighted at the base of a central cylinder, D, which is afterwards filled up to the top with fuel. The combustion proceeds upon the grate, E, at the base of the cylinder, and is absolutely constant so long as any coke remains. Fuel is put in at distant intervals to make up for what has been burned. This suffices to render the production of steam constant and regular, without any of those disturbances that take place in the ordinary boilers of small size. The intensity of the fire is regulated through the door of the ashbox and the damper in the chimney. The motor, B, is of the vertical type. Its cylinder, its piston, and its valves operate without ever being lubricated with any fatty matter. As for the condenser, C, that consists of a pipe, G, which surrounds the escape pipe, F, to a certain distance, and permits of the circulation of cold water round it. The steam produced in the generator passes into the cylinder, and, after moving the piston therein, escapes through the pipe, F, is condensed in the pipe, G, and falls in the form of water into the small reservoir, K. From this latter the distilled water is taken up by the feed pump, L, and introduced again, well aerated and free from grease, into the generator, where the level remains constant. This constancy in the level of the water and the automatic feeding of fuel in the furnace are characteristic traits of this new motor, the surveillance of which is thus reduced to its simplest limits. The smallest size "automotor" that M. Pifre constructs is of ½-horse power, weighs 770lb., and occupies a space of but 3½ × 2ft. Its height is 2¼ft. Notwithstanding its small dimensions, it is provided with all those safety apparatus that are found in large engines. The small reservoir, K, for condensed steam is surmounted by an electric telltale, which makes itself heard whenever anything wrong occurs.

DYNAMO-ELECTRIC MACHINES AND THEIR ENGINES.

IN a paper on this subject by Mr. Gisbert Kapp, Assoc.M.Inst.C.E., recently read before the Institution of Civil Engineers, the author summarised the improvements which have been made within the last few years in the design and construction of dynamo-electric machines and engines used to drive them. Starting with the mechanically imperfect machine first introduced by Gramme, he showed how, by degrees, the nature of the strains occurring in those machines became better understood, and engineers began to employ adequate means to meet those strains. Also how, by better arrangement and proportioning of the various parts, the efficiency and power of these machines had been increased, while at the same time their weight and price for a given power had been reduced. Those improvements have mainly been affected in the armatures and the field magnets. The former consisted in holding the wires firmly in place, and in admitting air to all parts of the wires, and in some cases also to the core of the armature. Another improvement consisted in supporting the core by solid metal spokes or arms, instead of by the old-fashioned wooden hub. As regarded the field magnets, the substitution of soft well annealed wrought iron for cast iron had enabled the makers of dynamo machines to increase the electro-motive from 20 to 30 per cent., and also to obtain machines which were almost self-regulating. In consequence of the ventilation of the armatures, the density of current carried by the wires had been increased considerably, in some cases even up to 6,000 ampères per square inch, although the general practice was to employ only 2,500 ampères. The author next classifyed the dynamos, according to their armatures into three great divisions—first, dynamos with armatures wound on the Hefner-Alteneck principle; secondly, those with cylindrical armatures, wound on the Gramme principle; and, thirdly, those with disc armatures, wound on the Schuckert principle and he gave a formula by which the electro-motive force created in any of these armatures could be calculated from the constructive data of the machines. The question of the length of conductor required for every volt of electromotive force produced in the external circuit was next inquired into, and after certain assumptions which were fairly in accordance with general practice, he found that the length of the conductor required to produce one volt was in the—

	Inches.
1. Drum, long	6·5
2. „ short	16·4
3. Cylinder, long	21·8
4. „ short	26·1
5. Disc, square core	26·3
6 „ circular core	26·3
7. „ flat core	78·8

Speaking of the intensity of the magnetic field in a dynamo machine, the author established the relation that the total number of lines of force passing across the armatures could be represented as the ratio of the exciting power and magnetic resistance, the latter consisting of three parts: that properly due to field magnets, that due to the armature core, and that due to the air space between the paler surfaces and the surface of the armature coil. The latter was assumed to be constant for all degrees of magnetisation; this increase, however not being taken into account for low intensity. Formulas were then given for the magnetic resistance, from which it was found that dynamo machines with single horseshoe magnets required about [illegible] per cent. less wire than those with double horseshoe magnets. With regard to the influence of the size of dynamos on the electrical energy which could be obtained from them, the author found that in small and medium size machines the latter varied as the 3½ power of their linear dimensions, and that the cost of manufacture varied as the 2½ power thus making the cost of the dynamo per lamp inversely as its linear dimensions. The influence of the electro-motive force on the cost of dynamos was shown by an example, which proved that, for economical reasons, it was better to work with average electro-motive force, and that very high tension should only be employed if the expense for cables in the external circuits became very considerable. Detailed descriptions were given of nearly all the improved dynamo-machines now manufactured in England, including the Edison-Hopkinson, Mather and Platt, Paterson and Cooper, Elwell-Parker, Crompton, Greenwood and Batley, the Brush Company, the Gülcher Company, and the author's dynamos. A table was also given which contained some of the more important constructive data of the various dynamos described, especially with regard to the density of current in armature and magnet wires, and the cooling surface provided to dissipate the heat which was necessarily generated by the current passing through those wires. As regarded the engines, the author maintained that the necessity of durability and economy in steam engines was as great if they were required to work dynamos as in cases where they were used for driving mills, propelling vessels, or for any other purposes, and that, therefore, electricians should not be content with economical engines, or with those which were liable to break down. If engine makers maintained that the speed at which dynamo machines must be driven was too great to allow them to make a substantial engine, electricians must reduce the speed of the dynamo to suit the engine.

TWIST DRILLS.—II.*

(*Concluded from p.* 338.)

THE shanks of twist drills are turned tapering, but unfortunately there has been no sensible standard adopted either for their diameters or the amount of taper. Each machine-tool builder has made the sockets in the spindles of drilling machines, lathes, &c., as circumstances or the fancy of the moment happened to suggest. The Morse Twist Drill Company established a standard, which has been adopted by most drill manufacturers and some tool builders; but, by some unaccountable perversity, the diameters are uneven and irregular, and each different size has a different taper. They also adopted, as a method of driving the drills, the use of a flat tongue, milled on the end of the [illegible] and fitting in a slot across the bottom of the [illegible] which method has unfortunately been [illegible] universally followed. This tongue [illegible] twists, its corners get rounded, and it [illegible] slot in the socket, soon rendering the latter [illegible] A far better device, to which the writer [illegible] long accustomed, is a key fitted [illegible] the socket [illegible] extending the entire [illegible]

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* A paper by [illegible] before the Ar

SCIENTIFIC NEWS.

THE death is announced of Dr. Samuel Birch, the keeper of the Egyptian and Oriental Antiquities in the British Museum. The deceased held a very high place in his special branch of learning, and had been for half a century connected with the Museum. He had just completed his 72nd year.

Prof. Horner, the famous ophthalmologist and oculist of Zurich, died the other day.

Another small planet, No. 253, was discovered by Dr. J. Palisa, of Vienna, on Nov. 12th, whilst searching for Erigone, No. 163. This is the ninth planet discovered in 1885, and raises the whole number of those found by Dr. Palisa to fifty.

Mr. W. Peck has just issued (Archibald and Peck, Edinburgh) "The Apparent Movements of the Planets, and the Principal Astronomical Phenomena for the Year 1886," illustrated with charts showing the paths among the stars of the eleven principal planets. It will be found useful by possessors of small telescopes and beginners in observational astronomy.

"Uranometria Nova Oxoniensis," a photometric determination of the magnitude of all stars visible to the naked eye from the Pole to ten degrees south of the Equator, is the title of a work by Dr. C. Pritchard, F.R.S., &c., just issued by the Clarendon Press, Oxford.

The Treasury has promised to submit to the House of Commons a grant to the Marine Biological Association of £5,000, to be paid in two yearly instalments, and an annual sum of £500 for five years afterwards. The conditions imposed by the Treasury will, we understand, be accepted by the association, the most important being that space shall be afforded to such investigators as the Treasury may select to inquire into definite problems. The success of the association is now, therefore, assured, and subscriptions may be expected to flow in. Mr. Walter Heape, M.A., enters on his duties as resident superintendent of the laboratory to-day. He has already visited the American laboratories, and will probably soon make himself acquainted with institutions of a similar kind in Europe.

In the last issued part of the *Records* of the Geological Survey of India are two papers of interest to seismologists. One is a report by Mr. C. S. Middlemas on the Bengal earthquake, July 14, 1885. The reporter enters into a careful analysis of the destructive effects, especially those at the jute works at Serajganj, where two chimney stacks suffered severely. Calculation seemed to show that the seismic focus, or subterranean centre of disturbance, was situated at an unusual depth; but after introducing certain corrections a depth of forty-five miles is approximately assigned to it. The second report is by Mr. E. J. Jones on the Cashmere earthquake of May 30, 1885. Notwithstanding the comparative mildness of the shock, no fewer than three thousand lives appear to have been lost by this catastrophe. The focal depth is calculated to have been seven and a half miles.

The new aquarium for Indian and Colonial fish in connection with this year's exhibition at South Kensington is in course of construction, and it is to be hoped may remain a permanent addition to the "institutions" of London. The tanks are being erected at the back of the present aquarium, but there will be no connection, many of the "foreigners" requiring special care and attention.

The number of breeding-ponds at Delaford Park belonging to the National Fish Culture Association has been found inadequate, so successful have been the operations carried on there—all the fish reared during 1885 being reported as "doing well." It has been decided, therefore, to increase the number of ponds, especially as it is expected that a large quantity of the ova of Salmonidæ will be hatched out during 1886.

The Sanitary Assurance Association have made arrangements for the delivery of a series of free lectures at the Parkes Museum during January and February, 1886. The first lecture will be by Prof. T. Roger Smith, on a "Damp House," Wednesday evening, Jan. 20; and on the following Wednesday, Mr. F. B. Jessett, F.R.C.S., will lecture on "Preventible Diseases."

It is stated that "Herr Max Muthel has patented in Germany an incandescent lamp which possesses the advantage of requiring no vacuum in the globe. He has, it is reported, very ingeniously overcome one danger that experiments of this kind have hitherto presented, and that is the fusion of the incandescent wire. The wire used by him consists of a mixture of bodies that are conductors and non-conductors of electricity." Possibly there is some connection between this novel incandescent lamp and that which it is said has been experimented upon in Prof. Lieben's chemical laboratory in Vienna. The latter is a new gas-light invented by Dr. Auer, and is thus described: "A cotton wick, saturated with an incombustible metal solution, is introduced into the flame of an ordinary Bunsen lamp, the result being a light similar to the incandescent electric light."

The *Sveat* is the name of a steamer constructed for the Russian Steam Navigation and Trading Company, which has just arrived at Odessa, and is intended for carrying kerosene, and, if necessary, petroleum itself, or even petroleum naphtha—but there will probably be some hesitation in shipping such cargoes. The vessel is 286ft. long, 36¼ft. wide, and draws 18ft. of water when fully loaded. The engines indicate 1,100 h.p., and the mean speed is 11½ knots. The middle part of the body of the vessel is taken up with 16 cisterns or tanks, to hold kerosene, arranged in two rows of eight cisterns in a row. Each cistern will contain about 530,000 gallons. Outside each row of cisterns is a passage or corridor, and between the under part of the lower range of cisterns and the bottom of the steamer is a vacant space to admit the possibility of at all times examining the state of the cisterns from underneath them. All the cisterns of both rows have a pipe leading to a cistern on the upper deck. At the lower part of the steamer, outside the cisterns, is a pipe, 12in. in diameter, connecting, in conjunction with other pipes, the pumping machinery with the whole of the cisterns. In order to prevent the accumulation of gases in the corridors running alongside the cisterns, 16 large-sized ventilating tubes are provided. Eight of these introduce air from without, and eight withdraw the gas from the corridors. The *Sveat* is intended to carry petroleum (kerosene) from Baku to Odessa, the oil being conveyed to Batoum from Baku by the pipe line.

Prof. Germain Sée, of Paris, continuing his lectures on dietetics, to which we referred on p. 295, spoke of the importance of water in connection with food, pointing out that the proportion of fluid contained in the animal organism was about 75 per cent., that it was important to keep it up to that proportion, and that no other fluid can replace pure water, as that alone can dissolve the salts and other substances taken with the food, and eliminate them from the system. Meat, or the flesh of animals, fowl and fish being included, is a perfect aliment for all purposes of nutrition; but, as Prof. Sée suggests, man cannot live on meat alone, nor can he live on vegetables alone, consequently the practice of pure vegetarianism is simply impossible, as it is not conducive to robust health, whether physical or intellectual. The so-called vegetarians are so well aware of this fact that they make up the deficiency by consuming a quantity of milk, eggs, and butter. Prof. Sée says that man is omnivorous, and is destined to live on the elements furnished by the three kingdoms of nature.

According to M. Witz, the average thermal value of purified coal-gas at constant volume is about 5,200 calories per cubic mètre (1·3 cubic yard) at 0° C. and 760mm. when the water formed is fully condensed. The thermal value is generally taken as 6,000 calories: but that is evidently too high, though the calculation is really complicated by the composition of the coal-gas, which varies considerably, and by the amount of dilution with oxygen in experiments, air apparently exercising no difference in its effects whether in the ratio of six or ten volumes to one of gas.

An electro-pneumatic steering apparatus has been invented by Mr. Washburn, and has been recently tried on a U.S. steamer. The rudder is worked by compressed air machinery, the motion of which is controlled by electrical mechanism applied to the compass. The course having been decided on, the contacts are so arranged that any divergence from the line plotted out by the master of the vessel will immediately complete an electric circuit, which will set in motion the compressed-air machinery, and so actuate the rudder as to bring the vessel back to her course.

The peculiar and deadly properties of the venom of the cobra have puzzled many investigators, and Dr. R. N. Wolfenden has been unable to find either a toxic alkaloid, or the principle called "cobric acid." Mixtures containing cobra poison were found to be inert when treated with such metallic salts as precipitate albumen, and any compound that removed albumen from solutions of the poison, or any agent, such as permanganate of potash, that oxidised albumens, destroyed the poisonous property of the venom. Dr. Wolfenden has found three poisonous proteids in the venom. The largest quantity of proteid was a globulin that had asphyxiating properties, and a smaller quantity of syntonin possessing similar properties was also detected. A form of serum albumen existed in minute proportions, and this was ascertained to have remarkable powers in paralysing small animals.

USEFUL AND SCIENTIFIC NOTES.

Oil on the Waves.—Lieut. John P. Holditch, R.N.R., says:—The results I have obtained are these. Fish or colza oil only is of any good; it does not matter how dirty it is, as long as it is not thick. Paraffin is too thin; paint oil too thick. Running before a gale naturally expends much more oil than "laying to," you have so much more water to oil. Carefully expended, one quart in three hours for running, one pint in four hours for laying to will be sufficient. The means I used was a canvas bag (No. 6) with large holes stabbed with a needle. I have heard of a bundle of oakum being saturated with oil, and then put in a coarse gunny bag, which I think would admit of a thicker oil being used for the time. The place for towing is undoubtedly forward, not aft. Whether in head-reaching oil could be used successfully I cannot say, but I doubt it. When running dead before the wind tow from each cathead, and the ship is as safe as anything can be at sea.

Seakale.—As the kale must complete its growth in darkness, the pots may stand in any odd corner of the house. Generally speaking, a couple of mats thrown over them will exclude both light and air. A friend, who is very fond of a few early forced flowers, sets aside a small house for that purpose; in the middle of the house is a stage for the flowers; beneath the stage he has a large box with a lid to it; the box is about 18in. deep, 3ft. long, and 2ft. wide. In the bottom of the box he places 6in. of soil; in this he plants his seakale crowns, introducing a few at the time as he wants them. He has no trouble in keeping up a supply from Christmas until it comes forward naturally in the open. He also forces his rhubarb under the same stage. He simply lifts a large old stool and plants it in a bed of soil made up on purpose for it, and secures a fair supply. As regards the table quality of forced seakale, there is no doubt the cooks are right when they say that the best is that which is forced on the ground where it is grown. The conditions under which it is produced are, no doubt, more natural when forced on the ground; both the tops and bottoms are surrounded with more moisture: hence the growth is more succulent and juicy, and requires considerably less cooking to make it tender. To force it in this way, it is only needful to put a proper seakale pot over each stool, and then cover them with a sufficient thickness of leaves and stable manure to create a temperature of 65°. In three weeks it will be fit to cut.—*Amateur Gardening.*

Writing on Glass with Common or India Inks.—Warm the glass to 50° or 60° C. (120—140° Fahr.) until vapour is no longer deposited. Then bathe the surface with the following varnish, moving the plate as when applying collodion in photographic work. The varnish consists of [illegible] grams of 95 per cent. alcohol, 5 grams of mastic in sheets, and 8 grams of damar. The solution made in a firmly-corked bottle on the wat
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LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

CAN A COMET "MAGNIFY" A STAR OVER WHICH IT PASSES?—CUBIC CONTENTS OF A SPHERE—PAINTING MAGIC-LANTERN SLIDES—OBSERVATORY SHUTTER—NEWTON AND HIS NIECE—DE MORGAN ON ENDOWMENT—RECORDS OF OBSERVATIONS—SPECTROSCOPE FOR SMALL TELESCOPE—OCCULTATION OF ALDEBARAN.

[25154.]—I SHOULD like to make one remark in connection with letter 25110 (p. 318). It is this: that it is not by any means necessary for a medium to be "refractive"—in the sense of magnifying an object—to render such object "larger and less distinct." I need only adduce the very familiar illusion of the seemingly gigantic proportions of people and animals generally as seen through a dense fog. One would like to see the "magnifying" effect of a homogeneous mass of vesicular vapour explained on any recognised optical principles.

"Apprentice" (query 58320, p. 327) may find the cubic contents of any sphere by first cubing the diameter and then multiplying the result by $\frac{3{\cdot}1459265}{6} = {\cdot}523597$. Take his own illustration, 12·5 × 12·5 × 12·5 = 1953·125; and 1953·125 × ·523599 = 1022·65 cubic inches as nearly as may be.

"S." (query 58327, p. 327) should get volumes XII. and XIII. of the ENGLISH MECHANIC and read "Sable's" capital series of articles on painting magic-lantern slides.

In reply to the query (58346) of Mr. Clapham, on p. 328, the mischief of observing through a narrow slit is that draughts are set up in front of the object-glass, with the result that the definition is rendered unsteady: though, of course, four or five times the aperture of his objective is not such a very narrow opening after all, and if the shutter be left open long enough prior to beginning work, to enable the telescope to acquire the temperature of the external air, ought to do very fairly well. It is certainly not worth while to alter it.

That Newton was one of the greatest mathematicians (if not the very greatest mathematician) of whom any historical record exists, I may assume to be incontestable. But our reverence and admiration for his almost unparalleled genius must not blind us to the fact that he was in many things very human indeed. His behaviour to Leibnitz, and his even worse treatment of Flamsteed, show that the idol of such biographers as the late Sir David Brewster had but feet of clay; and that spite, pettiness, meanness, and unfairness are by no means inseparable from the possession of the most mighty intellectual gifts. Save, though, in one respect, no one, so far as I know, has ever ventured to breathe a hint against Newton's morality; albeit the exception, were it in any legitimate sense provable, must be regarded as of an indictment against him of the most damning possible character;—that, in fact, of having purchased place and preferment at the cost of his own niece's honour! The story as originally, I fancy, set afloat by Voltaire, and repeated, more or less openly, by others, was that Catherine Barton, Newton's niece, who was brought up and educated by him, subsequently became an inmate of the use of the Earl of Halifax (to whom her uncle indebted for his Wardenship and, later on, tership of the Mint) under circumstances that [illegible] of but one interpretation: that, un- . . . some one bought her an annuity [illegible] Lord Halifax, by a codicil to his Rangership, Lodge, and furniture [illegible] Manor of Apscourt both for [illegible] considerable sum [illegible] circumstances [illegible] hypo- [illegible] (if [illegible] ord Halifax's death, married Mr. Conduitt, Newton's successor at the Mint. Now, in the course of a most laborious search among the materials for the history of the Life of Newton, the late Professor De Morgan came to the conclusion that every difficulty surrounding the repulsive (if true) tale which I have just given in outline was soluble on the hypothesis that Catherine Barton and Lord Halifax were privately married about the year 1706, and he prepared an article for *The Companion to the Almanac* for 1858, setting forth the series of facts upon which he founded his belief that this was the true solution of the question. Charles Knight, the then editor of the work, rejected this article, and subsequently the accession of fresh evidence (one piece of a very striking character) induced De Morgan to expand his original essay into the book which lies before me as I write, and whose title-page I copy verbatim: "Newton: His Friend: and His Niece. By the late Augustus De Morgan. Edited by his Wife and his Pupil, Arthur Cowper Ranyard. London: Elliot Stock, 1885." I would commend the perusal of this work to my brother readers for more reasons than one. Certainly it sheds a new light upon a dark and mysterious story, and embodies an amount of investigation only to be realised by those who read it. It cannot be denied that the late professor has made out a very strong case in favour of his own view of Catherine Barton's innocence and Newton's integrity; such a case, in fact, as must almost compel assent from some not too eager to render it. But I have a further reason for inviting attention to this noteworthy book; the reason that it shows what an evil influence was exerted upon Newton by endowment. At a time when all South Kensington is clamorous to be subsidised by the Treasury to go and find something out, it may not be without use and profit to reproduce the words of a man whose contributions to one branch of science are so universally recognised as those of the quondam Professor of Mathematics at University College: they appear, I find, on p. 340 of last week's issue.

Let me thank Mr. Grover (letter 25136, p. 340) for the information he affords. Speaking for myself, I think that no observation should ever be published without the fullest details as to the instrumental appliances, &c., with which it was made.

The spectroscope described under the title of the "Amateur's" in your XXth Volume, concerning which "Alchemist" puts query 58389 on p. 342, is suitable only for table use, and not with a telescope at all. The only form of instrument likely to be of service to my querist is McClean's star spectroscope, which will show the spectra of the brighter stars with a telescope of 3½in. aperture. It has no slit to be adjusted, and may be used by the most inexperienced observer; but it is not adapted for purposes of measurement.

In reply to "Copernicus" (query 58446, p. 350), Aldebaran was occulted three times during the evening and night in the course of 1885, and twice in sunlight. During 1886 this star will be three times visibly occulted (exclusive of daylight occultations), as it will be four times in 1887. These series of phenomena recur at intervals of 18 years; so that the next one will happen in 1903, 1904, and 1905.

A Fellow of the Royal Astronomical Society.

ASTRONOMICAL — DOUBLE STARS — TO MESSRS. SADLER, E. HOLMES, AND TEEKAY.

[25155.]—THE following are the double stars of your list ("E. M.," No. 1029, p. 61) which I think I have found—

No. 8 Position 60° ±
9 „ 140°
11 „ 240°

Nos. 6, 7, and 10 I have not yet been able to find, but I will continue my search, though for No. 6 I have now little hope, as it passes the meridian early; all the observations have been made with power 180. The position of No. 11 is the mean of three observations, and all the observations have been made during hard frost and unsteady air.

There is an 8·5 mag. star following about 4m. Σ 138, a little N., which I thought slightly elongated towards 5°, though I was unable last night to confirm this. The distance, if really double, is under half a second, and it would be worth while to examine it with a larger aperture than mine; it is easily found, having three 10 mag. stars N. preceding about 3′ or 4′ dist.

Σ 186 — 209 Piscium was notched some evenings ago, and its position seemed nearer 100° than 85°; certainly it is not single now as found by Secchi in 1876·99.

I am afraid Mr. E. Holmes's letter (25116) gives me credit for what I do not deserve. I believe my eye is of an average quality, and I owe to the excellence of my mirror all the successes I have obtained, if, indeed, some of my observations may be thus qualified. I have no particular mode of observation, and therefore I regret to say I cannot give any hint which might be useful to him. I certainly obtain discs on stars with power 180, even on Vega when the air is good. It is fortunate it is so, as in this climate the air is so unsteady that it is very seldom high powers can be used with any advantage.

In answer to Teekay (letter 25112), I think it would be well to study the disc of the same star. If he will fix on one I shall be very glad to say what is the appearance of its disc both in the in and out focus.

Dec. 26. **C. M. Gaudibert.**

ASTRONOMICAL MATTERS.

[25156.]—I REGARD the letters of Mr. E. Holmes as having a considerable value, inasmuch as they set us all thinking, and often are the means of obtaining valuable information from other correspondents. His courage in attacking intellectual giants is wonderful, and although nearly always wrong, he never seems to know he is beaten. I have thought the mauling he received at the hands of Mr. Franks, and since of Mr. Calver, would have taught him prudence, but no such thing. Here he is again with a nonsensical idea of the spherical error of a lens affecting the character of the internal and external star discs.

I venture to refer him to a little book of Hardwicke's called "Optics," which he can purchase for twopence, and which will explain to him why and how it is that spherical error is corrected for every ray falling upon the lenses of the Huyghenian eyepiece. I am supposing your correspondent has raised this question with a view to obtaining information, and not in a hypercritical, fault-finding spirit; and, following the lead of our esteemed friend Mr. Calver, I shall decline entering upon controversy.

I have a 12in. Calver mirror, and in response to the request for description of discs I append particulars, premising that whether with whole aperture or reduced the in and out focus discs are exactly alike with my highest power, which is Mr. Browning's G. The outer edge is bright; there is a very fine dark ring, thin, but intensely black, the rest of disc is uniformly bright, but less bright than edge, and numerous circular lines are visible in steady air, decreasing in intensity as they contract in diameter. In the centre is the black image of flat with a ring, and the supports of the flat show as black lines with straight diffraction lines.

With a side stop of course the central spot and lines of flat supports are absent; but unless the mirror is tilted slightly towards the centre the image of a star at focus becomes elliptic—might be imagined to be elongated. The diffraction rings are all on one side; but a little careful manipulation with the screws will make them symmetrical, and then, as that master of reflective science, Mr. Calver, says, we obtain def. and discs equal to a refractor.

If Mr. Holmes had taken the trouble to think before writing his queries to Mr. Calver, he would have easily seen why a small reflector does more with a smaller proportionate flat than a large one. Can he not see that it is the increased diameter of body tube which takes flat further from focal point proportionately.

I wish to bear testimony to the invariable courtesy of Mr. Calver in answering private inquiries when involving *real* difficulties, and put in a friendly spirit; but he cannot be expected to waste his valuable time answering such frivolous elementary questions as the one as to the difference betwixt a "star disc and the image of a star in the telescope." The star disc is, of course, the spurious planet resulting from the diffraction phenomena, while the image of a star is the mathematical point corresponding to the star itself, which is formed at the focus of a perfect telescope. The star disc is the creature of the o.g., the star image is a point with which the o.g. has nothing to do, as Mr. Webb said in "E. M.," April 15, 1870, "the image of a star, for it is well ascertained that this possesses no sensible magnitude."

George Goring.

BRILLIANT METEOR.

[25157.]—IN reply to Wm. Davenport (letter 25111, p. 318), I happened to be out of doors on the evening of the 8th inst., about the time mentioned by him; but as I made no note of it, I cannot say exactly when my attention was arrested by seeing a bright glare in the sky, and on looking round to find the cause I was just in time to see a briliant meteor in the act of giving up the ghost. It seemed to have been proceeding from north to south, as it left behind a very bright horizontal streak of light or train which appeared to lie in that direction. As I know nothing of astronomy, I cannot tell him the name of the place in the heavens where the meteor made its appearance. According to the Ordnance Map my position would be about 53° 53′ 20″ N., 2° 46′ W., and the meteor would be about due east from where I was, and between 40°

and 59' above the horizon. The train did not appear to me to be more than 20°, or at most 25° in length, nor last above half a minute.

Dec. 22. **Samothes.**

OCCULTATION OF A STAR BY SATURN.

[25158.]—On the day of 1886, January 9, the planet Saturn will make a very near approach to the third magnitude star μ Geminorum, and (if the ephemeris and my computations are correct) will occult its eleventh magnitude companion.

This very rare phenomenon is worthy of close attention, and if the star be not extinguished by the planet's light it will be seen through the opening between the ring and the ball, as Saturn will pass almost centrally over it. The near approach of the ring to μ will also be a sight worth seeing, though the nearest approach (6·7″) will not be visible in Europe, star and planet having set before that occurs.

My computations give the following results:—

Phase.	Greenwich Mean Time. h.	m.	Angle from N. Point toward E. °
Immersion, outer ring	14	47	282
Emersion, inner ring	15	31	289
Immersion, ball	15	55	294
Nearest approach to centre, 3·8′	16	44	4
Emersion, ball	17	32	71
Immersion, inner ring	17	46	76
Emersion, outer ring	18	28	83
Nearest approach of centre to μ, 17·1″ Nearest approach of ring to μ, 6·7″	22	43	184

The position of μ is—R.A., 6h. 16m. 3·85s. Dec. 22° 34′ 15·45″ N. The distance of the companion star is 73″, and position angle 76·6°.

I may say that the above times and angles of the phases are close approximations only, the computations being hurriedly made that this letter may go forward by the next mail. They will, however, be found sufficiently accurate for observation, I think. **Chas. L. Woodside.**

Boston, Mass., Dec. 17.

OPTICAL: TO MR. H. SADLER—MECHANICAL, UNANSWERED QUERIES, &c.

[25159.]—WITH reference to the star-disc controversy, will Mr. Sadler kindly tell us what is the error in Airy's "Undulatory Theory," corrected by Mr. Stone? I should be glad if he could give us short extracts from the paper, showing how the error affects Airy's analysis. Some years ago I read through Airy's book, and by a note I then made it seems that the angular diameter of the star disc, in seconds, is found by dividing 5·52 by the aperture of the instrument. This seems to have been the formula used by Mr. Knott, to which Mr. Linscott refers.

It is not easy to see how a mathematical theory or formula can be framed which shall give the diameter of a "star disc" viewed in a telescope. An absolutely correct theory may define the size of the smallest disc which a perfect o.g. or spectrum can give to rays issuing from a *point;* but what are we to take as the meaning of this word "point" when applied to stellar objects? Does it make no difference whether we call a star of the first or of the tenth magnitude a "luminous point"?

I am rather disappointed that my two queries, 57906 and 57907, should have to go into the Unanswered List. Mr. Shakespear, I observe, says that split steel parallel bearings are being adopted in German lathes. Surely some of our numerous lathemen must have had experience with such fittings? It does not seem unlikely that with the use of such bearings an amateur might construct a firm and easily-running mandrel, either stationary or traversing; whereas such a one would most likely fail to produce a durable and accurate cylindrical or conical fitting. Can these small bearings be cast in steel, or must they be forged from a good cast-steel bar? Perhaps shear steel would be better than cast for this purpose. I trust this second notice may induce some of our friends to give their ideas on the subject, as I think it is not unworthy of investigation.

The second query not being answered is probably in part owing to my odd way of putting it. Though clothed in mathematical language, it really referred to a very simple thing—viz., the "smoker" used among beekeepers. I have made smokers of several patterns, none of which I altogether like. I find the best result is attained when the blast is blown through the fuel; but this has the disadvantage that the fuel chamber gets exceedingly hot and heats the smoke; and to recharge with fuel is an awkward job, as the parts are too hot to be handled for some little time. I have an idea that a smoker of the "blower" pattern would, on the whole, be preferable; but the one I made was not a success, hence the reason of my query. The blower must be powerful enough to create a good vacuum, and thus cause a good supply of air to flow through the fuel-box. To do this well, or, in other words, to make the most use of the small blast furnace available, needs the blower or blast pipe to be very carefully arranged in size and relation to the outer cone. Perhaps Mr. Wenham, Mr. Fletcher, or others who have had practical experience with blowpipes embodying the vacuum or "draught" principle, will kindly give a few hints as to the best dimensions of the parts.

Orderic Vital.

OPTICAL.

[25160.]—IN the first place, allow me, Sir, to apologise to the several friends who have put queries to me. Mr. Woodside comes first, I believe, in that category. The year just passing away as I write has been productive of much pressure; indeed, practical optics have been so much in the way that I have had no time for writing. I am glad, however, that our obliging friend, "Orderic Vital," has answered partly for me. As to the "Pitch v. Paper" question, I may tell Mr. Woodside that neither supersedes the other—both are very useful in different classes of work. It would be an almost impossible job to use paper to figure to a true parabolic shape an abnormally short focussed mirror; pitch, or some other yielding material, would be a necessity in such a case. For reasonable foci fine paper with "Tripoli de Venise" is effectual and certainly cleaner and less troublesome than pitch.

Personally, I detest pitch polishers, with their concomitant sticky trimming and scraping. Mark you, even nowadays you cannot touch pitch without being defiled. Always having this in view, I have from time to time experimented with various materials of a more cleanly nature; finally adopting a mixture of fine wheaten flour, rosin, and bleached wax for figuring o.g.'s.

The surfaces of the lenses for Mr. W. G. Penny's experimental o.g., which, by the way, gives splendid definition, were figured to a perfectly spherical figure with such a mixture.

For simplicity and tolerable certainty of result I should say that paper was the neatest and best material for the amateur o.g. worker. So much has, however, appeared in the "E.M." concerning the interesting subject of optical surface manipulation, that I question whether it is possible to do better than to combine the methods of our highly accomplished correspondents, and select therefrom a method that will fall in with our needs.

Mr. Wassell's charming papers and practical instruction on specula working, together with Mr. Brashear's valuable hints and formula, to say nothing of the lesser lights, can be utilised for practical purposes for almost every possible form of surface needed, whether for o.g., prism, or mirror.

I am told that our American friends are making wonderful dumpy o.g's. Certainly, short tubes are an advantage; but, after a long experience, I regretfully come to the conclusion that the proportion of 15in. of focal length to 1in. of aperture is the "real best" for astronomical o.g's.

I may say that, while carrying out our ingenious friend Mr. Penny's experiment, I gave this question considerable study, and having the opportunity afforded by the separating arrangement of really testing the actual area that would be corrected, I found that the above-named proportion is the correct one for double glasses. Any alteration at all should be in the direction of lengthening the focus. Certainly, by figuring to an almost impracticable degree of ellipticity a sort of compromise may be obtained, which, with a little of the Marchioness's "make believe," would pass some critics.

With regard to star discs, I deal more with the refractor now, and I must say that Andrew Ross was right when he said that the best figured o.g. gave the least image of a star; but just coming away from testing an o.g. of considerable merit, it would indeed take a large lump of salt to get down the statement that such stars as Vega, Capella, Arcturus, Rigel, Betelgeux, &c., give mathematical points only. If our o.g. be slightly overdone for figure we get a larger disc, but supposing the figure correct, such stars have a real disc. I cannot quite understand spurious disc in that case, and even in the former case the disc is no more spurious than the image of a watch dial seen through the same glass.

Our friend Mr. Edwin Holmes some time since very cleverly explained the diffraction appearances in the "E. M.," illustrating his description by an illuminated puncture through an opaque plate. Would that be a spurious puncture because we see diffraction rings round it? As to Mr. Calver's statement that "we cannot magnify a star," I think that is only so far true as it is to say we cannot magnify a railway track. Anyone knows if we look along straight lines of rails they appear to go closer until they meet, the old optical delusion of parallel lines meeting at infinity. If we look along said lines of rails with an opera-glass or telescope, power 4 or 20, I think we magnify the lines, yet if distance be great enough they meet in appearance just the same a little further up. Now, there are rough points—say the point of a cambric needle under Mr. Dallinger's microscope, and also fine points—as the point of the lancet of a mosquito under the same gentleman's instrument. Certainly both are magnified. Then, again, of what use is the micrometer if there is no sensible diameter to any star shown in the telescope, always supposing a point has neither length, breadth, nor thickness? Do we not, when using the telescope, cut off the irradiation that makes a star look larger, or as large as its telescopic image? To imagine magnifying an object of some millions of miles in extent in the way a watchmaker magnifies a delicate spindle centre would be absurd in the extreme. But suppose we put the whole watch at such a distance as to appear only as large as a shilling, and then look at it with a telescope, I think we magnify it. I dare say I shall be taken to task for such commonplace reasoning, especially when I say I am conversant with the book lore treating on the matter.

Hoping all the sore places will be healed, and that even Mr. Holmes will have settled down to peaceful anticipations of a Happy New Year, allow me to wish the ENGLISH MECHANIC and all of "Ours" a successful 1886.

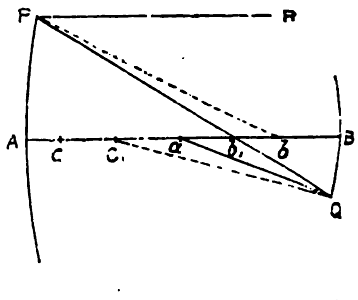
Prismatique.

SPHERICAL ABERRATIONS.

[25161.]—THERE is a very simple formula which may be given, and which is applicable to the aberration of pairs of mirrors or of lenses. If A be the aberration of the pair, A_1 that of the first mirror or lens, A_2 that of the second, u and v the distances from the second lens or mirror of the first and second images respectively, we shall have—

$$A = \frac{v^2}{u^2} A_1 + A_2 \quad \ldots\ldots\ldots\ldots \quad (1)$$

To show this, let us first take the case of mirrors.



Let the two mirrors be at A and B. Suppose that a ray incident upon the first mirror at P to be reflected by the second at Q, so as to meet the axis in a. Let b be the geometrical focus for [illegible] falling upon first mirror, b_1 the point where [illegible] PQ meets axis, c and c_1 the conjugate foci of b [illegible] then—

$$ca = cc_1 + c_1a \quad \ldots\ldots\ldots\ldots$$

is the aberration of the pair.

Let $Bb = b$ $Bb_1 = b_1$ $Bc = c$ $Bc_1 =$ [illegible] by the formulæ connecting the conjugate [illegible] have—

$$\frac{1}{v_1} + \frac{1}{u_1} = \frac{2}{r} = \frac{1}{v} + \frac{1}{u}$$

$$\therefore \frac{1}{v} - \frac{1}{v_1} = \frac{1}{u_1} - \frac{1}{u}, \text{ or } v_1 - v$$

$$= \frac{vv_1}{uu_1}(u - u_1) \quad \ldots\ldots\ldots\ldots$$

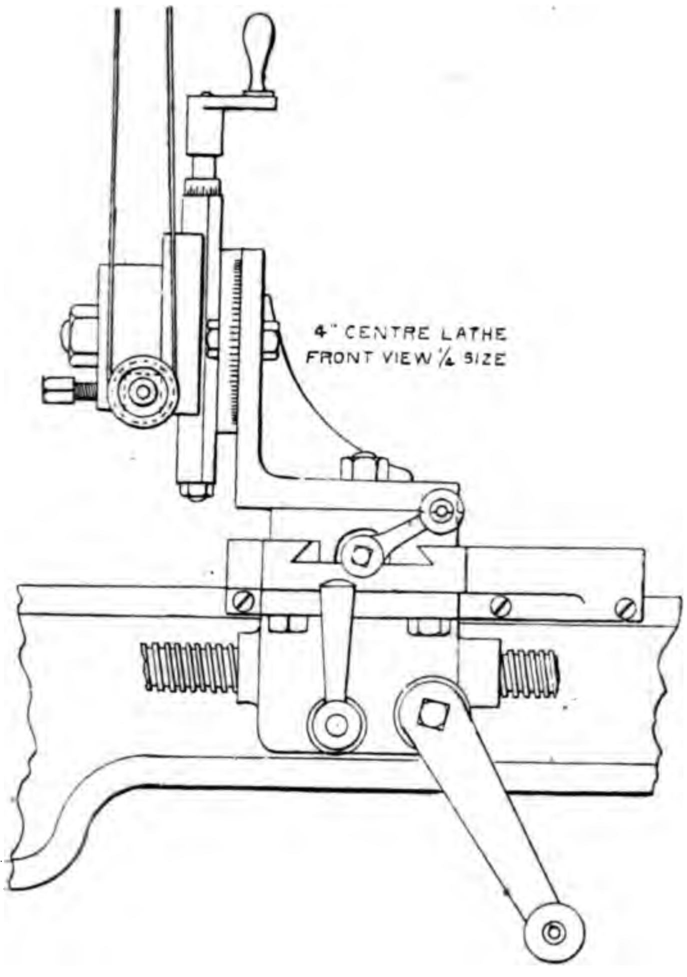
Now, $u_1 + Ab_1 = u + Ab$, or $u - u_1$ [illegible] $- Ab = A_1$. Also, in the multiplier of [illegible] eqn. (3) we may put $v_1 = v$ $u_1 = u$, so [illegible] becomes—

$$v_1 - v = \frac{v^2}{u^2} A^1 = cc_1, \text{ and } ca = A \ldots$$

$$\text{Whence finally } A = \frac{v^2}{u^2} A_1 + A_2 \ldots$$

We may note that in strictness ac_1 is [illegible] the [illegible] ration of the ray which meets the axis [illegible] is in [illegible] we may, if convenient, suppose it to be [illegible] that ray P b, since the two will only differ in [illegible] magni[illegible] by a quantity depending upon products [illegible] of a[illegible] rations, which we may neglect.

The above is the case of a Gregorian telescope, but may exactly in the same manner be [illegible] a Cassegrain, where the second mirror [illegible] b and c_1, the places of the two images [illegible] cases c_1 lies to the right of c; but in a [illegible] lies to the right [illegible] while in a Cassegrain [illegible] to the left; so [illegible] each other, w[illegible]



MILLING IN THE LATHE.

[25165.]—THOSE who have tried milling in the lathe by means of the drilling spindle and the overhead-motion, have no doubt felt the want of some means of raising and lowering the cutting tool.

There are of course expensive and bulky attachments to be bought for this purpose; but I have not seen any which could be made by amateurs who possess only a lathe and a medium amount of patience.

The sketch shows a cast-iron angle-plate bolted to the cross slide of a 4in. centre lathe by Milnes.

The top slide has been removed and fixed to the angle plate at right angles to its ordinary position, in such a way that it can be swivelled round horizontally and tilted in a vertical plane into any required position.

This simple addition increases the usefulness of the drilling spindle, and enables much work to be done in the lathe, which would otherwise have to be filed or planed.

I need say no more about it, as anyone who will fit an angle plate to his lathe, and try a few experiments with it, will at once appreciate its usefulness.

W. R. W.

THE BRITANNIA COMPANY'S PATENT SAW.

[25166.]—I WISH now to add to my former remarks the following items, specially regarding what I called storing up energy—at least, if I called it something else before, that will do now.

Within one minute from the first tread it will cut 8ft. 4in. of inch deal. To get up speed takes six or eight treads, occupying some ten seconds.

I have a slice also 4½in. thick, cleanly and beautifully cut. I think no saw as ordinarily mounted could have done the same by mere foot power. Hence it certainly appears to be a highly-economical plan to use speed gears, and to store up momentum to be given out in doing work, and although it is true that no more power can be got out of the machine than is put into it, the actual fatigue is not only far less than with the ordinary foot saw, but the latter will not do the work at all.

I can vouch for the facts above stated; but I confess I am still in a state of bepuzzlement about the why and wherefore. Had I seen the drawings, I should have condemned the plan at once.

O. J. L.

[25167.]—IN answer to "O. J. L.'s" letter which appeared last week, I may state my experience as a worker of one of the Britannia Company's patent saws.

"O. J. L." appears to think that a lot of work has first to be put into it; but this is not the case. For instance, I commence to work the saw when it is standing still, and within one minute I cut 8ft. 4in. of inch deal. At the end of the minute there is a lot of unexpended force in it.

I cut 4½in. picture mouldings so clean as to require no finishing whatever. By means of the handle at the side two can work, and it will do work which hitherto has been done by steam.

It is a tool to save time and strength. If power is not wanted, this saw enables a man to utilise his strength and his weight to the fullest advantage. Sawing, hitherto the most laborious of work, can, if time is no great object, be easily done even by an amateur.

Pattern-Maker.

SOFT WOOD TURNING.

[25168.]—AS this is a subject in which I have lately been interested, I shall be glad to offer a few remarks in reply to the inquiries of "Copeaux" (25147). Having had some experience in both kinds of work, I agree with your correspondent that more skill is required in turning soft woods with chisel and gouge, than in the elaborate work of ornamental lathes in ivory and hard woods, where scrapers and drills do all the ornamentation, though much care and ingenuity are required to turn out good results in this style. I think also there is more "breadth" in design and beauty of outline and form obtainable in soft wood turning, though greater richness in detail must be allowed to the machine work. The chisel and gouge work freely at the bidding of the turner, and are not cramped by the exigences of machinery. There are doubtless many exquisite specimens in ivory and hard wood of ornamental turning; but there certainly are many monstrosities when beauty of form is entirely sacrificed to the exhibition of the capabilities of some complicated and ingenious tool.

In the Turners' Exhibition at the Mansion House a few years ago, the first prize was awarded for a hand-turned pair of vases, whose elegance of form was hardly enhanced by their simple ornamentation, tasteful as this was.

But now as to soft wood turning. The hook tools referred to by "Copeaux" are very seldom used by amateurs or mechanics: they are chiefly serviceable in hollowing out cups and small bowls, &c., where the grain runs longitudinally. In these cases the tool, whether of the form of a 𝔰 or a j, will cut clean; practice is, of course, required to work with it. Bowls and pieces of large are turned out of plank-cut wood, when runs across, and here the hook tool is no work must be done by the gouge.

The wood can be attached to the lathe a screw chuck, or by jaw or cup chucks, to its size and form. The former is gener and if the screw would enter the wood wooden disc of the required thickness can posed. In the case of a bowl or vess nature the outside is first turned and fini wood is then reversed, and the holl roughly turned out, either in shavings by or in one piece by a round tool if the woo saving, the finish is gradually given by t which is applied to the inside of the rim tical position as regards the edge of the as the cut proceeds the gouge is gradual until, for the bottom of the bowl, the sid the tool is used for the flatter portion. cess has to be repeated by successive cu good form is given to the cavity. For th finishing cut the gouge should not be until it has traversed the entire cavity. off and recommence the cut produces a r it is difficult to efface. In fact, such a is seldom or never truly circular, as the direction of the grain of the wood is s lead away the gouge more or less fro circle, and it is difficult to get on the ri again; added to which, when the bowl bec the unequal tensions of the grain begin themselves, and produce distortion. Thi increase with time, so that it is desirable off work of this kind at once. Sand-pa be liberally used—Oakey's for preferenc

The great difficulty is to cut cleanly grain comes crossways. Hoping to get so ance in this work, I looked in at a cleve in Stanhope-street one day—Stagg, was the name—where I met with courteous replies to my inquiries; but there is no r to excellence, and a steady hand, plenty tice, and last, though not least, sharp an ground tools, are necessary to insure goo

Oddly enough I saw there work of sort I was making—viz., a bowl plain i this case it was made to receive a china b with a broad raised band outside, ha carved. This, of course, adds immensel beauty of the object. As to this much- art of wood carving, I should like to say s on a future occasion.

The best native woods are sycamore, ap lime, and chestnut. The worst is, that work is done the exterior has to be finish colour and grain of these woods is not w serving, and to stain or varnish them eith back the roughness which has been efface much patience, or destroys the clea moulding and cut, which is the charm of of turning; but without some such p these "works of art" will soon soil. It is hard woods and scrapery carry off the pa advice on this point would be acceptable. "Copeaux" can help me.

[25169.]—A GREAT deal of this can be gouge and chisel, if the former properly managed and used so as beyond instead of on the near side centre. The work is begun at th with the back of the tool against the e work, as if to face it. The tool is the inwards to scoop out a little conical hole, once carried on always beyond the c slightly inwards, which will bring out lon of shaving, and hollow the piece with As the hollow deepens the back of the to on the edge of the near side of the ho steadies it, and as it cuts it is rolled over the rest, so as to end the cut with its h wards, and near the highest part of the handle is gradually, therefore, depres general cut is from the centre outward also be reversed. After a while the too incapable of being carried deeper, and th the hook tools are needed, or inside too for hard wood; but the gouge can be ye lated with care by setting the T-rest face of the work and using it more in th way. The hook tools are, however, esse tools. The best place to get them is Cliff, seven miles from Oundle, North Ha they are in daily use in a dozen worksho are made on the spot by the village b and I may add it is worth the journey place and see them used to perfection. of very difficult manipulation, requi practice.

LATHE MATTERS.

[25170.]—THERE are more inclination or interest to [illegible] when a good example is se methods of cutting doubl not seen one mentioned w

I do not know; but No. 2 lived in his glass cage 121 days.

It is well known that some of the hibernating butterflies live only a few hours; but possibly some of your ubiquitous readers from "China to Peru," can give authentic information. Does Darwin say anything about it?

Papilio.

SMALL WATER MOTORS.

[25176.]—To ascertain the energy in small jets of water, allow them to flow for a short time, and find by experiment how many pounds flow per minute, and call this W. Find the area of jet in square inches = A. Then ft.-lbs. per minute = $\cdot 00002297 \frac{W^3}{A^2}$.

In calculating the above, I have taken the water at 52·8° Fahr., at which temperature it weighs 62·4lb. per cubic foot. Of course a turbine or other motor will only utilise a fraction of this power.

Glatton.

GREAT NORTHERN SPEED.

[25177.]—I HAVE much pleasure in sending this week some observations made by a friend and myself on the Great Northern line; I stood at the fifth mile post from London, and my friend at the 9¼, and the following are the results:—

UP TRAINS.

Due K.C.	Time betw'n 5 and 9¼ posts	Class of loco.	Load	Speed.
	m. s.			
3.20	3 51	8ft.	13	66·2
3.35	3 56	Coupled	6	64·8
5.20	4 4	do.	8	62·7
5.45	3 44	8ft.	15	68·3
5.55	4 26	Coupled	6	57·5
6.15	3 42	8ft.	10	68·9
		Average...	9·6	64·7

DOWN TRAINS.

Leave K.C.	Time betw'n 5 and 9¼ posts	Class of loco.	Load	Speed.
	m. s.			
3.20	6 39	8ft.	15	38·3
5.30	5 29	8ft.	10½	46·5
5.45	6 26	8ft.	15	39·6
		Average...	13·5	41·4

I think the performance of the 8ft. attached to the 3.20, 5.30, and 5.45 down trains is splendid when one considers the gradient is $\frac{1}{200}$ up. I hope shortly to send similar details of the Midland.

G. D. Seaton.

TRAIN SERVICE, OLD AND NEW.—LONDON AND NORTH-WESTERN.

[25178.]—THE London and North-Western Railway Company was formed, by Act of July, 1846, out of the London and Birmingham, Manchester and Birmingham, and Grand Junction (from Liverpool to Birmingham). Commanding in this way the main centres of traffic, the company soon obtained control of the Lancaster and Carlisle Railway, and in 1859 absorbed the Chester and Holyhead. A multitude of smaller undertakings have year by year come under the same management, and the system is now decidedly the largest and most important in the country, though only second in actual mileage. According to the last Report, the capital created is upwards of one hundred million pounds, the number of engines 2,328, and the number of miles constructed 1,771. The Great Western, with 2,337 miles, has 1,577 engines, and something over seventy-five million pounds of capital. The train mileage for last half-year is—G.W.R., 14,560,383; L. and N.W.R., 18,340,478.

In the appended tables we take 1848 as a year when railway service was well established; 1852 represents a period of steady-going quiet; 1872 is just before the great third-class extension; while July, 1885, marks the limit of present progress.

The vast increase of railway accommodation, bad times notwithstanding, is most encouraging; but no tables can adequately represent the boon conferred on third-class humanity by the alterations of the last ten years. It seems now scarcely credible that, for some four decades of railway travelling, the one solitary "slowest train," not averaging in many cases 20 miles an hour, and starting in the small and early hours, should have been for many the only link between our great centres of national life. Come what may, those "dark ages," at any rate, are gone beyond recall.

A.—LONDON AND RUGBY. *Down trains.*

Miles.		October, 1848.		March, 1854.		April, 1872.		July, 18
		a.m.	p.m.	p.m.	p.m.	a.m.	p.m.	p.m.
	Euston	9 30	5 0	5 0	5 15	7 15	5 0	12 0
5½	Willesden	...	...	...	...	...	5 9	12 12
17¾	Watford	...	...	...	5 42	...	...	...
31¾	Tring	10 15	...	...	...	[Bletchley 6 8]		...
40½	Leighton	...	...	...	6 18	...	...	...
52½	Wolverton	...	6 23	6 20	...	...	...	...
69¾	Weedon	11 22	...	...	...	...	...	...
82¾	Rugby	11 45	7 12	7 10	7 18	9 10	7 0	1 40
No. of trains from Euston to Rugby......		16		17		21		31*
		h. m.		h. m.		h. m.		h. m.
Average time of journey		3 13		2 55		2 14		2 2
Fastest train		2 12		2 3		1 55†		1 40
Slowest train		5 15		5 1		3 45		3 30
				Up trains.				
Miles.		p.m.	p.m.	a.m.	p.m.	a.m.	p.m.	p.m.
	Rugby............	7 50	8 15	8 19	8 35	2 36	7 29	1 45
30¼	Wolverton	8 38	8 58	...	...	...	...	...
36	Bletchley	...	...	9 11	...	3 26	8 19	...
42¼	Leighton	...	...	...	9 38	...	...	...
77¼	Willesden	...	...	...	...	...	9 16	3 18
	Camden	...	...	10 20	...	...	...	...
82¾	Euston	10 10	10 30	10 30	10 45	4 37	9 30	3 30
No. of trains from Rugby to Euston......		15		17		21		32*
		h. m.		h. m.		h. m.		h. m.
Average time of journey		3 9		2 58		2 22		2 0
Fastest train		2 15		2 10		2 1 (2)		1 45
Slowest train		4 25		4 38		3 55		3 0

N.B.—In 1885 some trains travel *viâ* Northampton, 2 miles further. † 8 trains in 2 hour

B.—LONDON AND BIRMINGHAM.

Down trains (113 *miles*).

	1848.	1854.	1872.	1885.
No. of trains from Euston to Birmghm	11	11	13	13*
Avrge. time of	h. m.	h. m.	h. m.	h. m.
journey	4 40	4 24	3 21	3 3
Fastest train...	3 0	3 0	3 0 (3)	2.45
Slowest train	8 0	7 40	5 30	3 18
	Up	*trains.*		
No. of trains from Brghm to Euston ...	11	10	11	11*
Avrge. time of	h. m.	h. m.	h. m.	h. m.
journey	4 39	4 23	3 35	3 0
Fastest train...	3 15	3 0	2 57	2 35
Slowest train	6 0	6 15	5 20	3 35

C.—LONDON AND MANCHESTER.

Down trains (186 *miles, average*).

	1848.	1854.	1872.	1885.
No. of trains from Euston to Manchster	8	7	12*	15*
Avrge. time of	h. m.	h. m.	h. m.	h. m.
journey	8 0	7 29	6 22	5 14
Fastest train...	5 10	5 35	5 0 (4)	4 15 (2)
Slowest train	13 40	11 45	10 30	5 45
	Up	*trains.*		
No. of trains from Manch. to Euston ...	8	7	12*	17*
Avrge. time of	h. m.	h. m.	h. m.	h. m.
journey	7 27	7 18	6 49	4 57
Fastest train...	5 10	5 25	5 0 (2)	4 15 (4)
Slowest train	11 30	10 30	9 50	6 0

D.—LONDON AND LIVERPOOL.

Down trains (193½ *miles*).

	1848.	1854.	1872.	1885.
No. of trains from Euston to Liverpool	8	7	13*	13*
Avrge. time of	h. m.	h. m.	h. m.	h. m.
journey	8 17	7 57	6 16	5 6
Fastest train...	5 30	5 50	5 0	4 30 (2)
Slowest train	14 45	12 45	10 25	6 10
	Up	*trains.*		
No. of trains from Livrpl. to Euston ...	8	7	13*	18*
Avrge. time of	h. m.	h. m.	h. m.	h. m.
journey	8 15	7 48	6 10	5 8
Fastest train...	5 30	5 45	5 15	4 25 (4)
Slowest train	12 30	11 15	9 15	5 50

E.—LONDON AND HOLYHEAD.

Down trains (263¾ *miles*).

	1848.	1854.	1872.	1
No. of trains from Euston to Holyhead	2‡	4*	7	1
Avrge. time of	h. m.	h. m.	h. m.	h.
journey	9 23	8 56	8 14	7
Fastest train...	8 45	8 0	6 35	6
Slowest train	10 0	11 0	9 45	8
	Up	*trains.*		
No. of trains from Hlyhd. to Euston ...	2§	4*	7	[illegible]
Avrge. time of	h. m.	h. m.	h. m.	h. m.
journey	9 30	9 43	8 39	7 40
Fastest train...	8 30	8 45	6 45	6 15
Slowest train	10 30	11 45	10 5	9 15

‡ 2 more to Bangor. § 3 more from Bangor.

F.—LONDON AND CARLISLE.

Down trains (299¼ *miles*).

	1848.	1854.	1872.	1885.
No. of trains from Euston to Carlisle...	3	5	7	10*
Avrge. time of	h. m.	h. m.	h. m.	h. m.
journey	10 54	10 25	9 45	7 [illegible]
Fastest train...	9 10	8 7	8 10	[illegible]
Slowest train	12 16	13 40	13 50	[illegible]
	Up	*trains.*		
No. of trains from Carlisle to Euston ...	4	5	7	[illegible]
Avrge. time of	h. m.	h. m.	h. m.	h
journey	11 21	11 20	9 45	[illegible]
Fastest train...	9 3	9 22	7 53	[illegible]
Slowest train	12 50	13 10	13 55	[illegible]

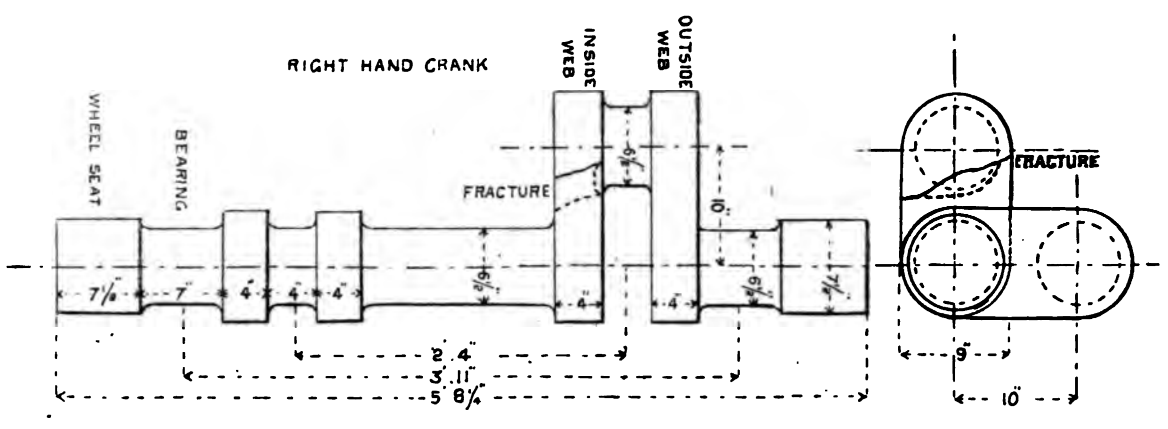
G.—MANCHESTER AND LIVERPOOL.

Down trains (31½ *miles*).

(Trains viâ Wigan, &c., not counted.)

	1848.	1854.	1872.	18
No. of trains from Manch. to Liverpool	16	10	22	21*
Avrge. time of	h. m.	h. m.	h. m.	h. m.
journey	1 39	1 41	1 20	0 [illegible]
Fastest train...	1 0 (2)	1 5 (2)	0 50 (7)	0 44
Slowest train	2 10	2 48	2 20	1 [illegible]
	Up	*trains.*		
No. of trains from Livrpl. to Manchster	17	9	21	[illegible]
Avrge. time of	h. m.	h. m.	h. m.	h
journey	1 37	1 31	1 12	
Fastest train...	1 0 (2)	1 5	0 50 (3)	
Slowest train	2 10	2 10	[illegible]	

* Besides auxiliary



AKING OF CRANK AXLES.

)N the 24th of August an accident t Larbert Junction on the Caledonian ritish Railways by the breaking of b of the right-hand crank of a Cale- pany's tank engine, No. 541, when 10.15 p.m. passenger train from Lar- gemouth, the speed being about 15 ır. The engine had six wheels, the lriving being coupled; a single frame :arings; the stroke was short, being

axle was of steel, made by the Bolton :el Company, and its dimensions will ›on the annexed diagram. It had ; since November, 1870, and had run ınce of 210,581 miles. It was not

ıtchinson, in his report just published, he surfaces of the fracture (which l-and-socket shape) indicated the ex- slight flaw which would have been ıible under any ordinary examination.)f the metal appeared good.

Board of Trade returns of accidents ne months ending the 30th September, ears that 158 engine axles failed— crank or driving and 26 leading or he 132 driving axles, 92 were made of made of steel. The average mileage xles = 221,487 miles; 40 steel axles les.

xle which caused the Larbert accident 81 miles, or about 24,000 more than erage.

ıtchinson states: "It is a grave ques- it is wise to continue to run crank heir mileage has reached a certain e fixed after careful consideration), the case of steel axles, which often tle warning before fracture." I am deed to see this important matter tion in the report. It is well known ıg time the Amalgamated Society of vants has considered that a limit aced upon the mileage which crank be allowed to be kept at work. There stion that it is exceedingly *unwise* to an excessive time. Growing flaws l the tensile strength of the material diminished by the long-continued ch it is subjected.

iously pointed out in your columns ıgines are passing through crossings, the wheels are frequently "pinched," ıous strain is thus placed upon the he report, it appears that the Govern- or found that at the crossing four of the first wheel mark, the space crossing point and check-rail was only being on a curve.

ion it is therefore certain that the axle *at that particular time* was due ng action caused by the curve, and of the check-rail.

lement E. Stretton,
Consulting Engineer, A.S.R.S.
g-street, Leicester, 12th December.

OBLEM IN DOMINOES.

FOR some time past I have wished to "Ours" an account of a somewhat result following a variation in the ninoes, which, no doubt, is capable but I cannot see clearly how that be obtained. It was in my family ening that this deviation from the de of playing was suggested — the the game being that each player, one case may be) *invariably* plays out as well as the "pool."

your readers, if they think it worth ll [illegible] ple directions :— [illegible] id put them [illegible] they are not wanted. The remaining 45 pieces may be divided equally between two players, 22 each, and one over for the "pool." Or, if three play, 14 pieces each, and three over. Say two players are engaged, double eight, placing another eight to it, and so the next plays as usual, each taking care to play his doubles, and it is better perhaps not to leave similar numbers at each end. The one who cannot play takes the one piece in the pool (and in most instances that one can be played). The result is that *all the pieces will be played out*, and the last piece may always be placed at *either* end. It is only with eights this result follows, as sevens or sixes will not answer.

I should like some light to be thrown, if possible, upon the above. This has become with us quite a favourite game, and it has always created some surprise to those who have seen it or joined in it.

G. F.

WHITE v. BROWN BREAD.

[25181.] — THE following extract from an article in Pappenheim's *Müller Zeitung* may interest some of your readers. At all events, we hear so much nowadays about whole-meal bread, Graham bread, &c., that it may be as well to also hear what can be said on the other side by a millers' gazette:—

It is unquestionable that bran (which, by the way, is universally used as cattle fodder) contains nutritive elements that are lost to human consumption by its elimination, and hence has arisen a problem of undoubted gravity, which has busied the energies of scientists of the highest eminence, such as Liebig, Pettenkofer, Voit, and others. So far, the result of all these investigations and attendant experiments has been to demonstrate that the human stomach is incapable of digesting the husks of wheat (composed as they are principally of cellulose), and that it is consequently unable to assimilate the nutritive elements which they contain. To this proposition its opponents advance a simple denial, without bringing forward any proof in support of their own view. And, in the very absence of weighty proof, people will think twice before reverting to that primitive condition, in which the wheat berry was crushed between stones—beard, husk, and all. Supposing again, it were shown that the human stomach can digest bran, it would merely follow that flour containing the branny portions of the wheat has a greater nutritive value than branless flour. Moreover, even then branless flours could scarcely be dispensed with when it is considered what an important element in food is flavour. The extraordinary contention, however, that flour free from bran has no nutritive value, or is even unwholesome, can only be explained by the blind fanaticism with which learned, or for the matter of that unlearned, men are wont to defend an opinion into which they have once stumbled. Now, all analyses of the chemical composition of the wheat berry agree that it consists chiefly—that is to say, from 70 to 75 per cent.—of carbo-hydrates (starch, sugar, &c.), and contains moreover, on an average, 14 to 15 per cent. of nitrogenous matters (albumen, &c.), and these are elements which one and all play a most important part in the nourishment of the human body.

We have met with an interesting example of the blind fanaticism above referred to in a little pamphlet which reproduces an address delivered by Dr. William Wallace, in September, 1883, before the Congress of the Sanitary Institute of Great Britain, held in Glasgow. Dr. Wallace had chosen as his theme, "The Comparative Food Value of Coarse and Fine Flour," and his address was lauded by the English journals as a valuable and important contribution. It is difficult to conceive of anything more disappointing than the perusal of this pamphlet. Dr. Wallace has actually the face to make our fine and extra fine—that is to say, our highest priced—Hungarian flours answerable for the prevalence of rickets among the children of the poorest classes! Moreover, throughout the whole address he is at the pains to strive might and main to force an open door, by proving (what has never been disputed), namely, that phosphoric acid and mineral salts are present in bran, while wanting in Hungarian and American flours. As to the crucial question whether bran is digestible by man there is not one word throughout. On the one hand are only universally admitted and known facts, and on the other conclusions drawn and propositions maintained with the most reckless disregard of proof, crowned by the pleasing news that the very worthy Dr. Wallace himself never eats white bread when he can get branny or "whole wheat" bread. The entire address reads like a very clumsy puff of the home bread or Glasgow low-ground flour. Yet the unthankful people of Glasgow still prefer the worthless and unwholesome branless flours of Hungary and America. Of greater weight is another objection raised by Liebig that the whitest flours are of little nutritive value, because they are produced from the innermost portion of the wheat berry, which section contains but a small proportion of gluten. It is perfectly true that the gluten has a centrifugal distribution, and that hence in lands the climatic conditions of which allow wheat to ripen but slowly, with the necessary consequence of giving that centrifugal force which is inherent in every living thing time to enter into full work, very little gluten is to be found in the centre of the berry, the bulk of this substance being found around the periphery. Such wheats yield to high grinding a very white but weak flour, which does not rise very well, and is of inferior nutritive value. Hence it follows that for such wheats American half-high grinding—that is to say, the separation of the flour into three, or at most, four grades—is in every case to be preferred. One rule will naturally not fit all cases. To Hungarian wheat, however, this objection does not apply, for our climate ripens wheat so quickly that the gluten is pretty equally distributed over the whole berry. As a matter of fact, the difference in the amount of gluten contained in white and dark Hungarian flour is very trifling, and it has, moreover, been proved by innumerable tests that in our fine flours the gluten is of better quality (that is to say is stronger) than in the dark flours.

Emerich Pekar, an Hungarian specialist, who has undertaken researches and made many experiments, comes to the conclusion that "the freer from bran is any flour, the larger will be the proportion of the same assimilated by the stomach, and of course its nutritive value will be increased in the same proportion. And seeing that in respect to freedom from bran 'middlings milling' produces flours of the first class, it may be laid down that flours made by 'middlings milling' excel all others as regards nutritive value."

For our part we hold this judgment to be in perfect harmony with the present state of science, and are not in the least concerned that, in some cases, bran eaters, who would like to bring our magnificent milling industry to the ground, have obtained the upper hand. We may, however, rejoice in the certain knowledge that the Hungarian milling industry has everywhere now the highest recognition and has taken the highest honours.

E. F. M.

THE MUSICAL INSTRUMENTS FOR HOME.

[25182.]—AFTER "many years of careful consideration," our friend the "Country Solicitor" gives the "ultimate result" of his experiments with keyboard instruments of the free-reed type, and that result is exactly what was predicted in the ENGLISH MECHANIC years ago. Except an expression of opinion. however, there is not much information in his letter; but probably he will supplement it by answering a few questions. In his second paragraph "Country Solicitor" says that "even a small harmonium is invaluable" as an accompaniment to the piano. Will he kindly explain how he manages to keep the two instruments in unison? In the third paragraph he says "the great lack of all American organs is that of expression." As your readers know, the difference between an American organ and a harmonium is mainly in the direction of the wind current, so it is pertinent to ask our friend why expression cannot be obtained on the American organ?—"do what you will," he says, "you cannot make your instrument really sing." What, then, is the reason? A writer who is so confident must have some solution of that problem. Then, again, one would like to know what is the peculiarity in the percussion action of the instrument which has so pleased our friend. He speaks of it as "absolute perfection," but is it in any way different to the actions applied on other instruments? Perhaps he will kindly describe it, as he has the instrument before him. The "metaphone," too—many of your readers would like to know what that is, and how it is managed. The "double touch" is rather too old to go into ecstasies over, and I am much afraid that our late friend, the "Harmonious Blacksmith," would have been made more than usually "savage" by the suggestion that he would have delighted in the double knee pedals (as if he did not know the arrangement!), or the implied suggestion that he would have preferred a reed instrument to a pipe organ. One is glad to find that your correspondent is satisfied with his instrument, and perhaps, by his help, we may all know more about it.

Organon.

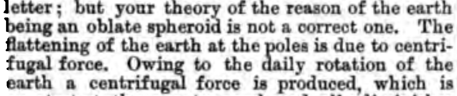
REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[57360.]—**Chronometer Balance.**—To J. W. THOMPSON.—Thanks for your courteous and able letter; but your theory of the reason of the earth being an oblate spheroid is not a correct one. The flattening of the earth at the poles is due to centrifugal force. Owing to the daily rotation of the earth a centrifugal force is produced, which is greatest at the equator, and gradually diminishes up to the poles, where there is none at all. Hence, owing to the difference in the intensity of the c.f., there must be, and is, the greatest amount of matter collected about the Equator, and if, as the geologists say, the earth was originally molten matter, or in a state of fusion, this theory of c.f. is quite unassailable. Astronomers have observed in other planets a flattening similar to that of the earth, and due to the same cause. I certainly will stand by the "idea" that the force of gravity is greater at the Poles than at the Equator; it is not an idea, but a well-known fact that it is so, as a brief study of the theory of the pendulum will soon convince "J. W. T." It is found, on taking a pendulum from the Equator towards the Poles, that the number of oscillations in the same time continually increases, hence demonstrating that the force of gravity increases from the Equator to the Poles. "Is not a chronometer independent of gravity?" that is just the question. The inertia of the balance, certainly not the momentum (nor can the strength of the balance spring enter into the consideration of this question, as it would be unaltered in either case), is one of the main factors, and is in proportion to the mass; but how the real mass of a balance, which in a chronometer is comparatively great, is to be "regardless of weight," I do not see.—FIRST-CLASS HONOURS.

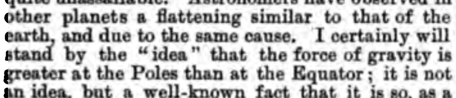
[57594.]—**Gunboat.**—I send herewith two rough drawings of the *Northampton*. Fig. 1 is an outline

FIG. 1.



of her hull, and Fig. 2 is a half section of her deck, showing how her guns are placed. A A are 18-ton guns, and B B B B are 12-ton guns. She has three

FIG. 2.



decks—upper, main, and lower; her guns are carried on the main deck, and she is barque rigged. A six-feet model of the *Northampton* would look both handsome and imposing, but I do not see how querist is to obtain particulars of all her minor details (unless he is content to draw upon his imagination) as they are not published.—JAMES M'CASH GOVAN.

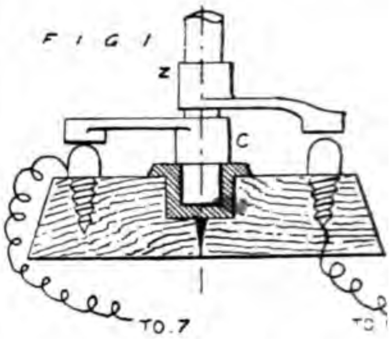
[57740.]—**Free Reeds—Tuning.**—There appear to be two correspondents using the signature G. Fryer, which must be very objectionable to the real Simon Pure. On p. 481 of the last volume it is stated that "American organ reeds, in most instances, are voiced and tuned in a tuning apparatus which is used in the various factories in which American organs are made." The writer of that is in some doubt as to the price of harmonium reeds, but there is no doubt that he thoroughly understands the other matter. That is one G. Fryer; the other appears on p. 344 of this volume, and wishes to inform somebody that "there are many reed-organ factories (to my knowledge) who do not use the tuning bellows." "If a reed-organ maker buys his reeds (and there are many such) he will, or does not, require this mysterious piece of machinery." Now at the end of the reply which appears on p. 481 last volume, the G. Fryer there writing indignantly repels the suggestion that he was not acquainted with the "tuning bellows," which the other G. Fryer now terms a "mysterious piece of machinery," but, strange to say, is going to elaborate into something worthy of the title of a "tuning apparatus." The modern G. Fryer says that "the chief use of the tuning-bellows is for the purpose of filing reeds up to pitch; but in no true sense of the word are the reeds tuned, either 'rough' or 'fine' in the apparatus described on p. 322." Without stopping to inquire how a bellows of any kind can act as a file, or even what is the other use of the tuning bellows according to this G. Fryer, it may be as well to point out that few, if any, reed-organ builders make their own reeds; that harmonium reeds are filed up to pitch on a tuning bellows by those who make them; that, as a rule, they require very little tuning when screwed on the pan; that American reeds are generally imported in the cavity board without having been touched by a file, and that they are filed up, voiced, and tuned on just such a "rough affair" as I described on p. 322, which, so to speak, was "drawn from the life," and described as found in use by a man who has filed and voiced more American organ reeds than G. Fryer could carry. I have one more passage to call attention to. This G. Fryer, on p. 344, says that if he had "understood previously that the querist required to know how to construct the rough affair recently brought to light," he would have sent sufficient information in the first place; but the other G. Fryer was distinctly told on p. 393, last volume, that the querist wanted to know how to make a tuning bellows, and the querist himself said on p. 529, last volume, that that was what he wanted. Further, in the query bearing the above number, which appeared on p. 131 ante, a Mr. Fryer was expressly asked for "instructions how to make a tuning apparatus," which he did not give, but says now that if he had known what was wanted he would have sent them before. I believe he would; but I suspect this G. Fryer did not know what a tuning bellows was like until he read a description on p. 322. I may be mistaken in supposing that there are two G. Fryers: I hope I am not, for the sake of the one who bears that name.—N. E. CHILD.

[57774.]—**Coupler to Harmonium.**—How "recent" have been those improvements in pipe-organs by which the touch is rendered almost equal in lightness to that of a pianoforte? Both pneumatic and electric actions are getting quite old now; they can be made lighter than a piano, but "too light" is as bad as "too heavy," and one of the best of the pneumatic actions at the Inventions was expressly designed to give the organist the sense of feeling the valves opening. There is no difficulty in having octave couplers to harmoniums without producing a heavy touch; but it is not easy to add one of these couplers to an instrument already built.—F. A. C.

[57813.]—**Gramme Dynamos.**—I am much obliged to "Sigma" for stating his views; and I bow to the common-sense of his argument, that it is better to use that nomenclature (irrespective of its scientific truth) which is best understood by those to whom you write. I shall, therefore, in future, when writing to the "E. M.," call that part of the needle which points to the north its N. pole. I saw a very simple rule in the *Electrician*, which is worth repeating. The thumb of the right hand will point to the N. pole when the palm of the hand is placed on the coil, with the fingers parallel to the wires, and pointing in the direction of the current.—W. H. EAVES, Coventry.

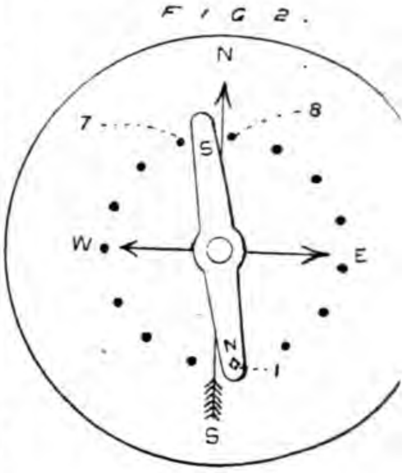
[57859.]—**Electric Wind-Direction Vane.**—Mr. Hindle's arrangement, as shown on p. 322, is certainly very simple, but there are a good many wires. If he were satisfied with pointing nearly to the various points of the compass, this modification would nearly halve the number of wires. In Fig. 1 there are two insulated springs on the shaft of vane, one connected, by a spring or otherwise, with the zinc pole of a battery; the other to the pole of another battery. The other poles two batteries are connected to earth. The magnets in the receiver arranged as in Mr

FIG 1

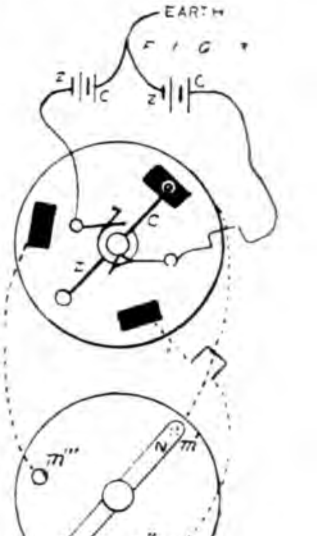


except that they are not horseshoe, b magnets, all similarly wound. The needle netised, and the north pole will always itself to the electro-magnet which happens south polarity, and the N. pole to the which has S. polarity. I have shown in

FIG 2.



15 magnets, and, therefore, 15 wires, giv points. Seven wires would allow the in move $\frac{1}{13}$th revolution, with 9 would move $\frac{1}{18}$ on. How does Mr. Hindle prevent his wasting by being always in circuit? Som ago I designed a vane which would work wit one wire, and in which the current wa



momentary, however long the van place. I am not at liberty to p Fig. 3 shows connection for th points.—GLATTON.

[57955.]—**Organ Pedal Pi** is this—I have a chamber or

:h; one manual or great organ, with pedals l down keys only, and not a separate pedal

I am now going to add swell organ with :ops through, and also a separate pedal organ on 16ft. tone, stopt. I should like a hum- :one. I have both played and listened to organs, and I generally like the tone of ; built by Foster and Andrews, of Hull, or h, of London; but, of course, these have n different churches and chapels, and I sup- he size of their pipes would not be suitable amber organ. If you will answer the above, so give diagram of concave radiating pedals, .ss CCC to E, two octaves and a third, I shall ı it a favour. Hoping N. E. Child will : me asking the question.—AMATEUR ORGAN DER.

)17.]—**Carpet-Beating Machine.**—There in existence at a steam laundry and carpet- ıg place near Birmingham. I almost think y a Nottingham firm.—R. GODFREY.

)13.]—**Metal Moulds for Vulcanite.**— plaster of Paris is used, the article has to be up and polished. When we want to bring ılcanite all finished and with a fine polish or moulds are made for the purpose of grain ıd they answer admirably.—DENS.

)41.]—**Springs.**—There is not much infor- n of the kind required by this querist; but ps the following will help him. For cylin- round spiral springs—

$$L = P \frac{\pi}{16} \times \frac{T^3}{R};\quad D = \frac{32}{\pi}\,\frac{L\,R^2\,A}{G\,T^4}.$$

ylindrical flat spiral springs—

$$L = \frac{P}{3R} \times \frac{B^2\,H^2}{(\sqrt{B^2 + H^2})}$$

$$D = 3\,\frac{L\,R^2\,A}{G} \times \frac{B^2 + H^2}{B^3\,H^3}.$$

safe pressure on spring in tons.
strain on spring in tons.
deflection in inches per ton of load.
thickness in inches for round spiral springs.
breadth in inches for flat spiral springs.
height in inches for flat spiral springs.
radius of cylinder in inches.
total length of the spring supposed to be stretched in a straight line.
¦ E: E being modulus of elasticity.—N. A. I.

)42.]—**Washing Fluid.**—Steep them in a ıre of water, dissolved soap, soda, and a little ıtine.—LAUNDRYMAN.

)51.]—**Cement for Lead on Damp Walls.** is usually fastened to the wall with paste strongly antiseptic with alum, corrosive sub- :, or something that will prevent decompo- . By the way, I don't think much of this lv. What is the cause of the wall being ?—NUN. DOR.

)55.]—**Tonnage of Ships and Steamers.**— ıeasurement tonnage of a ship is her tonnage ated according to her length, breadth, and ; tons burden or nett tonnage is her actual ng capacity, and is found by deducting her e and crew space, which is included in her tonnage, and thereafter calculating every bic feet of cargo space as one ton. Ships are iably designed to carry a cargo considerably er than, often nearly double, their register ge, as it is upon their register tonnage that pay dues, &c.—JAMES M'CASH GOVAN.

064.]—**Electrotyping.**—The process seems :t enough (except that you had two eyes); erhaps you did not move the articles about onally, or possibly the coating of plumbago ot perfect. Do you mean that you connected 'o eyes to separate wires and different poles? u use anodes of copper sheet? If so, only a ı must be inserted at starting, and the bat- ower must not be too vigorous at first.—

78.]—**Varnish for Zinc.**—How long is the expected to resist hot water and soap? I think stoving copal or amber varnish the kely preparation to answer the require- —NUN. DOR.

.]—**Cabinetto.**—Mr. Wenham stated in se of his articles that a suitable paper was these music rolls. It is a whitey-brown r, with smooth surface, and tolerably If I remember, he said it could be ob- Spalding and Hodge, Drury-lane; but paper warehouses would, no doubt, keep 's INN.

—**Jet Black Shineless Varnish.**— ions are rather too much, I am afraid. tine varnish and lampblack, two or and dust over the last coat whilst wet -sifted coke dust. You could try t coat mixed with glue, and olour, varnish o

[58094.]—**Unable to Sleep.**—The best way is to speak to the farrier about it. If he will not alter the arrangement, he can be proceeded against for creating a nuisance. The least expensive way is to move, and to tell your landlord that you are going solely in consequence of the nuisance.—LIMB-O'-TH'-LAW.

[58095.]—**Clock Chain.**—In the circumstances, and considering what you have done to the chain, I think it would be advisable to procure another. —T. J.

[58096.]—**Tempering Railway Waggon Springs.**—The plates are tempered in the usual manner, one at a time. They are bent to curve, and dropped into water perpendicularly. They are then "lowered" by holding in the furnace without touching the coal until hot enough to light tallow melted on them. They are then plunged into water, and should have spring temper. No special furnace is required. Any one large enough will do.—S. R.

[58097.]—**German Green Soap.**—This is Continental soft soap, known as Savon vert. It is made mainly from vegetable oils, while our soft soaps are made from fish oils. I should think it might be procured from some of the large drug stores, or possibly some of our Continental readers can give an address where Savon vert, or die grüne Schmierseife can be obtained in France, Belgium, or Germany. Failing that, it would perhaps be possible to make it in this country.—NUN. DOR.

[58106.]—**Landscape Photography.**—I should imagine that it is due to the quality of the plates, which are perhaps too quick for taking distances. What kind of a day was it?—P. R. J.

[58213.]—**To Mr. Grey.**—I suppose that uricate of potash means urate of potash. This salt crystallises without any water of crystallisation; but if the querist wants to obtain hydrated crystals, he might try to do so by cooling below freezing point a saturated solution of the salt. Many salts whose crystals are usually anhydrous can be obtained hydrated by this means, which was discovered by Guthrie. On adding KCy to a solution of ammonia partial interchange will occur, and the solution will contain AmCy, KCy, KHO, and AmHO, but I do not know that the exact proportions can be given.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[58226.]—**Colouring Brass Fishing Reels.** —To colour brass fishing reels black bronze, clean the reel in aquafortis, rinse it in water, and then place it in the following mixture, until it is of the desired colour: 12 parts of hydrochloric acid to one part each of sulphate of iron and pure white arsenic. Having taken the reel out of this mixture, you rinse in water, dry in sawdust, polish with blacklead, and lacquer with green lacquer.—S. H.

[58231.]—**Artificial Memory.**—Prof. Pick's method was to connect two ideas, in themselves unconnected, by some idea which had a connection with each—*e.g.*, to connect "tooth" and "friend." You think of tooth, toothpick, Pick, your friend. Sometimes he carried the connection through a whole series of objects; thus, to connect "coal" and "time"—coal, fire, chimney, chimney-piece, time-piece on it, time.—AN OLD PUPIL OF PROF. PICK.

[58231.]—**Mnemonics.**—The following extract from "All About Mnemonics" may give what is desired respecting Dr. Pick's system:—"Dr. Edward Pick, who was a pupil of Carl Otto, taught the latter's system in Germany in 1853, and thereafter lectured on the subject in London, preceding Stokes in his entertainments at the Polytechnic. The system as taught by Pick differed but slightly from that taught by Beniowski. In 1863, Pick published a work on 'Memory and the Rational Means of Improving it.' The most valuable portion of this was that devoted to the principles of memory. In associating ideas he contended that the first impression was always the strongest, and to insure strong impressions he gives as a rule that no more than two ideas should be placed before the mind at once. Attention being given to two ideas alone, the mind would then make its own natural association, by comparison. This natural association would always be found to be the strongest, and consequently would be the easier to recall. Pick defined the laws of association as follows:—1. Analogy: similar ideas suggest one another, as tree and branch, bookseller and paper. 2. Opposition: opposite ideas recall each other, as light and darkness, fast and slow, &c. 3. Co-existence: ideas that have previously existed in the mind together will recall each other, as Cain and Abel, Epps and cocoa, &c. 4. Succession: ideas that have previously succeeded each other in the mind will recall each other, as Plague—Fire of London. Analogous or opposite facts or ideas were remembered by comparison, noticing where they agree or differ, taking care to compare two only at a time. The words 'England, navigation, m, railway, telegraph, electricity, thunder, storm, &c.,' were presented to the mind in couples, as—'England—navigation; navigation—steam; steam—railway; railway—telegraph,' &c. Ideas that were neither analogous nor opposite were associated with an intermediate idea. This rule is best explained by Pick's method of associating the following disconnected words:—"Garden, hair, watchman, philosophy, copper, cloth, workman, apple, eclipse, dream, coal, balloon.' These were to be compared in the mind as follows:—"*Garden*—plant—hair of plant—*hair*; *hair*—bonnet—*watchman*; *watchman*—wake—study—*philosophy*; *philosophy*—chemistry—*copper*; *copper*—cover—*cloth*; *cloth*—tailor—*workman*; *workman*—gardener—garden—*apple*; *apple*—earth or moon—*eclipse*; *eclipse*—dark—night—*dream*; *dream*—nightmare—suffocation—*coal*; *coal*—gas—*balloon*." Pick's method is a thoroughly practicable one, and is now largely used."—A. E. MIDDLETON.

[58252.]—**Hardening Steel**—Have you a steel which does not contain enough carbon. That is an extremely necessary constituent part. We all know it is almost impossible to harden soft steels containing, say, 1 per cent. carbon. Does your steel work easy?—if so, you may rely on its being soft. It is a very peculiar way in which "J. F. G." describes his hardening process, especially his heating to a white heat. He will find he destroys all the nature of any class of steel he may so treat. My firm impression is that you have been overheating your steel; the less heating the better, after manipulating return to the fire until blood or cherry red; then temper.—BESSEMER.

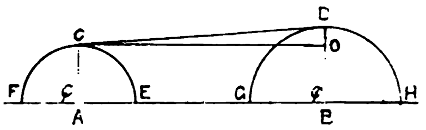
[58268.]—**Steam-Pressure Gauge.**—I think "Belgian's" advice to "Steam Gauge Cock" of last week is rather elaborate. Why have a cock drilled at side to communicate with atmosphere when steam is off? The fact of the pointer of a gauge coming back to zero does not prove gauge to be correct (and I imagine "Belgian" would not think so if he had the testing of a few). The cock is simply used in case you require to remove gauge under steam, which could not be done without cock. —E. E. W.

[58274.]—**Regenerative Gas Fires.**—"T. F." in his reply to "B. Sc." is mistaken in advocating burners of a lower temperature as more diffusive than regenerative ones. They are no such thing. What should be aimed at, according to eminent authorities, is the securing of as much radiation as possible, and this is most unquestionably obtained in the most efficient manner by use of regenerative burners. As to "T. F.'s" remark about "charring the dust," I must say that it leads me to believe that he has had no experience of regenerative fires. I have one in use which I have thoroughly tested, and it does not offend in this manner. I have had it lighted in a very small room, where there is no chimney or ventilation, and the result was everything that I could desire. In making arrangements for heating, it should be remembered that the heat is required near the floor to be satisfactory; and that, though the heat evolved is the same in all burners, the disposal of it differs very considerably.—J. G.

[58282.]—**Mariner's Compass.**—The brass tube at the back of Sir William Thomson's compass contains what is called a "flinders bar" —namely, a bar of soft iron 3in. in diameter and 24in. in length, cut into pieces of 12in., 6in., 3in., and 1½in., and two pieces of ¾in., so that you can put in as much as you require The longest piece should be at the top, and the others below, in order of their lengths. There is also a round piece of wood cut to the same sizes, so that when you take out a piece of iron you put in a piece of wood the same size in below the rest of the bar, so as to keep the iron at the top. The object of the "flinders bar" is to help and correct the "semicircular error," and also to wholly correct the "heeling error" on east and west courses.—CORSE DE LEON.

[58303.]—**Forge.**—I see by your issue this week that "A., Liverpool" makes the assertion that a fan, unless driven by power, is an infernal humbug. I take this opportunity to inform him that instead of being an infernal humbug, it is an accomplished fact, and that they can be made to work by hand and to be quite equal to the work done by an ordinary smith's bellows and at about one quarter of the cost. I have at these works a 12in. fan, driven by hand, which is quite able to do all the work required at these works. It was designed and constructed by my assistant, G. W. Young, and self, as an experiment, and I might say here that the amount of work done by it was an agreeable surprise to both of us. It has been at work since August, 1884, and is as good to-day as it was the first day it was made. We have had several visitors looking at it, and they are perfectly satisfied as to its perfect working, and have been quite taken up with it. I might state here that the cost for material, including wooden fly-wheel (exclusive of labour and gut band) would not exceed 10s. If agreeable, and likely to be productive of any good, I should be happy to send sketch of details," &c., for insertion.—JOHN YEOMAN, Harrington Gasworks.

[58308.]—**Length of Strap.**—"Amateur Jack" may find the length of his strap in a practical way by drawing on a board two circles, with diameters equal to the diameters of the cone pulleys plus half the thickness of strap, and placed at the required distance apart, and by inserting pins or tacks around the outer circumference of each, he can then, by means of a string, ascertain with sufficient accuracy the length of the strap. Probably, however, he wishes to know how this may be determined by calculation. In the annexed figure,



G D H and F C E represent one half of the large and small pulleys respectively; D B and C A their respective radii, plus half the thickness of strap, each at right angles to C D; at C and D the tangential points at which the strap leaves the pulleys. Then will F C D H equal one half the length of the strap. Draw C O parallel to A B.

Let R = radius of larger pulley
r = radius of smaller pulley
d = A B = distance between centres
ϕ = angle F A C = G B D = C O D.

Then, from the right-angled triangle C D O we get

$$CD = \sqrt{CO^2 - DO^2}$$
$$= \sqrt{d^2 - (R - r)^2}$$

Also, sin. C O D = sin. F A C = sin. G B D

$$= \sin.\ \phi = \frac{CD}{CO} = \frac{\sqrt{d^2 - (R - r)^2}}{d}$$
$$= \sqrt{1 \left(\frac{R - r}{d}\right)^2}$$

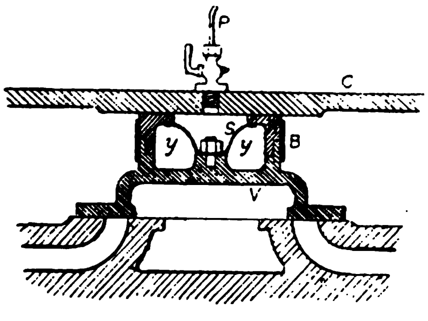
Whence the angle ϕ can be obtained. Then the arc F C will be equal to ·01745 × $r\,\phi$; and the arc D H will equal ·01745 × R (180 − ϕ). Hence, the total length of the strap will be

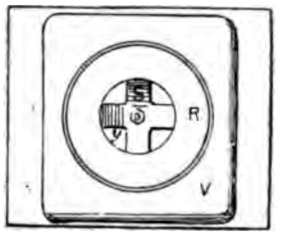
$$= 2\left[\sqrt{d^2 - (R - r)^2} + {\cdot}01745\,(r\,\phi + R\,(180 - \phi)\right].$$

LYONS, Dec. 12.

[58309.]—**Slide Valve.**—I heard a short time since of steam being admitted into the cylinder (with, I understood, an ordinary slide-valve) through the middle or exhaust port, the steam ports being used as exhaust ports. Thus the surface of valve exposed to the pressure of live steam would be reduced by the bearing surface of valve. Springs would be needed at back of valve to keep it tight. If this were done, the position of eccentric would be as much behind the crank as it is now put in front. I have not seen an engine working thus; but the plan seems feasible enough.—BOWLING.

[58309.]—**Slide Valve.**—There are many different ways by which the pressure is relieved off the back of a slide-valve. I send a rough sketch



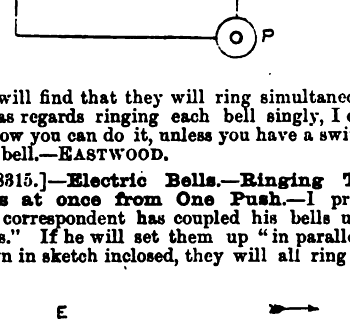


of a valve I have seen fitted to a marine engine. The valve V has a spigot on the back of it, into which fits a ring R. The spring S is in the form of a cross, and presses the ring up against the valve-chest cover C, which has a faced part on it to allow the ring to work with the valve, and be steam-tight. The joint between the ring and valve is encircled by a rubber band B, to prevent any possibility of a leak. The space Y inside this ring is connected to the condenser by the pipe P. We have now destroyed a space equal to the area of the outside diameter of R from the steam pressure, and we have the vacuum in Y to help to overcome what is left of the valve exposed to the steam pressure.—MENAI.

[58311.]—**Electrical.**—R. A. R. Bennett's reply to 58260 applies to this and many other queries of the same class. "J. T. P." might try, say, three "Silvertown Firing Batteries," which are Leclanchés on an enlarged and improved form, or three or four of the six-block form Leclanché battery. These are 9s. each cell, and would answer the required purpose. I have found from experience that Leclanchés in other forms are of no use for such work.—S. BRETTON.

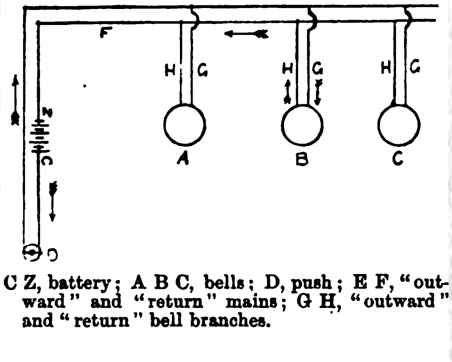
[58314.]—**The Bichromate Battery.**—To describe the different forms of this battery would take up a deal of space, and reiterate a great deal that has been "thrashed out" in these columns. I may at once say that the Trouvé form is the best now before the public. It is composed of two plates of carbon and one of stout zinc, and I believe was a short time ago fully described in the "E.M." The solution used is made as follows:—Water, cold, 36oz.; powdered bichromate potash, 8oz.; add very slowly 15oz. of sulphuric acid. This heats the solution gradually, and causes it to become super-saturated; no chromic alum crystals are formed upon cooling. At first contact, it gives 2 volts, r = ·0016 ohm; after what we may call the spurt, 1·9 volt, r = ·07 to ·08 ohm. Will give further description and sketch, if desired.—S. BRETTON.

[58315.]—**Electric Bells.**—If you connect your bells up, as shown in the sketch I give you, I think



you will find that they will ring simultaneously; but, as regards ringing each bell singly, I do not see how you can do it, unless you have a switch to each bell.—EASTWOOD.

[58315.]—**Electric Bells.—Ringing Three Bells at once from One Push.**—I presume your correspondent has coupled his bells up "in series." If he will set them up "in parallel," as shown in sketch inclosed, they will all ring when

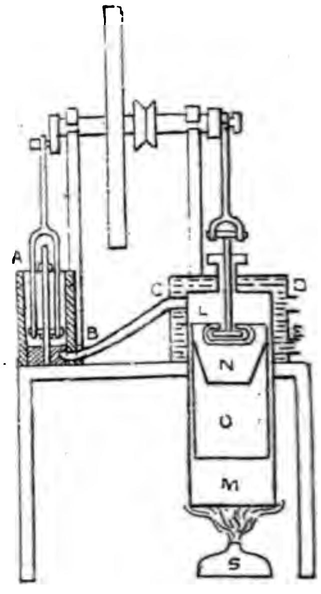


C Z, battery; A B C, bells; D, push; E F, "outward" and "return" mains; G H, "outward" and "return" bell branches.

the push button D is pressed. To cut out one or two of the bells, it is only necessary to insert a switch at any point between the main leads and the bell branches. To insure equality of effect it is desirable that the magnet bobbins should be wound with equal lengths and gauge of wire, so that each of the bells may offer the same resistance. Otherwise the "current" would avail itself of the bell having least resistance in it, leaving the others to be only feebly sounded, or, perhaps, not sounded at all.—LLAHMAILLIW.

[58314.]—**Bichromate Battery.**—Exists in two forms—A with a porous cell, B without a porous cell. Of the former only one modification is in general use, and this consists in a zinc rod having a large base standing in a porous cell, and surrounded by a carbon plate in an outward stoneware cell. Water only is placed in the porous cell, while a saturated solution of bichromate of potash, to which ⅛ of its bulk of sulphuric acid has been added, is placed in the outer cell. Mercury is placed in the porous cell to assist in keeping the zinc rod amalgamated. In the form invented by Cloris Baudet in 1879, there is a supply of sulphuric acid and bichromate arranged in the outer cell with the carbons so as to keep up the strength of the depolariser. In Higgins's cell the zinc, which is perfectly amalgamated, stands in a mixture of 1 part of sulphuric acid to 30 of water, the carbon plate, in a chromic solution, containing 45 parts water, 15 sulphuric acid, and 5 of bichromate of potash (by weight). In D'Arsonval's form we have a porous pot full of broken-up retort carbon, plain water with the zinc; the depolariser is a mixture of equal volumes of hydrochloric acid, and saturated bichromate of potash solution. Of the second form (without porous cell) we have Poggendorf's form, which was invented in 1842, consisting of zinc and carbon rods, or plates immersed in a solution of 1 part of bichromate of potash dissolved in 10 parts of boiling water, to which, when cold, is added half a part of sulphuric acid. Delauner modified the solution, putting 80 parts of water, 18·4 of bichromate, and 42·6 of sulphuric acid. Chutaux, in 1868, devised a modification of this battery, in which the fluid was kept in circulation in the cells by means of siphons, &c. Besides the bichromate solution as described above, he added half a part of bisulphate of mercury. Dronier modified the solution by mixing bisulphate of potash with the bichromate solution instead of sulphuric acid. Fitzgerald and Molloy were the first to propose the use of bichromate of sodium and of calcium, instead of the potash salt. Now, Anderson and others have claimed priority for the use of these salts, which are more soluble than the corresponding potassium salt. Trouvé's solution consists in adding 15oz. of strong sulphuric acid, drop by drop, to a mixture of 36oz. of water and 8oz. of powered bichromate. The zinc must be well amalgamated. Tissandier's receipt is the same as Trouvé's. M. Grenet devised the bottle battery. Trouvé, Gaiffe, and Ducrete suspended the plates from a windlass.—S. BOTTONE.

[58318.]—**Hot-Air Engine.**—I send section of the hot-air engine of which a perspective drawing is given, p. 246, No. 1078. A B is the working



cylinder, with a pipe from the bottom at B to the top of the heating cylinder L M, the bottom of which is heated by the spirit-lamp S, and the top cooled by a watertight casing, through which a constant current of water flows by the inlet E and the outlet D. In the heating cylinder, L M, is the copper plunger N O; the part O is filled with small lumps of charcoal, and N is a tin plate dish containing asbestos or else plaster of Paris; finally, a top piece is soldered or screwed on airtight. This top piece can be moved by a button at the end of a rod which passes through the stuffing-box in the top of the heating cylinder; the plunger hangs on this button when the rod moves up and down, like the slide-valve of a common vertical steam-engi[illegible] which has a similar action. The crank of working cylinder is at right angles [illegible] crank. The plunger should be [illegible] diameter to catch the air and [illegible] It must be observed that the hot-air [illegible] different to a steam-engine, and the ot by the quantity of air it contains, but by ount of surface contained by the air-heating r. For this reason small engines are better rge ones.—J. SUTCLIFFE.

19.]—**Soda Ash.**—5·0 tons of 51·1 per cent. mixed with 2·2 tons of 47·5 per cent. alkali, e 7·2 tons of 50·0 per cent. alkali.—GARN- ROAD.

19.]—**Soda Ash.** — Find the difference n the percentage of each material and the age of the desired mixture, and interchange nbers so found; this will give the proportion h the two ingredients should be mixed.

Thus A contains 51·1 per cent.
B contains 47·5 per cent.

A	51·1	∽	50	2·5
B	47·5	∽	50	1·1

ore, bringing the sum to whole numbers, s of A must be mixed with 11 parts of B to product containing 50 per cent. Then a rule-of-three sum will show how much of B required to reduce five tons of A.

: 11 : : 5 : 2·2. Ans. 2tons 4cwt.

JACKSON, Bridlington Quay.

3.]—**Bookcase.**—Mix some lampblack th French polish, and polish in the ordi- ay.—S. H.

23.]—**Bookcase.**—With glass paper make smooth as possible. Stain black thus: or four coats of sulphate of iron solution, l to dry between each coat, then apply a hot on of logwood and nutgalls two or three et dry, paper down with fine paper, slightly ied with linseed oil. Polish in the ordinary sing white French polish; procure some fine powder, tie same in piece of rag, and dust rk occasionally during the polishing: this oduce a dull, heavy polish, as ebony. If the g above suggested is too much trouble, use n's black stain instead.—S. BRETTON.

27.]—**Painting Magic-Lantern Slides.**— n slides are painted with ordinary water- , then varnished with Canada balsam dis- in an equal quantity of turpentine. The rent colours are Prussian blue, burnt gamboge, burnt umber, all the greens, all es, rose pink, and carmine.—S. H.

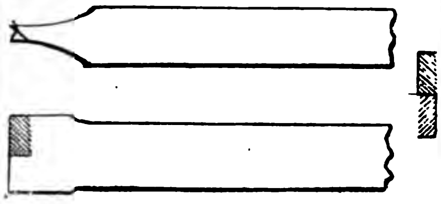
27.]—**Painting Magic-Lantern Slides.**— tried both oil and water-colours, and have quite an expert in painting with these, so y advice may be useful. A shilling in- n book is published by Messrs. Bernard and tists' colourmen, in Oxford-street (I forget mber). Ordinary colours will answer so we use only the transparent colours; these ussian blue, French blue, crimson lake, yellow, gamboge, burnt sienna, and a few Painting in water-colours is easier than in oils take so long to dry. Water-colours be varnished after each coat to prevent g off the paint. I found the best varnish to ada balsam dissolved in turpentine, as it twenty minutes, and takes water colours If oils are used, the best medium I found to inary turpentine, and a good smoothing hould be used, as I don't think much of abbing" process for oils—a dabber is useful er-colours: otherwise it is impossible to get nt. The dabber should be of very soft wash- , well washed and stretched, then a piece be made up into a little ball with cotton side, and tied at the neck with thread. Get eady outlined subjects to begin with; they each. But by far the most brilliant pro- that of painting, or rather dyeing on gela- I get plates ready prepared by Wratten and right, Great Queen-street, W.C., 3¼in. square. are made for taking photographs on for the , so I dissolve the chemicals out in a strong 1 of hyposulphite of soda, leaving only the e. Of course they must be well washed and 1 a cool place. The subject may then be with a lead pencil. Judson's dyes can be any chemists for 4d. or 6d. each little bottle. equire to be diluted considerably with water using, and they must not be mixed before The plate should be wetted before using s, at least that part of it on which you are paint; there is no drying required, and es not affect the picture. The plate should swilled with water during the painting; s no fear of washing off the colour. The however, are apt to fade, and must be hened. The result is very beautiful, if well ont of course some practice is required. In ocess there is no grain or spotty appear- hen magnified, such as we find in other s.—M.I.C.E., Bath.

—**Testing for Metals.**—If "J. B." gh chemistry to do this from mentary works on analysis, d in the "E.M." pace. The allo[illegible] contain any or all of at least 10 metals.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[58331.] — **Tempering Circular Milling Cutters.**—Put your cutter in the fire until cherry heat; slake at once in water; then take a piece of metal (or two if required); get red hot, and place your cutter on; you will see your temper line run when hot enough; then slack off at plum colour, when at end of teeth. You need not be afraid of their buckling if they are thick enough—say, ⅛in. in body.—BESSEMER.

[58337.]—**Keyways.**—Your idea of a traversing drill is correct. The drills have a square end, and look rather like two wood chisels (though, of course, not ground so sharp) placed side by side, and facing opposite ways. Will send one for inspection if necessary.—BOWLING.

[58337.]—**Keyways.** — I suppose "Belgian" means sunk keyways. Where quantities are made, they use a special tool called a slot drill. This machine is made different ways: some have a spindle to move on a horizontal slide, and the table to move up and down; others, the table moves horizontally as well as up and down, the spindle being the same as in an ordinary upright drill, only without up and down motion. The article to be cut is held in a vice. They may also be cut in a milling machine, or, as "Belgian" thinks, in a lathe. The cutter used is something like the sketch given.—W. M., JUN.



[58344.]—**The Richardson Arc Lamp.**—This lamp is in use at Robey's works, Lincoln, I believe, and a letter addressed to Mr. Richardson there would no doubt meet with a reply.—NUX. DOR.

[58350.] — **Electric Lighting.**—I am surprised that Mr. Bottone cannot understand the difficulty of this querist, as it is one that often arises in practical electric lighting. I am also surprised that Mr. J. H. Hindle should state that the insertion of resistance will not reduce the E.M.F. of a dynamo, and I think if he will quietly think the matter over he will alter his opinion. The amount of resistance the querist must insert in series with each lamp is roughly 6·7 ohms. I understand that the querist wishes to run more than one lamp; in this case, it would be better to run the lamps on a separate parallel, as only one resistance coil would be required, the resistance would then depend on the number of lamps: If ten lamps, then 6·7 ÷ 10; if five lamps, 6·7 ÷ 5; if 20 lamps, 6·7 ÷ 20.—W. H. EAVES, Coventry.

[58352.]—**L. T. and S. R. Engines.**—These engines, 30 in number, were built by Sharp, Stewart, and Co., of Manchester. The following are the principal dimensions:—Cylinders (outside), 17in. by 26in.; centres apart, 6ft. 8in. Diameter: Bogie wheels, 3ft. 1in.; coupled wheels, 6ft. 1in.; trailing wheels, 3ft. 1in. Centres of bogie wheels, 6ft. 6in.; centre of bogie wheels to centre of front coupled wheel, 10ft. 4in.; centres of coupled wheels, 8ft. 6in.; centres of hind wheels to centre of trailing wheels, 7ft. 3in; total wheel base, 32ft. 7in. Boiler barrel: length, 10ft. 6in.; diameter inside, 4ft. 1in. Firebox: length at top, inside, 5ft. $1\frac{15}{16}$in.; length at bottom, 5ft. $4\frac{3}{16}$in.; width inside, 3ft. $2\frac{3}{4}$in.; height inside, 5ft. $5\frac{5}{8}$in.

Heating surface, 200 brass tubes, 10ft. $10\frac{1}{16}$in. long, $1\frac{5}{8}$in. outside diameter	923 sq. ft.		
Heating surface firebox	97 ,,		
Total	1,020 sq. ft.		
Grate area	$17\frac{1}{4}$ sq. ft.		
	tons	cwt.	qr.
Weight on bogie (leading)	15	18	0
,, front coupled wheels	16	0	2
,, hind ,, ,,	16	0	2
,, trailing ,,	8	2	3
Total weight	56	1	3

The trailing wheels are fitted with radial axles, giving the engines a very small rigid wheel base. The cab is very commodious, and extends right over foot plate; a sketch is given in No. 951. Painted green, picked out with various coloured lines, and are named after stations on the company's road. Capacity of tanks, 1,300 gallons; capacity of coal bunkers, 50cwt. These engines ·ow having the steam brake taken off, and being fitted with the Westinghouse, the donkey being fixed on the right hand side of the smoke box. Any other information willingly supplied.—UPTON PARK.

[58353.]—**Soda Ash Analysis.**—The NaHO and Na_2CO_3 in ash may be estimated direct with standard acid solution and phenacetolin as indicator. The alkaline solution is made faintly yellow by the addition of a few drops of phenacetolin, and the acid solution run in until the yellow gives way to a permanent rose tint, which shows the neutralisation of the NaHO, and that of the Na_2CO_3 by the red giving way to a yellow colour. —GARNGAD ROAD.

[58354—58377.]—**Steam Cock—Grinding-in Steam Valves.**—The advice given to the above correspondents seems to me wrong. To grind cocks, &c., in, loam mixed with water is used, and sometimes, if the cock requires a lot of "tighening," fine flour emery mixed with water is used first, and then finished off with loam. Mix the loam or emery up with water to a sloppy condition, wipe the inside of barrel and the plug clean, apply a little of the mixture to plug, and then work the plug into the barrel with a backward and forward motion, lifting the plug from the barrel a little occasionally. To finish, wipe barrel and plug clean, rub a little tallow over the plug, put it in the barrel, give it a turn or two, and then it will be readily seen if the "bearings" are coming up properly. If a shoulder is formed on the plug, ease off with a smooth file, as recommended by "T. C., Bristol." Loam is a clayey substance, easily obtained in the neighbourhood of Birmingham, and is the material used by cock-founders for the purpose here mentioned. I should, however, pick up any fine lump of clay, free from stones, dry it, crush it up, and sieve it. The genuine loam requires no sieving.—HUGO.

[58357.]—**Vine Pruning.**—Vines on outside walls or in unheated houses are best pruned on the "short spur" system, cutting back the current year's growths to one or two eyes from where they sprang. This should be done as soon as the leaves have fallen. A few rods of last summer's growths may be retained to fill up any vacant space, provided they are well ripened. All unripened shoots must be cut back to where the wood is mature. At no time should vines be allowed to make more growths than can be laid in without crowding. Those shoots that do not show fruit shorten back, leaving three or four leaves to preserve the spur.—W. EVANS.

[58357.]—**Vine Pruning.**—I have some experience in vine pruning in a climate very ill-suited to grape growing, and I give it to "Hortus," merely premising that it has reference to vines under glass, but without heat. Situation, N.W. of Ireland, and, therefore, probably similarly situated to vines in open air in South of England. Spur-pruning is undoubtedly the most generally suitable; but some kinds of vines do best on the long-rod system. What vines have you? "Early stopping" cannot take the place of winter pruning. As soon as the bunch shows, stop the shoot two leaves beyond it, and when the buds at their base push, as they will, stop to one leaf. Treat all after shoots in the same way all through summer. It is advisable, at winter pruning, to cut out the unripe wood. The vine bears best from eyes on new wood, so they must not be all cut out; but the old spurs must be cut out when too long. They may be 6in. without being too long. Take a new rod—the first year the eyes will be on rod, therefore no spurs. Each eye will push, and if they are closer than 12in., they should be rubbed off to that distance. During the season the eyes will grow till they are stopped—two leaves beyond the bunch, leaving, say, five or six eyes altogether on the shoot—i.e., three below and two above the bunch. At winter pruning, this shoot will be cut back to the second eye, or, if the base bud is plump, and the wood well ripened, cut back to it. If two eyes have been left, when they push in spring, if both show fruit, cut off the second, and stop short from first, as in first year; thus your spur will grow at the rate of one or joints each year. Some gardeners will tell you always prune to one eye. This you may do if your vines are strong and your seasons good; but if this is not so, by such close pruning you will lose your crop, as I have more than once proved. The shoots bearing no fruit are treated same as those with bunches.—FREDK. CARRE.

[58360.] — **Jordan's Barometer.** — I inclose sketch of a glycerine barometer which will give readings showing the height of mercury column, and thus it may be easily read and understood by anybody. x, x^1, x^1, x^1, x^1, is a continuous tube closed at y. The dark portion is the glycerine, and the portions x^1, x^1, x^1, x^1 form the air-vessel. There is no danger of a leak anywhere, as the whole is made from a single tube bent over a gas-burner to the shape shown; the glycerine is then put in at z, and y is closed by heating in a flame. T is a thermometer, A is a sliding scale for correcting the height of glycerine for temperature; B is a fixed scale marked as shown 28, 29, 30, 31, and divided into tenths, as in an ordinary barometer. To construct the scale A, find out how much the height of glycerine is influenced by heat, say, 1¼in. for 10°. Then make the divisions on the scale 1¼in. apart, and mark them as in Fig. 2, and sub-divide them into ten divisions. To construct the scale B, find out the equivalent movement due to pressure. This can be done by taking readings at different times by means of a temporary scale, and allowing for temperature. Thus, say the equivalent movement for 1in. of the mercury column is 3in. on the glycerine barometer, then make the divisions on the scale 3in. apart, and mark them as in Fig. 1, and sub-divide them into tenths. To take an observation, suppose the temperature is 80°, and your barometer is correct at 60° (one I have constructed is correct at that temperature; but it is a matter of choice, depending on the position of the scales). You would make the division 80° on the scale A, Fig. 1, correspond with level of glycerine C; the pointer *d* (Fig. 2) will then give the height of the mercurial column, if the barometer has been properly constructed. The sketches are not drawn to scale; but barometer is about 2ft. 6in. × 5in., and ¼in. tube.—ELAG.

FIG. 1.

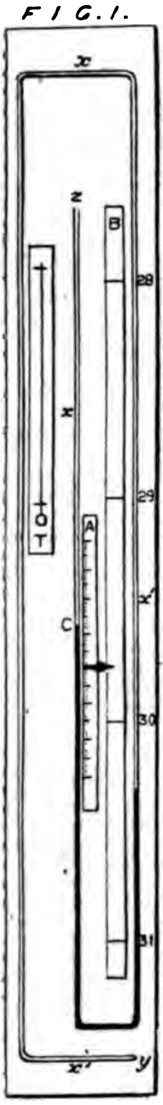
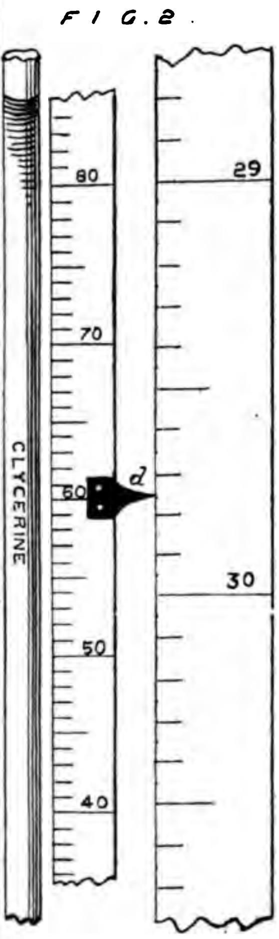


FIG. 2.



[58369.]—**Ammonium Bichromate.**—(1) It is completely decomposed. (2) Chromic oxide is left. (3) The residue is not metallic chromium. (4) The equation representing the decomposition is as follows:

$$(NH_4)_2Cr_2O_7 = 2NH_3 + Cr_2O_3 + H_2O + 3O.$$

—E. J.

[58369.]—**Ammonium Bichromate.**—On heating this salt, it decomposes according to the following equation:—

$$\underset{253}{Am_2Cr_2O_7} = \underset{153}{Cr_2O_3} + \underset{28}{N_2} + \underset{72.}{4H_2O}$$

The chromic oxide separates as a powder somewhat resembling green tea, and occupies a volume many times greater than that of the salt. It is a very good example of resolution, the fifth form of chemical action.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[58369.]—**Ammonium Bichromate.**—This question is answered (save as regards the equations) in the report of Mr. J. M. Thomson's lectures on "The Chemistry of Pigments," at the Society of Arts, in which he says, "By heating ammonium bichromate the ammonia is driven off, and the chronium absorbing oxygen from the air becomes converted into the oxide."—S. AND S.

[58369.]—**Ammonium Bichromate,** when heated in the air, is decomposed into chromic oxide, with the evolution of water and nitrogen. The following equation expresses the change:—

$$(NH_4)_2\,Cr_2O_7 = Cr_2O_3 + 4\,H_2O + N_2.$$

This, in fact, is one of the best methods of preparing chromic oxide which is left as olive-green scales when ammonium bichromate is heated. Metallic chromium cannot be prepared in this way; but it may be obtained by fusing violet chromic chloride with potassium and sodium chlorides, and granulated zinc. The chromium forms an alloy with the zinc, from which it may be afterwards separated by the action of nitric acid, in which metallic chromium is insoluble. The metal may also be obtained by the electrolysis of a concentrated solution of chromic chloride, or by strongly heating chromic chloride with charcoal. It is a very difficult metal to prepare.—HENRY FLECK.

[58370.]—**Watch Query.**—"Lord Pivot" can obtain a tool for the purpose he requires at any London tool-shop or material dealers; should he wish to make one for himself he will find sketches and information sufficient for the purpose in either Britten's or Saunier's handbooks. The best and speediest method, in my mind, is the old one of polishing them on a soft wood block, with bell-metal and grain tin polishers, but it requires a good deal of practice.—FIRST-CLASS HONOURS.

[58373.]—**Finishing Small Forgings.**—The following dull black paint is what I have used for painting the inside of lens tubes: 5oz. of turps, 2oz. of lampblack (mix them well), and add gold size till the paint dries without rubbing off; if it is too glossy, add more lampblack and turps.—S. H.

[58379.]—**Millstone Dressing.**—The furrows should be perfectly flat and smooth. Sink them ⅜in. back edge, and taper to nothing on feather edge. Make your furrows 1⅜in. wide, put in, say, 14 quarters, with three furrows to each quarter; second furrows running or cut into leading one. Give the leading furrow 5in. draft: that is, set it back 5in. from centre of stone, left or right, according to the way in which the stone will run—i.e., with or against the sun. If with the sun, set your furrow stick 5in. at left hand side of centre; if running against, set 5in. to right hand. You have not given sufficient data in your query. You should have given size of stone, also its quality, whether an open or close burr, or what the stones are to grind. If you cannot get sufficient information through this journal, advertise your address and I will give you drawings of dress you require and how to set about putting it in. It would take up too much of the valuable space of this paper, or I would answer your question more fully.—YOUNG MILLER.

[58380.]—**Koumiss.**—There is a recipe on p. 363, No. 1057. On p. 241, No. 999, there is a method of making it in small quantities from cow's milk. Put into a strong bottle (champagne), fresh, unskimmed milk, with one ounce of powdered sugar, and a spoonful of brewer's yeast. Cork and tie firmly, seeing that at least an inch of air space is left between the top of the liquid and the cork. Shake several times and put into a cool place, turning up and down at intervals during the day. In about five days it is ready for drinking. For full information see p. 13, No. 677; p. 632, No. 676; and Nos. 492, 464, 374.—NUN. DOR.

[58380.]—**Koumiss.**—The following is extracted from Whitta's "Materia Medica":—"Sakovich recommends the preparation of koumiss from the fresh milk of the cow in the following manner: He rubs up one pint of a mixture of the fresh, unskimmed morning's milk from the cow and cold water (equal parts) with 15 grains of German yeast in a mortar. To this 1oz. of finely-powdered white sugar is added, and the mixture is poured into a champagne bottle, and exposed for 24 hours in a warm place (a little over 60° F). After this it is carefully corked and tied down, and placed in a cool cellar for five days, after which time it is ready for use. Dose, 5oz. to 10oz. three or four times a day, or oftener. Koumiss is [illegible] valuable in the treatment of wasting lung diseases, in which cases it may be taken *ad libitum*. [illegible] various forms of dyspepsia, and especially in [illegible] diarrhœa of children, its use is attended with very great benefit."—PLAYFAIR.

[58383.]—**Brass Boiler.**—This can be brazed with borax and spelter solder; you will want a good strong fire, and if you are a novice you will probably burn the boiler before it is brazed. It will be quite strong enough if you rivet it and then fill in with plumber's solder; first
bend up to shape, drill the holes
brass rivets, and fill up the seams
This will stand any pressure whi
put on a model boiler.—OS.

[58385.]—**Polishing Hard-w**
A little ordinary French polish
work is removed from the lathe.–

[58390.]—**Silver Solution.**—
is to make some fresh solution
made of hard wood, held togeth
nuts at the ends outside; the sid
beyond the ends to take long b
round for the bottom to fit in tigh
grooved for the ends. If this i
and screwed up, when dry it will h
but I would recommend you to u
shaped glasses such as are sold f
are cheaper in the end, and need
if bought at the right place.—Os

[58391.]—**Arc Lamp.**—See an
consider there are lamps to-day
more steadily, and not cause any
For a 500-c.p. light, use 8 mil
The lamp described by Mr. Bot
periments with the Dynamo" mi
with an improvement added, whi
next week.—JOHN H. HINDLE,

[58393.]—**Lead Wire Spiral**
steel wire for mandrel somewhat
length you want, and bend one en
a winch handle, and put the
wood brackets on a bench or bo
of lead wire to the crank end of m
away. You will require someo
and you will have both hands f
wire.—OS.

[58395.]—**Chemical.**—Bayl
Pocket-book" is a better autho
"Practical Chemistry." The list
given in Jago's "Elementary Ch
accurate.—WM. JOHN GREY,
Chemist, Newcastle-upon-Tyne.

[58397.]—**Light.**—This seem
pure and simple (or else I a
simple). If the sun is 30° abov
must be reflected from the pool a
which is also the angle of inciden

[58412.]—**Regulator for I**
and zinc would be very suitabl
mentioned. Take a strip of e
1in. by $\frac{1}{32}$in. thick, and solder
one on the other on the princip
meter balance wheel rim. Now
fixed and the whole warmed, it w
the unequal expansion of the me
from some experiments made in
free end of the pair would move
$\frac{1}{16}$in. in rising from the ordina
110°.—J. BROWN, Belfast.

[58415.]—**Lubricant.**—Wash
simply lard which has been fre
pouring hot water on it, and stir
a hole is made in the layer of f
poured off. A fresh dose of h
given, and so on until all salt is e

[58416.]—**Vaseline** is not a
is only a trade name, and if i
within certain limits, it will ans
ceutical) purpose for which it is
it is made from the residuum
distillation of petroleum. It is
makers under as many different n
probably a mixture of solid a
carbons. I should be rather surp
chem [illegible] composition of various
ferent [illegible]urces, identical.—OS.

[58426.]—**Leclanche Batter**
Leclanche battery I use I bough
Swan. It appears to be a bund
surrounding a central one of lar
know how they are made. The
plate in each cell. I believe this
f[illegible] electric bells, and for a sm
lamp for occasional use for a m
but not for continued use. You
than follow "Sigma's" advice
WM. WRIGHT, Fiskerton Mano

[58429.]—**Petroleum Spirit.**
light spirit which comes over fir
ture or distillation of petroleum
usually sold at the oil shops u
benzoline, and is very cheap; i
that the proprietors of said oil
what it is. Tradesmen, nowada
kn[illegible] much about what they sell.

[58430.]—**Micro. Mounting.**
remarkable liking for anything
aniline dyes. You will have to t
colour or another medium; in a
glycerine, see that every partic
colour is washed
trating effect u

o. **Mounting.**—All the ordinary freely soluble in glycerine, and l "diffuse" in glycerine jelly. Canada balsam, either liquefied ved in chloroform, pure benzine, solution of acetate of potash, or nearly so, may be used, and ELTA.

vas Canoe.—The crankness is insufficient breadth of floor, cely be remedied without almost ssel. The false (unless of metal) to her stability, and will detract There is also a considerable between the water and a canvas e roughness of the latter. This by repeated painting and rubbing ice. Querist might try the effect inside, or, better still, on the lse keel, to increase stability.—J.

e on Plaster Casts.—A reply number as query. They can also ipped in melted stearine.—OS.

te Amalgam.—I would suggest should be driven off by heat, and ted the remainder could be melted an ingot, and then reduced with a s.

istance.—To MR. EAVES.—No; nning.—W. H. EAVES.

John H. Hindle, Jun. — In the request made by "Parch," I vings and description of arc lamp er the head of Letters to the H. HINDLE, JUN.

P. of Engine. — The h.p. of is 95·96160, with 45lb. pressure; th 60lb. pressure. Rule—

$$\frac{A \times (2 \times S) \times R}{33{,}000}$$

n pressure on piston
in square inches of piston
h of stroke in feet
ber of revolutions per minute.—

rmostatic — Indicating Tem- reenhouse.—Querist might use a thermometer, so arranged that y rose to the given height it would ring an electric bell; or, instead uble metal strip of unequally ex- say, zinc and iron soldered to- nciple of the chronometer balance end with the rising temperature ct similarly; or, simpler still, a to carry a current of air from top some accessible point where its d be tested at any time. See reply OWN, Belfast.

ctric Light for Bicycle.—I our pockets are big enough or not. apted to a tricycle.—JOHN H.

Accumulator.—To do what you ily be made; but I should advise, as it would weigh too much for your pocket.—W. H. EAVES,

VERED QUERIES.

d titles of queries which rem unan- ts are inserted in this list, and if still eated four weeks afterwards. We trust k over the list, and send what information fit of their fellow contributors.

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ngs, 170.
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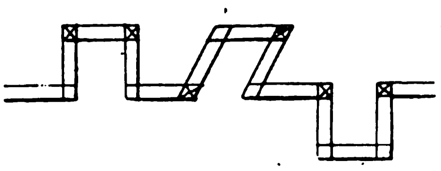
QUERIES.

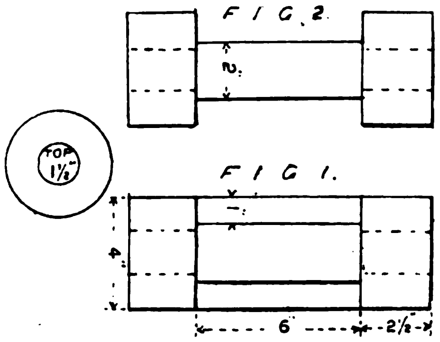
◆

[58447.]—**Crank.**—Will any friend inform me the best way to forge a crank with three throws in it for pumps with 12in. stroke? The round part is 2¼in. dia., and from



centre to one centre of the crank is 8in. The sides are 3in. by 2¼in. This is the sketch.—BIRMINGHAM.

[58448.]—**Forging Swivels.**—Will any kind friend tell me the best way to forge swivels, and what sort of tools will be the best? The holes are 1⅛in., and when forged



they have to go from me finished to be tapped 1⅜in. These swivels are for tightening stays. These are the drawings.—BIRMINGHAM.

[58449.]—**Cutters for Grooves.**—While on the subject of cutter frames, &c., I should be thankful if someone would kindly tell me what would be the best shape cutter for cutting grooves in cast iron in the lathe; said grooves would average 1-16in. wide, 3-16in. deep, and from 2in. to 4in. long. If a circular cutter is to be used, a few hints as to diam. and number of teeth would oblige—C. M. T.

[58450.]—**Pattern for Small Cylinder.** — Will "Sand Rat" kindly tell me the proper way to make a pattern for a small cylinder, about 4in. diam., 6in. long, and ⅜in. thick, with a flange inside at one end? Should I be obliged to make a core-box for it, or simply make the pattern the shape I require the iron casting?—C. M. T.

[58451.]—**Chemical Action.** — A friend recently asked me the use of carbon plates in a bichromate, or any other battery. He said they were useless, as no chemical action can take place without detriment to the carbon, and it is a well known fact that carbon is not eaten away like the zinc. Could any of "ours" explain what chemical action takes place between the carbon and zinc in a bichromate battery?—WATFORD.

[58452.]—**G.N. Engines.**—Will anyone say if the new 7ft. 6in. singles described last week have any arrangement for adapting themselves to the curves, as a rigid wheelbase of 19ft. 1in. seems rather a novelty?—W. B. P.

[58453.]—**Free Reeds.**—TO MR. N. E. CHILD.—I wish to thank N. E. Child very much for his kind answer to this query. The instructions given, I must say, are so simple and easy that any person can understand them. I had almost given it up for a bad job, as far as getting an answer was concerned, so I made one myself, much like the one described, which acts very well. I may here state that it is only a hobby of mine: there need not be any fear of me being a rival in trade. I will take this opportunity of asking N. E. Child one question. I have noticed when I have tuned reeds in tuner and then put them in the instrument, they are not the same in pitch. Could the weight be gauged so that the reeds would be in instrument as in tuner? If not, what is the cause?—AMATEUR TUNER.

[58454.]—**Furnace for Wrought-Iron Scrap.**—Having eight smith fires, and making a very great deal of scrap iron, and requiring forgings from 50lb. to 70lb. in weight, I should be glad if some of your readers will give particulars through the "E. M." of a small furnace; also an idea of the cost. A rough sketch would oblige—A NEW SUBSCRIBER.

[58455.]—**To "W. H. E., Coventry."**—Many thanks for your kind offer, of which I gladly avail myself. Owing to my stupidity, I have omitted to state in my query (58292, p. 309) that I wish to wind the "F.M.'s" compound, shunt, and series. Will you, please, give me quantities and sizes in B.W.G. (I suppose the wire on A. is B.W.G.)? The E.M.F. and number of lamps will be just the thing required. I will give you any other data you may require, or if the drawings of the machine will be of any help, I shall be most happy to send you them.—H. E. J.

[58456.]—**Battery.**—I have a battery of ten cells (carbon and zincs). In place of the usual acid or other solution to excite it, the cells are filled with chalk or lime, which has been moistened with liquid. Could any of "ours" [illegible] what this compound consists of, and how to recharge them, as they are exhausted and dry? It is called an atmospheric battery.—WATCHMAKER.

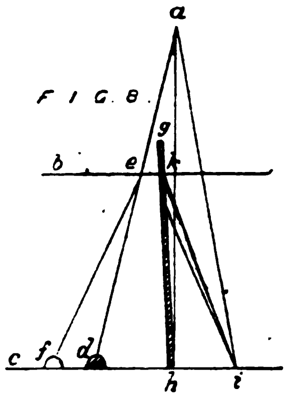
[58457.]—**Rifle Conversion.**—I purpose converting a Whitworth muzzle-loading rifle (small-bore) into a breech-loader? Would the Snider-action answer, or what breech is most suitable? I should like to adopt one that would permit of it coming to bits to pack in a case. Can [illegible] a breech action, to buy, or would I require to [illegible] it?—WATCHMAKER.

[58458.]—**Speed of Lathes.**—Can any of our readers inform or tell me of any work that gives the average speeds for boring and turning brass or wrought iron? I have a small work which gives the speed for brass same as for cast iron, which I think is an error.—JAMES JOHNSON.

[58459.]—**Dumpy Level.**—Will some kind fellow reader give me instructions for making an instrument that will answer the purpose of a dumpy level? I want one to fix on a tripod, and it must have an arrangement for turning round.—JOHNNY NASH.

[58460.]—**Binocular Microscopes.** — Can any of your readers give me the benefit of their experience of Nachet's binocular, or of the new binocular of Zeiss? Up to what powers will they work effectively, and is there more loss of light than with a Wenham binocular? Is the Stephenson binocular superior to both the first-mentioned? They have the advantage of being applicable as an eyepiece, whereby the instrument is easily converted to a monocular for higher powers.—R. R. WHITEHEAD.

[58461.]—**Perspective.**—On looking at a book of "Linear Perspective," by R. Burchett (head master of the Training Schools for Art Masters, Sc. and A. Dep.), I saw the following:—"When the eyes are open to the light, light streams into them from space, the light, constituting what may be termed a flood of rays; if any objects occupy a portion of that space, the rays passing from every part of those objects will convey to the eye the image of the part from which they pass; thus we become cognisant of the existence of objects in space. Where the medium through which these rays pass exercises no deranging influence, the rays pass in straight lines, and even where deflection occurs it does not affect this principle in so far as perspective is concerned; thus water deflects, or bends, rays passing through it. As Fig. 8, let *a* represent an eye,



b the surf. of water, *c* the bottom, *d* the stone lying on it. The ray of light from *d* to *a*, represented by the straight line *a d*, will be deflected or bent at the surface by passing through the medium of water as the line *e f*; from *e* the ray will pass to the eye as *e a*. But from this deflection of the ray the stone will appear to lie at *f*. On the other hand, let *g h* represent a stick in the water; by the deflection of the ray, it will appear to be bent in the direction *i*, the ray appearing to pass from *a* to *i* in a straight line, but being really bent as *i*, *k*, *a*. But perspective represents the appearances of objects, therefore it would represent the stone as appearing to lie at *f* and the stick to be bent as *g*, *k*, *s*." One friend tells me that this is wrong, and has altered the text and figure. Another friend tells me that it is perfectly right as perspective, and that the book should not have been altered. I want to know which opinion is right, as I am just beginning perspective, and am learning drawing preparatory to being an artist.—DANIEL LAMBERT.

[58462.]—**Magic Lantern.**—Will some kind correspondent give me a hint how the roller curtain effect is produced in the biunial lantern? Is a slide let into the stage immediately in front of condensers, or in front of picture? As I have no opportunity of seeing a lantern fit up, a slight sketch would be an advantage; possibly "Invicta" would oblige—G. N. READ.

[58463.]—**Drilling Machine.**—Wishing to make a drilling machine for home use, will any fellow reader oblige by giving the working size of the parts of the drilling machine to drill any angle with, and the pitch of wheels? One that will drill to ⅜in.—YOUNG ENGINEMAN.

[58464.]—**Hot-water Joints.**—I have a number of joints to make, but I have never made any myself. I have had to cut some out which are made of rope jammed to the bottom of the socket, and a thin layer of cast borings and sal-ammoniac mixed. I wish some kind reader of this paper would give me particulars as to mixing this cement, and the particular time when to use. I should be very thankful if some reader would give me particulars as to making a good firm joint.—IGNORANT.

[58465.]—**Momentum.**—Will one of "ours" kindly say what amount of power (in horse-power) is exerted by the brakes in bringing an ordinary passenger train, say, of six coaches, guard's van, engine, and tender, to rest, from a speed of 15 miles an hour, also from 60 miles an hour, on level ground, showing the calculations in each case?—STUDENT.

[58466.]—**Flexible Compound.**—Can any reader inform me of a cheap flexible compound, capable of moulding into shape, and that would withstand water and retain its moulded shape. Indiarubber would be most suitable, but is too expensive. Any hints will be most thankfully received.—S. AND C.

[58467.]—**Chemical.** — I found lately, on heating together a mixture of oxide of aluminium and sulphate of copper made into a paste with oil, to a red heat, that scattered throughout the mass were very small shining particles, like small crystals, or ground glass. What are these likely to be? I may add that the Al_2O_3 I used was the commercial.—J. M.

[58468.]—**Furnace.**—Would some of your chemical students kindly inform me how to make a furnace that will melt ½lb. of cast-iron at one operation? I have read somewhere of a petroleum furnace that was able to effect this. Particulars of this would much oblige—J. M.

[58469.]—**Chloride of Lead.**—I have to use cold muriatic acid in a lead-lined cistern, and I fear the lead is gradually dissolved, though chemical books state this acid has no effect on lead. Will some of your readers, or Mr. Grey, inform me if lead is much dissolved by cold muriatic acid, and what is an easy and reliable test for proving chloride of lead is formed, and in solutions?—ENQUIRER.

[58470.]—**Breaking Strain of Timber.**—Will any of your readers kindly inform me by what rule to ascertain the weight that will be safely carried by pitch-pine and Baltic beams, which are 12in. square? The beams vary from 12ft. to 21ft. length (and are fixed on walls); hence my inquiry for a rule, as I know the 12ft. will probably carry in the centre double the weight the 21ft. would be safe with.—ENQUIRER.

[58471.]—**Brass Fringing Work.**—I will feel grateful to anyone who can tell me where I can purchase the above of various patterns in light brass. I am told it is made principally in France and Austria to ornament bronze drawing-room clocks; also in very thin light brass to ornament cornices of ceilings of the houses of the rich in those countries. I shall be thankful to anyone who can give me the address.—READER OF "E. M."

[58472.]—**Lathe Treadle.**—Will some reader kindly say if, for driving small lathe, 3in. centres, a connecting rod attached to side of driving wheel would answer as well as crank; I mean a similar arrangement to a sewing-machine driver?—H. H.

[58473.]—**Legal.**—Will any legal authority kindly answer the following? I have a tenant who, 2½ years ago, got behind in his rent, but who, from that time and during the period has regularly paid his current rent. Are the old arrears recoverable at law? If so, by what process? Or am I barred by the recent regular payments?—CRUX.

[58474.]—**Chemical Balance.**—Possessing above, I am anxious to know what to keep in it to absorb the moisture. Is sulphuric acid a good thing? Do not the fumes injure the balance?—BALANCE.

[58475.]—**Dynamo.**—Can Mr. Bottone, or others, kindly give me dimensions of a dynamo (Siemen's H type) capable of giving 500 candle-power? Also, would an engine, cylinder 3in. by 3in., drive the same, say, running at 100 revolutions per min. and at 60lb. pressure? Sketch would oblige.—P. WALKER.

[58476.]—**Medical.**—Will any medical gentleman kindly tell me the cause of the following affection, and what is the cure? From the time my little girl was seven years old till now at her age of twelve she has been subject to a species of sleepy fits, which come on at any time and without any previous notice to her. She appears to lapse into a state of somnambulism for a minute, during which she imperfectly carries on the mechanical operations of eating, walking, &c. When she recovers, or if aroused, she at once attains her normal brightness. She is merry and excitable, and of average intelligence; but, I think, has a tendency to hysteria, nervousness, and too much introspection.—ANXIOUS FATHER.

[58477.]—**Clarionet.**—Will some clarionet player kindly inform me whether it is possible to prevent the wind escaping from the sides of the mouth? When I practise, I find that the wind nearly always escapes, especially when playing the notes above the lines.—C.

[58478.]—**To "Sigma."**—Would "Sigma" please to give instructions for making the Planté storage battery, such a one as would store up the electricity from a one-horse dynamo for, say, six hours' use? How many cells would be required, and of what size and thickness would the lead plates be? I should like to have sufficient power to light up an optical lantern with the arc light for about three hours. Are there more than two plates in one cell, and are wooden boxes used? Would it do to line the boxes with lead and insulate the suspended plates from them? Information will be gladly received.—WM. WRIGHT.

[58479.]—**Telephones.**—I have made myself a pair of telephones on Bell's principle, with magnetised core, about 5in. long and ¼in. thick; bobbins wound with 38 silk-covered wire. I have tried them, but with non-success; so I tried with a battery, to see if there was a break in the wire; but find, on closing the circuit, that both iron discs are drawn to the core; but when the circuit is closed without battery, I cannot get the least results, no matter how hard I shout. Might the iron discs be too thick to vibrate (I got the same as used by photographers for ferrotype portraits)? I ought to have said that the cores are properly magnetised. Should the terminals come from the extreme end of the handles, or from the back of the case? Mine are done the latter way. Should any fellow reader be able to put me right, he will receive the best thanks of—CATHODE.

[58480.]—**Weather Charts.**—I am obliged to Mr. Jordan for his notice of my letter (25105). I shall be glad if he will inform me, per the ENGLISH MECHANIC, whether the prepared charts are more sensitive to light than ordinary sensitised photographic paper, or only in a similar degree? I am accustomed to manipulate the latter. On receiving the charts from London, they were opened in weak, diffused light: they have never been exposed to ordinary daylight since I received them, but usually to gas-light for a little while. I can only imagine that they have either been exposed a little before I received them, or were badly prepared. Some of my photographic friends here suggest that the sun at this season, even when shining, is too weak to leave a sufficiently strong impression.—EDINBURGH.

[58481.]—**Windmill.**—In query 58325, page 327, "Puzzled" says his windmill is about one horse-power. Would you kindly permit me, through the columns of the "E. M.," to ask him what are the dimensions of his mill, or, what is better still, the rule for calculating the H.P. of a windmill? Would he also kindly say if he has got his lamps to burn all right, as I was seriously thinking about setting up a similar machine?—MATHERELL.

[58482.]—**Soap.**—Could anyone kindly tell me the easiest way of making a soap with castor-oil and liquid potash? Would a boiler with heat-regulating apparatus be an absolute necessity, or would an ordinary washing-house boiler (pot-shaped) do? I am anxious to know whether the simple mixture of the two substances in proper proportions, and the subsequent application of heat for an hour or so, would give a good soft soap. I have special reasons for using no other oil than castor, and no other alkali than liquid potash.—MASCHERA.

[58483.]—**Conveying Hot Water.**—I require a frequent supply of very hot water about 150 yards from my kitchen boiler. If I carry pipes thereto, similar to those fixed to bath-room, can I utilise the waste heat of stove to supply same to this distance? If so, which will be my best plan to attain my object? Any practical suggestions will much oblige—A NEW SUBSCRIBER.

[58484.]—**Lantern Details.**—I have one pair 4in. condensers, ¼-plate lens, and five wick lamps. I want to know size of lantern to fit above, distance of condensers from lamp, slide from condenser, and front lens from slide.—N. W. E.

[58485.]—**Electric Lighting.**—To S. BOTTONE.—The lamps have each a resistance of 66·6 ohms, as given by the formula $\frac{100\ (E)}{1{\cdot}5\ (C)} = 66{\cdot}6$ ohms. I only require to use three of them. The installation consists of 20-c.p. lamps, above being 50-c.p. Kindly help me further.—ELECTRA.

[58486.]—**Painting Lantern Slides.**—Can any reader tell me how to colour the sky for magic-lantern slides, and what medium to use either for oil or water colours? I have tried copal varnish thinned with turps and oil, but find it is too sticky. Also ox-gall for water colours. I use the finger (stippling) to flatten. Looking at a purchased slide, I find it has not that sticky appearance, but dry, yet transparent if looked at sideways, and transparent if held up to the light.—B, A. F.

[58487.]—**Short-Circuit Bells.**—Mr. Sprague, in his new edition, says: "Electro-magnets for quick action, and so that they shall lose their magnetism instantly, should have short cores and thicker coils, and the armature should be light in weight, and short." Will some of our practical readers give me the dimensions of core and armature? Also the best size of wire (B.W. gauge) to use? I want to fit these bells to three indicators; the ordinary trembling bell prevents them working, and there is not room for a relay and local battery. Do these bells require more battery-power than the ordinary make to work properly?—M.M.I.S.C.S.

[58488.]—**Specific Gravity.**—Would someone please give the rule for finding the specific gravity from Beaumé Hydrometer? Also from Twaddel?—ENQUIRER.

[58489.]—**Skates, to Grind.**—On looking through back numbers, I can find several answers to the above query; but none to say how to give any desired radius or curve to the bottom of blade. Will someone tell us the best way to do it? Also how to grind them evenly on a narrow stone or wheel—that is, without making hollows and lumps in them? They can be done very fairly on a thick stone in good order, but I cannot do them as nicely as I should like on a narrow one.—SAMOTHES.

[58490.]—**Scissors, to Sharpen.**—Will someone please to tell us the proper way to sharpen scissors, and, where necessary, the best way of taking them apart when riveted? Also how to make new rivets and put them in?—SAMOTHES.

[58491.]—**Lavender Culture.**—Will W. J. May, who some time ago promised to answer gardening inquiries, if still a subscriber–if not, then someone else–please to tell us how to propagate and keep lavender in a healthy and flourishing state? I may say that I live in Lancashire, near the shore of Morecambe Bay.—SAMOTHES.

[58492.]—**Concrete Path.**—I saw in a paper some time ago directions for making a path with lime and cinders, or ashes, but I cannot find it now. Will someone please to give proper proportion of materials and how to mix them? I think it would interest many if they knew how to make a good hard road with materials that are plentiful and cheap in many places.—SAMOTHES.

[58493.]—**Microscopic Objectives.**—In high powers I have a 1-10in. and 1-20in. water-immersion objectives, both of nearly full aperture; but I want more power still. I have many test diatoms which I cannot yet resolve. Would it be best to go in for a 1-30in. to 1-40in., or to have a homogeneous immersion lens of about same power as I now possess?—F. E. F.

[58494.]—**Photographic Lens.**—In books on photography, amateurs are told they will require more than one lens. I have a ½-plate Dallmeyer rapid rectilinear, and for a long focus one I split the lens and use only one combination. I find, however, I require a shorter-focus lens than I possess for taking portraits and very near objects. What aperture and focal length should I have? Will the three lenses that I shall then have cover all likely work?—F. E. J.

[58495.]—**Economical Use of Gas.**—I heard a scientific lecturer recently (Mr. A. B. Harding) say that the best way to burn gas was to have as hot a flame as possible, keeping the gas cool, and he showed the economy of regenerative burners, both by figures and by illustrations of their use. But is the gas in a regenerative burner kept cool? Is it not rather very hot, as shown by recent correspondents? Is the principle he laid down sound? I am sincerely anxious to know the exact truth of this, and shall be thankful for any information.—IGNORAMUS.

[58496.]—**Sensitive Flames.**—I want to get, or make, a burner which shall, under pressure, give a flame which will be very sensitive to the action of sound. Shall be grateful for any hints as to shape, size, &c.—IGNORAMUS.

[58497.]—**Currents Set up by Flame.**—I have been lately experimenting a good deal on flames, and have tried to prove that a candle burning under a tall glass open at top tends to set up currents of hot and cold air when the opening is divided by means of a wedge-shaped piece of card. The principle is beautiful, and the plan seems simple enough, but I find the results uncertain. Sometimes the candle burns without a card, and goes out when the card is introduced. At other times the flames burn equally well in either case, and sometimes the experiment succeeds. How can I insure success?—IGNORAMUS.

[58498.]—**Electric Clock.**—Will "Acolyte" kindly give directions for winding the solenoids so as to get both poles facing each other? Do the pointers both turn in the same direction? I do not see how you d
three wheels; and do the pointers come fr
dial?—CORSE DE LEON.

[58499.]—**Perfect-Tuned Piano.**—
the musical readers of the "E. M." inform
perfect-tuned piano (supposing it possible
would be more appreciated than the prese
sidering it to cost no more nor be larger,
present ones?—J. K.

[58500.]—**Cream Buns.**—What past
superior confectioners for making these?
the French "chou" paste, but the result was
both in flavour and appearance.—FANCHONN

[58501.]—**Stohrer Medical Battery.**—
20 cells, and fail to get more than a very fee
notice the nuts on screws of hangers that
carbon plates are in continuous contact one w
the plates also hang very loose. Should the
—MORSE PRINTER.

[58502.]—**Measuring Refractive I**
"Abacus" will kindly state an accurate and
able method of measuring the refractive inde
substances, he will much oblige; their da
desiderated, as will be seen on reference to
some recent numbers of the *Jour. R.*
where they are stated to be "at present wantin

[58503.]—**Cheese Cakes.**—I am anxio
recipe for the ordinary kind, made by most s
as I can judge, they are made without curds.
NETTE.

[58504.]—**Gas Queries.**—Will "T. T. V
other, kindly answer the following? I ha
manometer, consisting of 3-16 glass tubing be
One end is connected to a gas-pipe near the
the other end is left open, each tube being first
water to the height of about 2½in. I find, on
the gas, that the difference between the levels
tubes varies from 2·3in. to 3·5in. in the course
Am I right in supposing these figures repres
pressure in the ordinary acceptance of the term
any practical difference in the pressure of g
various floors in the same house, say in the ba
on the 3rd floor, 34ft. above? Are governor ba
a single governor on the main pipe, the bes
controlling consumption of gas? I have a 2
pipe to a 60-light dry meter, but certainly neve
than 18 five-foot burners at the same time.—ST

[58505.]—**Continuous Brakes.**—Wood's
mentioned as being in use on the Victorian
Australia. Can anyone give a description of i
of "Webb's air-brake" on the London and Nort
Railway?—TRIPLE VALVE.

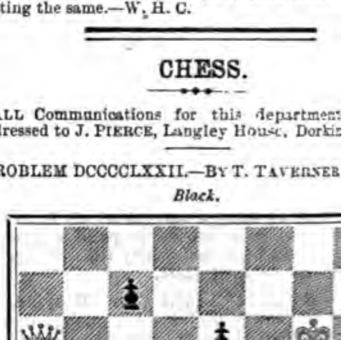
[58506.]—**Microscopic.**—I shall feel oblige
our microscopic friends would tell me how to p
mount sections of wood, and what instrument
cutting the same.—W. H. C.

CHESS.

ALL Communications for this department
addressed to J. PIERCE, Langley House, Dorkin

PROBLEM DCCCCLXXII.—BY T. TAVERNER

Black.



White.

White to play and mate in two moves.

SOLUTION TO 970.

White.	*Black.*
1. R-R 4	1. Anything
2. Q or Kt mates	

(Six variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 969, by G. T. String
Hensing: to 970, by W. T. Bayne.

A. F. M.—"Weekly Gleaner" duly received. M
for acceding to our proposal.

J. W. HOOD.—We think you will find 970 can
in two moves, though for a two-mover it is diffi
has, unfortunately, two solutions instead of one

W. N.—The budget is most acceptable.

IN order to stimulate the flagging energies of
we offer for the highest scores in the next thre
First prize, "Pearson's Chess Problems"; an
"Miles's Chess Problems," from 1882 to 188
special prize for best solution of two-mov
"Pierce's Chess Problems." There must
least 12 entries. Solutions will com
problem, 972. No one competing for th
can try [illegible] ird.

he English Mechanic
WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 8, 1886.

HE SENSATIONS OF TONE.*

E famous work of the distinguished
Berlin professor is well known in this
ry to all who take an interest in the
y of music, and it is one of those books
all candidates for musical degrees are
ted to study. As a matter of fact, the
nt of music owes something more than
thanks to the translator of Helmholtz,
f the body of the work in its English
is only a rendering of the meaning of
uthor, the copious notes and the general
cter of the information given by
translator render the volume of more
than the original German editions.
last German edition is the fourth, pub-
l in 1877, and the present is the second
ish edition, thoroughly revised and
cted, Mr. Ellis having taken special
in order that not even a verbal change
author's language should escape him.
ty-two years ago, when Helmholtz's
ies were first introduced to the notice
usicians, they were so novel as to be
strange; but they were so true that
re now accepted as essentially valid by
o are competent to pass judgment. In
any the published objections almost
sively related to the Theory of Con-
ce propounded by Helmholtz, those who
r mechanical explanations expressing
t that room had been left for the action
istic invention; while others, with more
physical proclivities, rejected the Theory
onsonance propounded by the author
coarsely mechanical. In view of such
Helmholtz concludes, justly enough,
he must have struck out "nearly the
path." His theory of consonance is a
natisation of observed facts, and it is a
ke to make it the foundation of a theory
usic, the essential basis of which is
ly. Harmony has become to Western
peans an essential, and, says Helmholtz,
r present taste, an indispensable means
rengthening melodic relations; but
-developed music existed for thousands
ars and still exists in ultra-European
ns without any harmony at all. The
t of this work is to connect the
laries of physical and physiological
tics with those of musical science and
tics. Physiological acoustics deal with
nsations of hearing, as when we recog-
he difference between the tones of a
and of a flute without our artistic en-
nt of the concert depending upon our
ption of a violin or a flute; physical
tics are essentially only a section of the
y of the motions of elastic bodies. The
Part of the work treats of the pheno-
n of harmonic upper partial tones and its
n to quality of tone, leading to the
nent of an hypothesis which explains
ode in which the auditory nerves are
d. The Second Part deals with dis-
nces produced by the simultaneous
ption of two tones—i.e., the combina-
tones and beats; and the Third Part
of the construction of musical scales
otes, and the differences of national and
dual tastes. The difference between a
al sound and a noise is defined by
holtz as a rapid periodic motion of the
us body in one case, and as a series of
riodic motions in the other. A
[illegible] ne, and its quality. The force depends on the amplitude of the oscillations of the particles of the sounding body; pitch on the number of vibrations completed in a given time (a second); and quality on that peculiarity which distinguishes the musical tone of a violin from that of a flute; of the clarionet from the human voice. The vibrational number, or pitch number, as it is now called, is found by several methods; but Helmholtz describes only the siren. Mr. Ellis, however, in one section of a lengthy appendix gives an account of the string method, the optical and electrical methods, and the application of harmonium reeds and tuning forks. The ratios of the pitch numbers being once assigned to the consonant intervals, it is easy to calculate the ratios for the whole extent of the musical scale. The pitch numbers adopted throughout this work are based on a 16ft. C, having 33 vibrations per minute; but Helmholtz points out that all tones below E of the double bass are imperfect, and cannot be used musically except in connection with their higher octaves, to which they impart a character of greater depth. Musical tones which can be used with advantage and have a clearly distinguishable pitch lie between the limits of 40 and 4,000 vibrations; but the range of audibility for the average human ear is from 20 to 40,000 vibrations, or about 11 octaves. The 32ft. organ pipe has a pitch number of 16½ vibrations, and its value is chiefly to enforce the higher octaves. The only possible hypothesis as to the cause of the difference in quality of tone suggests that it depends upon the manner in which the vibratory motion is performed within the period of each single vibration: that is to say, the quality of the tone depends on the form of vibration; but it also appears that different forms of vibration may correspond to the same quality. The ear, too, when its attention has been properly directed to the effect of the vibrations which strike it, becomes aware of other tones besides that due to the pitch number of the musical note, and these are called the harmonic upper partial tones. It follows, then, that a musical tone is compound, and, according to G. S. Ohm, there is only one form of vibration which will give rise to no harmonic upper partials—viz., the pendular or simple vibrations of the tuning-fork. The tone produced by a tuning-fork is said to be simple, and it follows, therefore, that a musical tone may be either simple or compound, but generally compound. The subject having thus been placed before the reader, Helmholtz proceeds with the analysis of musical tones by sympathetic resonance and by the ear, and then treats of the difference in the quality and of the apprehension of those differences. Thus the peculiarities of musical tones depend to a certain extent on the way in which they begin and finish; as, for instance, with slender strings on mobile soundboards, which yield the most piercing sounds when struck, as in the pizzicato of the violin. In brass instruments, notably trumpets and trombones, the tones commence abruptly and sluggishly, probably because it requires so much effort to excite the new condition of vibration; but in the flute, clarionet, &c., the length of the column of air is readily changed by opening and closing holes, and the transition from one tone to another is easy. Helmholtz refers to pianoforte makers selecting from 1-7th to 1-9th of the length of the string as the best striking-point, because it was found to produce the best quality, and Mr. Ellis introduces a long note in which he quotes a most interesting historical *résumé* by Mr. A. J. Hipkins, from which we learn that 1-8th is the best distance. Notes of similar value are scattered throughout the book, which is thus, in its English dress, a complete repertory of the science of music and musical truments. The chapter on the apprehen- of tone involves an essay on the construction of the human ear, which is freely illustrated, and which brings down the record of known facts that help to support the generally accepted hypothesis to the most recent of the more important investigations. Part II. commences with a chapter on combinational tones, which are heard whenever two musical tones of different pitch are sounded loudly and continuously together. They are often called Tartini's tones, grave harmonics, and by Prof. Tyndall resultant tones. In a note Mr. Ellis says that he has found it easy to render combinational tones audible to a hundred people at once by means of two flageolet pipes or whistles, blowing strongly, and choosing very close dissonant intervals. Thus g'''' being sounded loudly on one pipe by an assistant, Mr. Ellis blows f'''' sharp, when a deep note is instantly heard which, if the interval were pure, would be *g*. The experiment is varied by giving first f'''' sharp and then e'''' in succession, when, if the intervals were pure, the combinational tone would jump from *g* to c''; but, in reality, the jump is very nearly the same and quite appreciable (the notation is that which makes *g* fiddle G, and c'' pitch C). For particular instruments, as the harmonium, the combinational tones can be made more audible by suitable resonators; but they are more readily heard when the intervals are pure, as, e.g., from stopped organ pipes in just intonation. The importance of combinational tones in the construction of chords shows that a thorough understanding of them is essential to the student of the theory of music, as are interference and beats. Interference can be readily appreciated by striking a tuning-fork and rotating it slowly near the ear or a resonator. Four positions will be found in which the fork is heard strongly, and four in which it is inaudible. The four strong positions are those in which either one of the prongs, or one of the side surfaces of the fork, is turned towards the ear, the weak or inaudible positions being intermediate. Beats are produced by notes of nearly the same pitch, and the number of them in a given time is equal to the difference of the numbers of vibrations of the two tones. A consideration of the phenomena of beats naturally leads up to the subject of consonances and their harmoniousness, and so to Part III., which deals with the Relationship of Musical Tones. One-part music is the original form of music with all people, and still exists amongst the Chinese, Indians, Arabs, &c., as Mr. Ellis has recently shown in his elaborate paper, portions of which are reproduced in an appendix. The history of the growth of music from homophonic to polyphonic, and from the latter to the modern harmonic music, is briefly but sufficiently sketched, and in some of the chapters on the tonality of homophonic music, on the consonant chords of the tonal modes, on the system of keys, we find remarks which will perhaps astonish those who are merely mechanical musicians. Thus Helmholtz says, "Most of our modern musicians, accustomed to the major thirds of the equal temperament, prefer them to the perfect thirds when melody alone is concerned. But I have convinced myself that artists of the first rank—like Joachim—use the thirds of 4 : 5 even in melody. For harmony there is no doubt at all. Everyone chooses the natural major thirds." The origin of the major scale is traced out by Helmholtz with some degree of elaborateness, and he shows how the *e* of the Lydian mode of the ancient Greeks (the major scale of the moderns) is readily changed into *e* flat by its second relationship to *g*, which gives the ascending minor scale. The twenty appendices, especially the last, are full of information, the notes to Helmholtz's appendices being also of the greatest value. Diagrams and full explanations of the most useful of the keyboards for justly intoned instruments are given, such as Mr. Bosanquet's manual, Colin Brown's and H. W.

Pooler keyboards [illegible] the miscellaneous notes where Mr. [illegible] upon which [illegible] are errors, [illegible] as, for instance, where [illegible] the American free reed, he [illegible] asserts that the American [illegible] a deep excavation for [illegible] soon as the tongue gets [illegible] the frame, and it is [illegible] expression, but [illegible] kind of tone. In the same volume, speaking also of the American reed, it is stated that "in voicing, a bend is made [illegible] turning the point upwards," an error which has been corrected several times in our columns. Similarly [illegible] Helmholtz's remarks on the [illegible] of the keys," which he is unable to discover except in pianofortes and [illegible] instruments, the opinion of Mr. H. K[illegible] M[illegible] is quoted that the difference is due to the different leverage of the black digitals—an idea which was shown to be rather [illegible] in one of our back volumes. We must, however, take leave of this work, which we can cordially recommend to all who desire to learn what amount of science underlies music and musical instruments.

MECHANICAL TABLE FOR FORMING OVALS OR CIRCLES.

THIS invention, which has been recently patented by Mr. J. P. T. Slade, of Elizabeth Street, Cheetham, is in the form of a table for carrying work to be punched, drilled, milled, slotted, or otherwise shaped, and the improvement consists in the arrangements by which work can be wrought to an oval or circular figure, or any part of a circle or oval, with any proportion between the major and the minor axis of the oval. The novelty of the invention lies in the formation of an oval or circular figure without the rotation of either the work (as in the oval chuck) or of the tool (as in oval boring machines, in which the tool describes an oval): thus enabling punching, drilling, milling and slotting machines with this table attached to execute work of an oval or circular figure on an object too large to be revolved. In the annexed drawings Fig. 1 is a sectional elevation parallel to worm shaft, and Fig. 2, a sectional elevation at right angles to worm shaft. Upon the top side of a framework A, is a planed surface B for a slide C (the crown-slide) to work upon; and upon the bottom side of framework is another planed surface D to enable the framework A to traverse upon a base-plate E at right angles to the line of motion of the crown slide C. Within the framework is a worm-wheel F, which has its bearing on its rim, and is placed in such a position that its faces are parallel with the planed surfaces B and D of the framework, which framework is so constructed that the top and bottom faces of the worm wheel F are open. Upon the framework A are two lugs G G, between which is a worm H, which is fastened with feather keys. Across the top and bottom faces of the worm wheel F are two grooves I I, one in the top face and one in the bottom: these grooves must go from one edge directly across the centre of the worm wheel F. Within these two grooves I I are two slides K K, which have a to and fro motion, which is obtained by means of two screws L L, by which screws, the slides K K can be wound either to or from the centre of the worm wheel F: upon these slides are fixed two blocks M M, which revolve upon studs O O, fixed in the slides. One of these blocks M¹ fits into a groove P in the base plate E, upon which base plate the framework A slides. This groove is at right angles to the direction in which the framework A moves. In a suitable bearing upon the base plate E is fixed the shaft upon which the worm H is keyed with feather keys. The other block M, which is fixed to the slide K in the top face of the worm wheel, works in a groove S in the crown slide C, which groove is also at right angles to the direction in which the crown slide travels. On the worm H being turned by the shaft, the worm wheel F is turned [illegible] and the blocks M M in the slides K K [illegible] to press against the grooves P and S in the base plate and crown slide, [illegible] to and fro motion to the framework [illegible] and crown slide C, causing them to travel at right angles the one to the other. The crown slide C, upon which the work is fixed, sliding upon the framework A thus partakes of both motions. When the slides in the worm wheel F are placed equidistant from the centre of the same, any point on the crown slide C will describe a circle, the size of such circle being regulated by the distance of the slides from the centre of the worm wheel. When the slides are placed at unequal distances from the centre of the worm-wheel, an oval figure is formed, the proportion of the major and the minor axis of such oval depending upon the respective distances of the slides from the centre of the worm wheel.

Fig. 1.

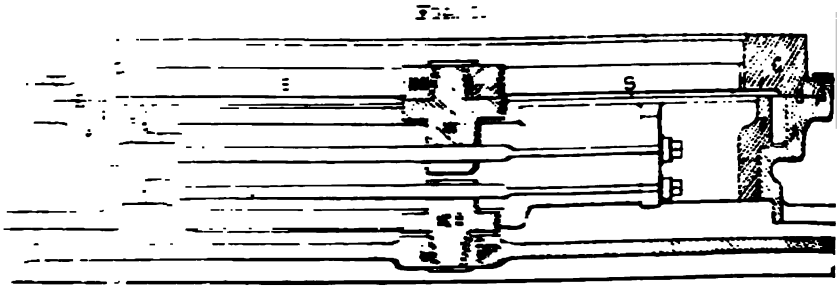
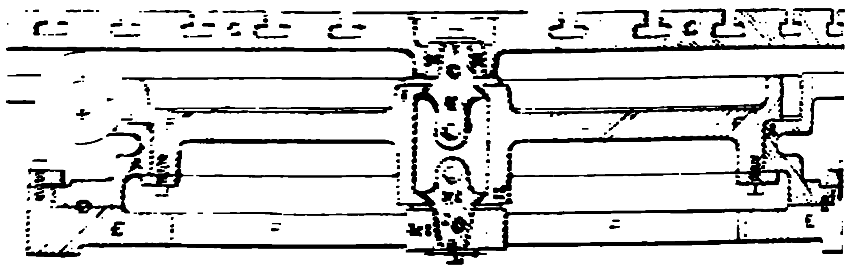


Fig. 2.



MOULDING.—IV.*

By "SAND RAT."

I WILL next give a description of a few different kinds of chaplets, as I think it very important that all moulders should know what kind of chaplets to use for the different kinds of work. I have seen chaplets used for large pipes, and when the pipe was cast it was through at the top, the core having lifted and forced the chaplet plate up the stem, and, of course, was a waster. Then there is another bad fault in having the plates too small, and when there is much loam on the barrel they sink into the loam, and, of course, become a waster by allowing the core to rise, leaving no metal at the top, but all at the bottom. Then again, in some shops it is a custom to make the chaplets for large jobs in cast iron, as shown in Fig. 1. I have known them used where the metal was 2in. thick, and having two cores, one above the other, leaving 2in. under and 2in. over; they were about 2¼in. broad and 8in. or 9in. long, and ⅜in. thick. They were right enough until they got covered with metal and the lift of the cores; then they gave way under the pressure and let the cores float about, and the result always was a perfect waster. Had they been made with wrought-iron plates, as shown, in about 8in. or 9in. long and 3in. broad, and ¼in. thick, with stems 1in. diameter, having a good shoulder on them, as shown at No. 2, and either screwed on or riveted on, they would never have lifted. Then, again, I have seen the small cast-iron chaplets made in the form of No. 11; small in the middle, larger at top and bottom, used for loam moulds, and when there was a great pressure under them, and a fair thickness of metal, they gave way. Whereas, if they had used the chaplets, as shown at No. 5, wrought iron, with good shoulders on the stem, they would have stood any amount of pressure. No. 10 is a very good springer chaplet for light loam moulds. It can be made either for light or for heavy moulds, [illegible] to the strength of hoop-iron it is made. The insides are left open and are [illegible] about ⅛in., so that when the top plate [illegible] it forces it right down to its place. [illegible] 2 shows a large, sharp chaplet. In [illegible] cases they are better left loose and [illegible] before putting in the core. Some [illegible] them riveted on; but where they [illegible] be tapped, I prefer them to be [illegible] you can then regulate them to the height required. No. 3 is one ½ diameter. [illegible] well riveted on, as the diameter is small [illegible] will not allow of a large shoulder [illegible] custom to put on such a large [illegible] this size of chaplet. No. 4 shows a [illegible] chaplet, which can either be screwed [illegible] tapped, or left loose and put on after [illegible] a blunt one, the plate will require [illegible] on when it is for the top part. No. [illegible] springer to force between two cores [illegible] hoop iron, according to strength required [illegible] is a very good and firm chaplet [illegible] where a long core has to rest on [illegible] is only one print for instance in [illegible] or any thing of the kind last [illegible] bottom portion is cast iron [illegible] have used them not tapped by [illegible] through, and using a plate [illegible] stem to rest on. But they are [illegible] tapped, as you can then raise [illegible] will. They can have either [illegible] plates on in the usual form. [illegible] chaplets there ought to be plates [illegible] (3½ by 4). No. 8 is a common [illegible] ought to have a collar on [illegible] them from forcing the plates [illegible] be riveted on both for sharp and [illegible] No. 9 is a small cast-iron chaplet [illegible] useful for steadying a core when [illegible] on other strong chaplets to [illegible] wobbling over.

I will now give a description of a [illegible] tool in a millwright's shop, where [illegible] much facing work done (Fig. [illegible] the larger tool; it takes two [illegible] (Fig. 2). B B is the sliding part [illegible] slide (Fig. 4), having a small [illegible] at C, with a small nut on, milled [illegible] D is a small slot-hole ½in. by [illegible] A is as shown at Fig. 1; B as shown [illegible] with C the bolt. This smoother [illegible] to 1/16 or any size we wish by slacking [illegible] screw; it can be set to any thickness [illegible] I have given the sizes and proper [illegible] ought to be rounded on the face [illegible] that they will not cut the [illegible] smoothing.

Fig. 4 shows section of an engine [illegible] different sizes of facings where the smoother is useful, A A A A being found [illegible] with sizes, which would [illegible] of smoother four [illegible] ought to be made [illegible] sharp much better [illegible] be polished very [illegible] scratch the mould.

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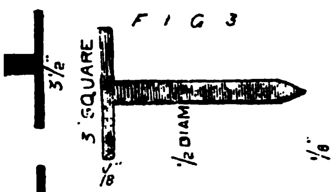
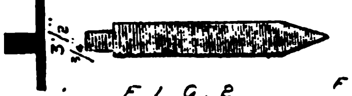


FIG 3



G. 1.

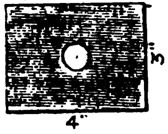


FIG 2

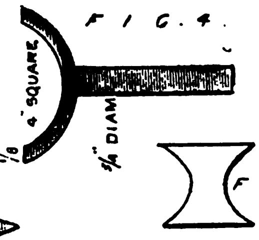


FIG. 4.

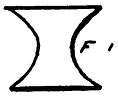


FIG. 11

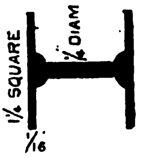


FIG 5

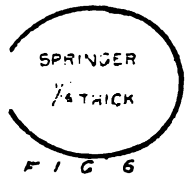


FIG 6

CHAPLETS

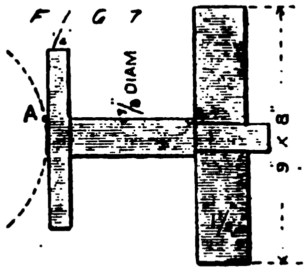
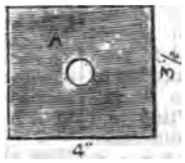


FIG 7



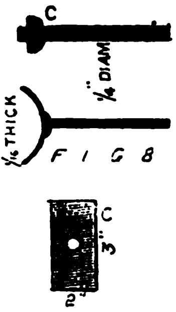


FIG 8

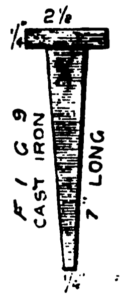
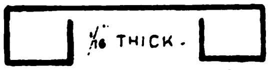


FIG 9

FIG. 10
5 LONG 1 BROAD



SPRINGER. CHAPLET

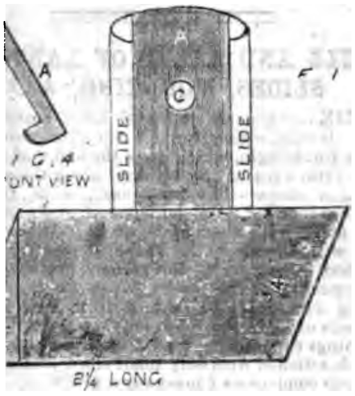
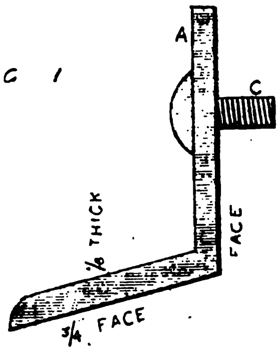


FIG 1



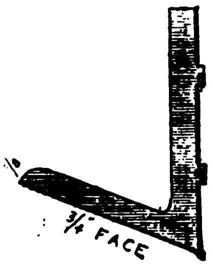
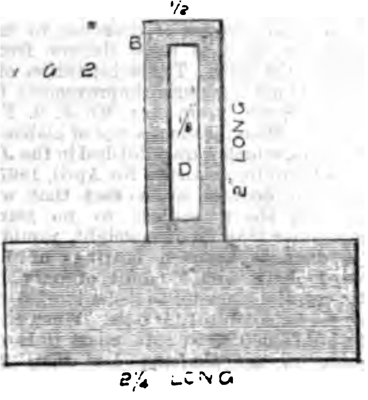


FIG 2



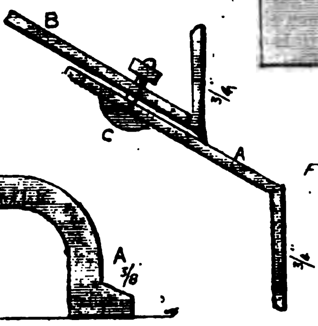


FIG 3

FIG 4

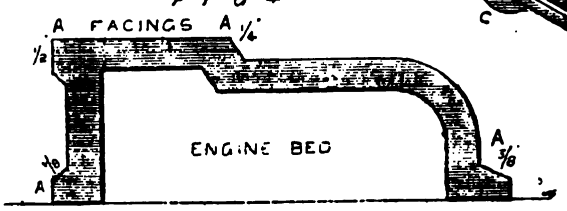


FIG 5

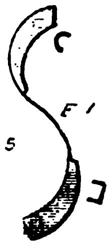


FIG 6

FIG 4

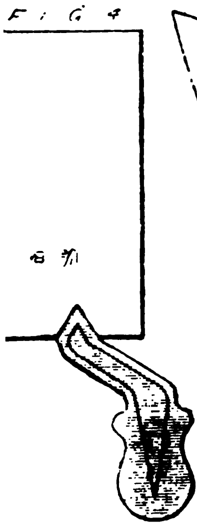
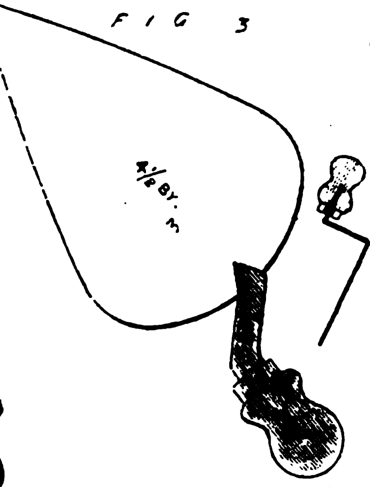
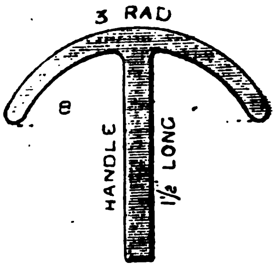


FIG 3





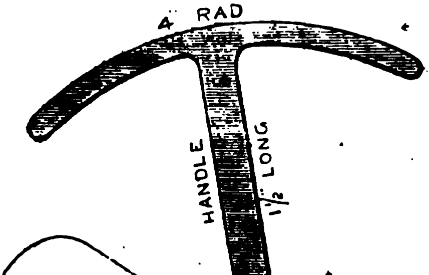


FIG. 1

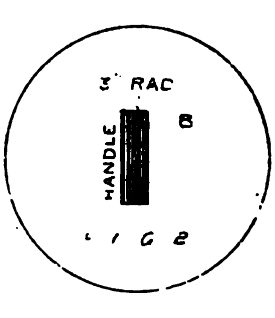
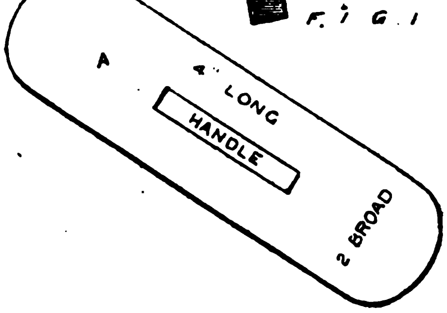


FIG 2



n. long and 2in. broad, having a radius t 4in.: and a flat handle (No. 2) is a r for elbow pipes, or anything where a oother will not work. They can be long, in the form of an egg cut into ts, with a flat handle, as shown. No. 3 size of heart trowel with wood handle. nk ought to be about 3i d [illegible]

4in. long. No. 6 is a flange slaker 9in. long, ¾in. broad, square hollow at one end, and round hollow at the other end, as shown in sketch.

FRICTIONAL RESISTANCE OF SHAFTING.

HE allowance to be made for frictional sistance in mill-shafting forms the sub- iscussion amongst mechanical engi- merica, some contending that the is ought to be taken with the on the loose pulleys of the s others point out, justly, it seems, that as the loose pulley is part of the machine, is for the convenience of the workers, and is in no sense part of the shafting, the frictional resistance should be tested with all belts off. The amount of power consumed by the belts running on the loose pulleys will average, in a cotton mill, say, 10 per cent., and that, added to the 16 per cent. which is due to the shafting alone, shows a total of 26 per cent., which is considered much too high. It must be remembered, however, that the careful engineer, asked to estimate the power necessary to work a given mill, must make allowances for something more than the frictional resistance of the shafting when run ning free. In the United States, in properly-arranged mills, it is usual to allow 6 per cent. for the engine and 10 per cent. for the shafting, including the counter belts, but not those which actually transmit the power to the machines. It is obvious, however, that tight belts must increase the friction of the shafting, and it would seem to be advisable in calculating the power required for a mill to take as the basis data gathered from experiments in which the belts are left on the loose pulleys. Mr. S. Webber, in a paper read before the American Society of Mechanical Engineers, says he is convinced from many experiments that 15 per cent. for engine and shafting, or 10 per cent. for shafting alone, is an ample allowance to make for a cotton mill in good running order, and he speaks from a number of test experiments made in the course of considerable practice. Undersized shafting and over-tight belts make an important difference in calculating the power required, for far more friction in the bearings is caused by the springing of a flexible shaft than would be due to the necessary excess of diameter to make it sufficiently rigid to resist flexure from the strain of the belts. The substitution of steel for iron is not a material improvement in this respect. Some years ago Mr. J. B. Francis, of Lowell, Mass., made a series of elaborate experiments, which were published in the *Journal* of the Franklin Institute for April, 1867, from which he deduces as a fact that while a 2in. iron shaft, subject to no transverse strain other than its own weight, would admit of a distance between bearings of 15·46ft., a steel shaft would admit of only 15·89ft. although the diameter to resist tension need be only ·85 for steel to 1 for iron. When the bearings are from 8ft. to 10ft. apart it is not advisable to use shafting less than 2in. in diameter, unless for the last length of a line, or where the machines to be driven are of the light class, such as knitting and sewing machines. Even in cases where the beams are only 10ft. apart it is well to use an intermediate hanger near the pulley, if any large amount of power is to be taken off. If light shafting leads to "buckling" and its contingent disadvantages, it is certain that heavy shafting is a great evil in more ways than one: as in other matters, the happy mean is the desideratum. In the course of the discussion on Mr. Webber's paper, Mr. Oberlin Smith called attention to the evil of too slow speed in machine shops, an evil recognised and remedied in this country, or parts of it, some years ago. It does not exist so much in cotton mills, for in connection with them the diameters of pulleys and the relative speed of countershafts has been worked out with much elaborateness, as, indeed, was necessary to attain success in the operations; but in machine shops the shafting is often run as slow as 150 or 100, when it ought to make 200 or even 300 revolutions per minute. One great factor, says Mr. O. Smith, in frictional resistance is the straining of the belts, and if we run slow, and have to put on wide belts, they suffer more strain than narrow belts, which latter have another advantage in being more easily shifted. He advocates faster running, counter-shafts of larger diameter, and narrow belts run at a quick rate. In some factories the shafting is of steel tubes mounted on flange ends, and in that case the belts are often taken direct from the shaft, and pulleys dispensed with; but unless the plan is very carefully carried out it is not altogether satisfactory. Mr. H. R. Towne says that the Wheeler and Wilson Company have their shafting belted without the intervention of pulleys, but he thinks that the system is applicable only where the class of machinery employed in one room is approximately uniform. In the case mentioned the shafting is of hollow cast iron, 12in. in diameter—the shaft is, in fact, a 12in. pulley. At some places where hollow shafting has been tried, so much has been broken that the owners have been glad to replace it with the older-fashioned solid shafts; but there is much to be said for hollow work, though it is not so important in calculating the power required for a given mill as a just apportionment of the frictional resistances.

THE date of the General German Exhibition has now been definitely fixed for 1888.

ON THE ADHESIVENESS OF SOME MICROSCOPICAL CEMENTS.

By PROF. A. B. AUBERT.*

IN looking over the literature of microscopy, I have often wondered why no tests have been made of the comparative adhesiveness of the various cements used. Personal experience in the use of cements is undoubtedly of very great value, nevertheless, direct experiment may often be equally useful in deciding what cement to use for a certain purpose. In journals and works on mounting, I found so many more or less conflicting statements that I decided, as soon as time permitted, to make some tests with our most common cements.

For this purpose I chose metallic cells, having an outer diameter of ·77 of an inch and an inner of ·51 of an inch; thus offering a surface of adhesion equal to about ·2262 of a square inch. To these cells was soldered a loop of strong brass wire; they were then attached with the cements to heavy glass slides, and put aside to harden for one hundred and three days. The slides with rings were put into a rigid frame, supporting them at both ends, and a hook, with a deep pan attached, was slipped into the loops of brass wire. Sand was cautiously poured into the pan, and when enough had been added to occasion the breaking apart of ring and slide the quantity added was carefully weighed, and the condition of the cements noted, with the following results:—

Name of cement.	*Condition of cement.*	*Wt. added. Grammes.*
R. Miller's caoutchouc cement	dry	6,150
Bell's cement	nearly dry	4,520
Canada balsam, chloroform solution	somewhat soft	4,087
Lovett's cement	dry	3,850
American styrax, chloroform solution	a little softer than the Canada balsam	3,538
King's cement	nearly dry	3,274
Gold size (Winsor and Newton's)	very soft, dry only around edges	2,423
Dissolved marine glue	nearly dry	1,867
Zinc white	dry	1,481

By calling Miller's cement 1,000 we have the following table representing the comparative adhesiveness of the cements tested:—

Miller's caoutchouc cement	1,000
Bell's cement	735
Canada balsam	664
Lovett's cement	626
American styrax	575
King's cement	532
Gold size	395
Dissolved marine glue	304
Zinc white cement	241

Gold size would undoubtedly have stood much higher in the list had it been sufficiently hardened. It certainly showed considerable tenacity when the fact that the edges only were hard is taken into consideration. Most of the other cements were dry enough to make the results sufficiently accurate for comparison.

R. Miller's caoutchouc cement is of English manufacture, and is well recommended. Having only used it for a short time I cannot say much in regard to its qualities from personal observation.

Bell's cement is said to be a solution of shellac in alcohol. It has always worked well in my hands for glycerine, camphor, water, and some other liquid media.

Canada balsam I have only used as a mounting medium, and should fear that it might become too brittle in time to be reliable as a cement.

Lovett's cement consists of thoroughly mixed, finely powdered white lead 2 parts, red lead 2 parts, litharge 3 parts. For use the powder is mixed with gold size to the consistency of cream, and the cells immediately fastened to the slides. They will be found quite secure in two weeks. It is the best cement I know of for liquids containing alcohol.

American styrax is an excellent mounting medium. It would probably remain tough longer than Canada balsam. I have never used it as a cement, however.

King's cement, prepared by J. D. King, Cottage City, Mass., I have found to be a pleasant cement to finish mounts with. The label states that it is "strong and reliable to attach cells and secure fluid mounts."

The gold size I use is of Winsor and Newton's make, it dries rapidly, and is very tough; my experience with it is such that I consider it one of the safest, if not the safest, of our common cements. Cells made many years ago, which have been roughly handled, show no tendency to crack or loosen.

Dissolved marine glue is a fusel
alcohol) solution put up by Robert
Birmingham, England. The label s
is "very good for fixing cells, or mak
troughs, etc." My experience with it
that I am unable to say anything addi

The zinc white cement (benzole
gums) was prepared by Geo. F. H.
Warren-street, Boston, Mass. I like
very well for dry mounts, but have al
the habit of covering it with a ring e

I have found asphalt cement and
black so brittle that I did not test th
to do so hereafter, when I expect to a
cements to my present list.

Let it be remembered that the fo
must be looked upon as comparative
absolute; they were made to assig
cements in a comparative list. To d
absolute adhesive strength of a cem
number of tests of that one cement w
be made under various conditions.
present too little time at command to
complicated a series of experiments.

Orono, Maine.

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* From the *American Monthly Microscopical Journal.*

SIZE AND SHAPE OF LA
SLIDES, MOUNTING, &

THE size generally adopted for a l
is 3¼in. square, being a very con
with ¼in. margin, which gives the sight
ture 2¾in. square. By square I mean t
cushion shape—that is, square, wit
corners rounded. All lanterns of any
are fitted with condensers of 4in. dia
this will take nicely the shape above-m
out any falling off at the corners, the
the opening of the masks I use for th
being 3¾in. If the lantern is fitted
densers of 3½in. diameter only, masks w
openings can only be used for all pictu
one is satisfied with only small-sized pic
regards condensers I must say a few word
many of the modern lanterns fitted with c
made with two plano-convex lenses, mou
their convex sides to each other, and the
surfaces outwards. For limelight I c
condenser of this kind the worst
sible, as it is almost impossible
centering the light (especially w
mixed jet is used, where the light emanat
very small spot only), to get a perfectly
or I may perhaps make myself better und
I use the term "depth of focus"; and th
ment of the light requires to be so accura
disc is not perfectly white. Not so if
form of compound condenser be used, ma
bi-convex lens, and the other lens of a
form; and when mounted, the side whic
cave being towards the light and the co
towards the screen, a condenser of this ki
hands always gives the best results with th
jet. The defect to which I have referred
first-named condenser is not so great if th
or blow-through jet is used, as the spot of l
the lime is much larger; and the defect is
in the oil lantern, as the size of the flam
larger. I suppose the plano-condensers ar
being much cheaper. To resume: to su
takes, the masks for lantern slides are b
of what is known in the paper trade as
paper—that is, paper black one side and
the other, the black side being p
wards the film, and the white side to
cap glass, and on this white side of th
the name of the subject can be written w
and ink. The white side is also very co
as it can be easily seen in a very dull ligh
operator. In making slides for amateurs I
ally mount them in this way; but I think
elegant way is to use masks black on bo
and write the title in white with a pe
this, get a bottle of Chinese or permanen
which can be obtained at any artist colo
empty the contents into a much larger b
thin down with water, stirring well with a
stick kept for that purpose, to a consist
will flow in an ordinary fine-pointed pe
the title is long, it is best to use a steel p
crow-quill size, and sometimes called a
pen; the writing is then quite as easily
with an ordinary pen and ink. The white
occasionally stirred or shaken up, as the
being heavy soon settles.

Whichever system of mounting is
white side, or where the title is writte
always goes to the light, unless the pi
be seen by the audience on the othe
sheet, then matters are reversed, and
written side of the slide must g
sheet.

The shape of opening of the ma

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* By WM. BROOKS, in the Bri
graphy.

and judgment according to the subject; for nary landscape or interiors, the cushion shape generally be found the best, except in some ances where there is something objectionable e corners, then a circular opening may be an rovement. Or take the subject of a distant scape with too much of a grassy field in the ground, the circular shape decidedly will be a great improvement; in few instances an oval be a greater improvement still, but it is all rding to the subjects. I think for portraits oval form is far superior to any other.

many instances, the square or cushion shape ot suitable to the subject, especially where s have to be made from negatives not taken hat purpose. The 7½in. by 5in. and the 7¼in. in. size negatives, are mostly very unsuitable ntract into a square shape, unless the sides ain unimportant matter and can be cut off; if whole of the subject has to be included, it is er to make a mask of the same proportions. In instances, the sky can be made higher; if the ect be a flat country scene, then the sky being e higher will give a better representation of lat or marshy country; but if the subject be ntain scenery, making the sky higher would the effect of dwarfing the mountains, which ld not be truthful, which I think will be readily rstood, just the same as in mounting an ordi- portrait, the higher the subject is mounted aller he or she looks, and the lower the shorter, it is just the same with the landscape subjects re alluded to. Many pictures are entirely ed by injudicious mounting, whereas, with a care and taste, their value would be greatly nced. The masks I use I generally purchase he gross, of the standard sizes, taking care that are accurately cut and not out of the centre, for odd sizes I have a lot of shapes made of sheet brass, 3¼in. square outside, with the ous sized openings, using the Woodbury cutter, h is very easy to use, cutting on a piece of -glass.

to the binding of slides, I find nothing better *thin* black paper—not the ordinary so-called le-paper that is generally used. I find the cer the paper the more easily it is pushed off. aware that many use gum to stick it on with. self always use paste, which I find with the paper sticks far better than gum. The heat e lantern makes the gummed paper tumble off glass, whereas it has no effect if paste is used. nk I have mentioned this matter before in a er article some time back. And to make the ing more durable, if a little trouble is not an t and the thin paper is used, is to just pass a ls'-hair brush, charged with ordinary negative ish, over the paper, which makes it very hard, will stand a lot of rubbing without getting ged.

ELLIGENCE OF THE ELEPHANT.

his interesting "Two Years in the Jungle," Mr. Hornaday gives us these impressions of ntelligence of the elephant:—The elephant is ost patient and obedient of all animals, and r the most intelligent. He has more ability ason from cause to effect than most other als of docile temperament, and he is, beyond estion, the most capable of being taught, and ost willing to obey after he has been taught. e it is a matter of surprise that Mr. Sander- who has, I presume, more personal knowledge he animal, both tame and wild, than any pean living, should place so low an estimate his mind. He declares that "its sagacity is very mediocre description," and also that "its ning faculties are far below those of the and possibly other animals." From this , which I think is due to the fact that iliarity breeds contempt," I differ very ly. My acquaintance with tame elephants created in my mind a respect for their lectual qualities which I never could have ired in any other way. A trained dog or horse h a rarity, even among the thousands of their es, that it is considered a proper object to ex- at a circus. A horse which will promptly at the word of command, or a dog that will or stand on its hind legs when told to do so, sidered quite accomplished; but in India any rained elephant, at a word or touch from his , who sits astride his neck, will "hand up," l," "speak" (trumpet), "salaam" (salute is trunk), stop, back, lie down, pull down an cting branch, gather fodder and "hand up" attendant, turn or lift a log, or drag it by its drag-rope between its teeth. He will rotect his attendants, or attack a common with fury. I think I am safe in asserting there are in India to-day scores of captive ants who are capable of performing all the es enumerated above; but, of course, are many which are not so intelligent. ast with this the performances of our most igent breed of dogs, the pointer. Even when young and trained under the most favourable circumstances, they are at best but capable of being taught a few things, as to "go on," to "charge," to go in a given direction, and retrieve. The extreme difficulty of teaching a dog anything after he has passed his puppyhood is so universally acknowledged as to have given rise to the familiar proverb, "It is hard to teach an old dog new tricks." What a strong contrast is seen in the wild "koomeriah" elephant, caught when he was about sixty years old (by Mr. Sanderson), who "was easily managed a few days after his capture." Of all animals in the world what other would have so quickly learned that mind is superior to matter, that man is master of the dumb brute, or would have succumbed so gracefully to the inevitable?—*American Naturalist.*

"ELASTIC LIMIT" IN METAL.

THE *Engineering and Mining Journal* raises the question whether steel, which is becoming so popular a substitute for wrought iron, will, when it is subjected to continuous strain in suspension bridges and other similar structures, do as well as iron has proved that it can. Recent tests of sections from the cables at Fairmount Park, Philadelphia, and at Niagara Falls show that long use has not materially changed the structure. The *Journal* says: "It is a serious question, and one which time only can completely answer, whether steel structures will prove as uniformly and permanently reliable as wrought iron has proved itself to be. In other words, whether the fibrous texture of wrought iron can be equalled in this respect by the granulated texture of steel or ingot iron. In this connection it is interesting to note that the fibrous texture referred to is imparted to wrought iron by the presence in it of a small proportion of slag from the puddling furnace, and that this can be secured in the Bessemer converter also if desired. The so-called *Klein-Bessemerei*, carried on at Avesta in Sweden for several years past, produces an exclusively soft, fibrous iron by the simple device of pouring slag and iron together into the ingot mould. This requires, however, a very small charge (usually not more than half a ton), and a direct pouring from the converter, without the intervention of a ladle, which would chill the slag." The effect of the introduction of slag would seem to be to retrace the steps usually taken in producing steel, viz., to separate the iron from its impurities, and then to add definite quantities of carbon and such other ingredients as are found to neutralise the effects of certain impurities not fully removed. The most intelligent engineers, after ascertaining by exhaustive physical tests what they need, present their "requirements" to the iron and steel makers, whose practical experience and science guide them in the protracted metallurgical experiments necessary to find the exact process required. The engineer verifies the product by further tests, and by practical use may find that his "requirement" needs further modifications. As a result of all this care, some degree of certainty is secured as to what the material may be expected to do. No doubt the chemical composition of the slag used at Avesta was known, and met some equally well-known want in the iron, and thus the result arrived at was one which had been definitely and intelligently sought. An important factor in selecting material for the cables of suspension bridges is its "true elastic limit." By this term we mean the percentage of the total strength of the material which it can exert continuously without losing its resilience—i.e., its power to resume its former shape and position when stress is removed. Now, in the case particularly of steel wire as commonly furnished in spiral coils, the curve put into the wire in the process of manufacture seriously diminishes this available sustaining power. For it is evident that it would be unsafe to subject these cables at any time to a stress beyond their elastic limit. If, e.g., a snowstorm or a great crowd of people should load a bridge beyond this limit, when the extra weight was removed the cables could not bring the bridge back to its normal place, and the result would be a permanent flattening and weakening of the arch.

By a process invented and patented by Col. Paine, the wire in the New York and Brooklyn bridge was furnished *straight* instead of curved. Now, if a short piece of common steel wire is taken from the coil, and pulled toward a straight position, and then released, it springs back into its former curve; but if a short piece of the straight-furnished wire that was put into this bridge is bent, and then released, it springs back toward its straight position. It is easy to see that if a curved wire is pulled straight there must occur a distention of the particles on the inside of the curve and a compression of those on the outside. The inside is in fact strained past its elastic limit before any stress comes upon the outside. Hence, after the wire has been pulled straight, the elastic limit of only a portion of it can be taken into the account in calculating the load that can safely be put upon it. In the case of curved steel wire pulled straight, its ultimate strength was found to be only about 90 per cent. that of similar wire furnished straight by this process. The superior ductility of iron wire in some measure compensates for the distension of the particles on the inside of the curve, and that is a reason why it has heretofore been used for suspension bridges. But with straight steel wire there is no such distinction, and its entire elastic limit is available. This elastic limit is 66 per cent. of the ultimate strength, and, besides, that ultimate strength is 10 per cent. greater than that of similar curved wire. Thus, if we have a curved steel wire large enough to sustain 1,000lb. without breaking, a similar straight wire, such as those in this bridge, will hold up 1,100lb., and 66 per cent. of this 1,100lb. = 720lb. The elastic limit of curved wire has never been determined, since any stress that will cause it to reach a straight line is beyond the elastic limit of the inside of its sectional area. That of curved iron wire has been estimated at 40 per cent. of its ultimate strength, which is about half the ultimate strength of curved steel wire—that is, it would be unsafe to put more than 40 per cent. of 500lb.—or 200lb.—upon a curved iron wire when a straight steel one can sustain 720lb. without injury. In the Yew York and Brooklyn bridge the cost of a sufficient amount of such iron wire as is used in all other suspension bridges would have been some 200,000 dollars greater than that of the straight steel wire which was used. At 5 per cent., this effects an annual saving in interest of 10,000dols. There must, too, be a considerable saving in the current expense for painting and care, to say nothing of the more neat and elegant appearance of the less bulky steel. And as the whole area of the section of these wires is subjected to an even strain that is always far within the elastic limit, there is no danger of a change of structure under that stress.

It is highly probable—although Col. Paine has been too busy to work up the matter—that piano wire made in this straight method could be drawn up to and kept at pitch, without approaching very near the elastic limit. In that case not only would pianos seldom if ever require tuning, but probably all along the tone would be more satisfactory. And there would not be those exasperating periods when the pitch is not quite perfect, but yet is not far enough out to make it seem worth while to send for a tuner.

FUEL ECONOMY OF LOCOMOTIVES.*

IN a recent French work on American railroads ("Les Chemins de Fer en Amerique," by Lavoinne and Pontzen), is a statement, of which the following is the substance: "The style of construction peculiar to American locomotives is not calculated to reduce the fuel consumption to that of European locomotives. The small proportion of heating surface due to short tubes is as little qualified to utilise the heat produced by means of large grates as the very restricted use of expansion in the cylinders is to obtain the maximum work from the steam. Consequently, it is not surprising that, while an average of 35lb. of coal per locomotive mile is not considered low in France, American locomotives still average about 56lb." This led the writer to make a few comparisons between average bituminous coal passenger engines in this country and those used in France and England, omitting all of the special forms of boilers and engines which are in use on a few of our railroads, but which are not yet in general use. These comparisons are now called to mind by an article which has recently appeared in technical papers, in which various changes, and some of them startling ones, are recommended as the necessary means by which to produce an efficient locomotive.

Now, the writer believes that there is undoubtedly much room for improvement in some classes of engines, but also that as high an efficiency can be and is obtained by careful firing, from some American engines now in use, as from any simple foreign locomotives. And, further, that the immediate causes which result in a high average consumption of coal are simply overwork, careless firing, and insufficient boiler power for the sizes of cylinders used. These faults can be corrected without using larger grates than many now in use, and other improvements can then be added without necessarily remodelling the whole machine.

As to overwork, it is well known that there are locomotives in all parts of the country which, apparently intended for the slow speeds of a few years ago, are now forced beyond all region of economy to haul trains at a speed of 50 miles per hour or over. When we consider that, for example, a 16 × 24 engine, with 62in. drivers, has at the above speed a mean piston speed of 1,085ft. per minute, compared with a piston speed of 862ft. per minute for the same engine, with 78in. drivers, and also consider the volume of steam thus required of a small boiler and small grate area, no one can doubt the overwork.

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* By Prof. A. T. Woods in *American Machinist.*

In regard to careless firing, while it is by no means an easy matter to prevent escape of steam at the safety valve, it is evident to any observer that much steam, and consequently much coal, is thus wasted daily on many roads. The cause is probably to be found in the fact that in many cases the engineer and fireman have very little, if any, interest or object in saving coal.

In regard to the relative proportions of cylinders and boilers, it would seem that the importance of their relative size is too often under-estimated. For comparison, take (*a*), an American type, 17in. by 24in. engine, with 66in. drivers, and (*b*), a Paris, Lyons, and Mediterranean express locomotive, having cylinders 19·7in. by 25·6in. and 82·7in. drivers. Suppose each to be running so that the cylinders are to be half-filled with steam from the boilers at each stroke, and consider the number of cubic feet of steam required by each to run a mile. The first requires

$$2\left(\frac{5280}{17\cdot28}\right)\times\frac{226\cdot98\times24}{1728}=1923\text{c.ft.}$$

The second requires 2,203 cubic feet, but the boilers are so proportioned that while (*a*) requires about 117 cubic feet of steam per square foot of grate, and 1·9 cubic foot per square foot of heating surface, (*b*) requires but 96 and 1·5 cubic feet respectively. The average results of the comparison referred to above, while not differing as much as the two engines just mentioned, showed that we require of our ordinary bituminous coal passenger engines, as compared with sample French and English engines doing the same class of work, from each square foot of grate, 12 per cent. more steam than French, and 8 per cent. more than English, practice demands; and from each square foot of heating surface 22 per cent. more steam than French, and 17 per cent. more than English, practice.

In these comparisons, the average results for the boilers, taken apart from the engines, do not vary widely. The ratios of total heating surface to grate surface were about 67 to 1 for the foreign boilers, and 62 to 1 for the American: those of total heating surface to direct (firebox) heating surface were, approximately, 15 to 1 for French, 12 to 1 for English, and 9·5 to 1 for American; while the ratios of grate area to cross area of tubes were 6·8, 6, and 5·2 to 1 in the same order. It would appear that we make up in direct-heating surface what is lost by larger and shorter tubes. All of the above figures should be accepted with some allowance, for, although they represent an apparently fair average, the number of locomotives considered was small. It is true that many of our latest locomotives are being better proportioned than those considered; and with proportionately larger boilers, larger driving wheels for high speeds, and greater boiler pressure, they are showing a corresponding economy, as might be expected. But the majority of passenger engines in use are of about the proportions here given, and, what is more to be regretted, more have been recently built. While it cannot be said that master mechanics are unprogressive, for to some of them we are indebted for nearly all of the practical improvements in locomotives of all classes, there still seems to be a disinclination on the part of many to adopt improvements which have been tested and approved by others.

The writer concludes that the average American passenger engine can be made more economical by a more ready adoption of appliances which have been proved to work well: by proportioning boilers with more regard to the amount of steam they will be required to furnish: by a system of premiums which will save coal directly, by giving the firemen a substantial reason for saving it, or by a blow-back to save coal by utilising the waste from safety-valve: by an increase of boiler pressure: and by adopting a valve-gear which will give at early cut-offs a good diagram, compared with the theoretical card. When this is done, it will be time enough to figure on compounding.

"**All About Mnemonics**" is the title of a little work by A. E. Middleton, published by Simpkin, Marshall, and Co., which may be commended to the attention of those who are desirous of discovering the secrets of the "memory systems." It contains six chapters, and in less than 80 pages Mr. Middleton has contrived to tell us all that is worth saying about the subject, treating it from the historical and practical points of view, as well as from the utilitarian.

IN some experiments with Leclanché batteries, Dr. Emil Boettcher used for the negative element plates consisting of 40 per cent. of retort carbon, 55 per cent of manganese, and 5 per cent. of binding medium, the whole being combined under a hydraulic pressure of 200 atmospheres. The dimensions of the plates were 12cm. long, 4·2cm. wide, and 2cm. thick.

SCIENTIFIC NEWS.

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THE Dun Echt Circular No. 105 contains an announcement of the discovery of another comet by Mr. W. R. Brooks, of Phelps, N.Y. Its approximate place on December 27, at 8h. 11·6m. Cambridge, U.S., mean time was R.A. 19h. 55m. 40s.; N. Dec. 4° 8′. Daily motion in R.A. − 11m., in Dec. + 2′.

Several comets are due to pay their periodical visits this year. That of Pons, discovered in 1819, and rediscovered by Winnecke in 1858, has a period of about 5·5 years, and was last seen in 1875; it was due in 1880, but was not observed. A small comet with a similar period, discovered by Tempel in 1869, and since 1880 more generally known as Swift's comet, is also due, but will be in an unfavourable position for observing. Olbers's comet of 1815 should return to perihelion in the end of the present year, as its period is about 71·5 years.

M. Perrotin's small planet (No. 252), discovered by him on Oct. 11 last at Nice, has been named Clementina.

The report of the Superintendent of the United States Naval Observatory for the year ending June 30, 1885, has been received. After detailing the work accomplished, and giving an account of the state of the instruments and other appurtenances of the establishment, Commodore Belknap urges the speedy removal of the observatory to the new site which was purchased for the purpose in 1881, and renews the suggestion that a "board of visitors," composed of competent persons, should be appointed to annually visit the institution, and make "recommendations." It is suggested that the best constitution of such a board would be a committee of Congress, acting in conjunction with a number of gentlemen of well-known attainments and authority in the scientific world. It will probably surprise many in this country to learn that during the year 1,408 visitors were recorded, and 1,137 permits were issued for night visitors, for whose accommodation the small equatoreal (9·6in.) is set apart. The records kept by observers show that only one night in eight is good for observing, while an exceptionally good night cannot be reckoned upon much oftener than once a month.

According to M. Egoroff, as he explained to the Academy of Sciences, Paris, the origin of the telluric bands in the section A—*b* of the solar spectrum is oxygen and water-vapour respectively; thus, he says, that 126 bands distributed in equal proportions and identically in groups A, B, and *a* depend on the oxygen, the others being due to the vapour of water.

Mr. E. J. Stone, the Radcliffe Observer, describes the appearance of a fine halo with mock suns, as seen at the Radcliffe Observatory on Dec. 30. Measurements of the vertical radii of the first circle gave 22° 24′, while the angular distance between the true and mock suns was 22° 30′. The radius of the second circle was rather difficult to determine, but the mean of several measures gave 46° 40′. The inverted arcs at the vertices of the two circles were clearly seen. The zenith distance of the sun's centre was nearly 75° at the time of the observations.

We regret to announce the death, on the 31st ult., of Mr. W. Wray, the well-known optician and telescope maker. Mr. Wray was seized with apoplexy on Christmas morning, and died on New Year's Eve, at his residence at Highgate, aged 57 years. The business will be carried on as heretofore by Mr. Turnbull, the brother-in-law of the deceased, in conjunction with Mr. Wray's two sons.

The death is announced of the Rev. Thomas John Main, formerly Fellow of St. John's College, Cambridge, and for thirty-four years Professor of Mathematics in the Royal Naval College, Portsmouth.

Dr. Gautsch, the new Minister of Public Instruction in Austria, has prohibited the use of paper with square or diagonal ruled lines in all public schools, on the ground that such paper injures the eyesight. In future, if ruled paper must be used, the lines must be straight.

Some railway men are, it appears, tested for colour-vision by means of the dyed wool skeins
at night time, usually by gasligh
complain that it is not a fair test.
the shades used in the wool are no
tinguished by such light. The te
wool skeins should certainly be m
light, supplemented by examinatio
lantern and coloured glasses.

In the December number of the
Chimie et de Physique M. A. Crova,
sciences at Montpelier, has a pa
"Comparaison photométrique des
Teintes différentes," which should
interest in connection with railwa

A series of experiments was ma
improved water-cartridge invent
Miles Settle in some of the most fi
the North Staffordshire district la
this cartridge the charge is said
pletely surrounded by water, and
that the flame is thoroughly extin
mediately after the charge is fir
periments were thoroughly suc
shots bringing down the coal, w
slightest indication of flame foll
plosion. In the course of the
"blown-out" shot occurred, an inci
in such a mine, and with an ordina
would in all probability have ca
destructive explosion: but with
cartridge there was no appearance
the "blowing out" of the charg
cluding experiments were the firin
cartridge and of an ordinary pow
in bags of coal-dust on the pit ban
explosion of the water-cartridge t
dispersed in a cloud, mixed with st
the powder-cartridge fired the d
arose in a sheet of flame, and dis
smoke.

The number of applications f
during the year ending Dec. 31, 18
to 16,101, being a decrease on the p
of 1,009. The Board of Trade have
a committee, consisting of the Earl o
and Balcarres, Sir Farrer Herschell,
H. de Worms, M.P., to inquire into th
of the Patent Office, under the Ac
This committee will discover so
curious results: for instance, they
that the cost of "examination," as it
absorbs nearly the whole of the initia

On Thursday last week, Prof. W. H
director of the Natural History Muse
lecture on "Horses of the Past and Pr
the London Institution, in the cours
he said that one of the earliest know
of the horse was the tapir, which wa
interesting animal, and had from the
the tertiary period remained unchang
especially interesting branch of the
group was that to which the horse b
and that family was the one which ha
gone the greatest modifications f
ancestors. The points in which the h
gradually changed was a great increa
and especially in the length of the
certain alterations in the structure of th
but mainly in two points—viz., the
the feet. Both these changes had be
duced by adapting the horse to its
conditions of life. There was very litt
but that our domestic horse was deriv
the wild horse of Europe and Asia, but
not possible to say at what time it
domesticated.

The preliminary work for the conne
Ceylon with the triangulation of India
going on, the progress being slow owing
necessity for economy in Ceylon, double
stakes being substituted for masonry
except where the latter are a
necessary.

The Post Office authorities of Vie
Pesth have decided to utilise the
wire between the two cities for te
purposes. The distance is 174 miles,
experiment will, therefore, be watche
much interest.

Mr. Mellard Reade's presidential ad
the Liverpool Geological Society h
printed in separate form, and will
geologists. He discusses the way in w
enormous amount of mineral matter
into the Atlantic is distributed. He
that deposits thousands of feet in
being laid down about the

P. 380. OΣ 29 (66). Bu's angle should be diminished by 180°.

P. 382. B's pair. *For* XIXh. 35·5m. read XIXh. 34·0m.

P. 383. 54 Sagittarii. The 16mag. is at 244·5°: 35·8″. Error in Sm.

P. 387. ν Scorpii. *Dele* "De and others."

P. 394. θ¹ θ² Tauri. *Dele* "?."

P. 395. 111 Tauri. *Add* Rectilinear motion.

P. 395. P. IV. 257. *For* 70″ *read* 54·7″. Error in Sm.

P. 403. α Ursæ Maj. Klein and Weber's periodical redness probably an error.

P. 405. P. XI. 111. *Dele* "Engelmann" to "13·4″." Transpose "[" from before "13mg." to before "missed."

P. 412. γ Virginis. *For* 338·5° *read* 158·5°.

P. 414. P. XIII. 25. Add, "Bu 52·5 : 64·6″, 1881; owing to p.m. of A."

P. 419. P. XX. 113. *For* 45″ *read* 28·8″. Error in Sm.

December 31st. **H. Sadler.**

RE-OBSERVATION OF A CATALOGUE OF RED AND ORANGE STARS WITH A 17¼ REFLECTOR.

[25184.]—IN the third vol. of the *Journal* of the L. A. S., p. 83, will be found a catalogue of some new red or orange stars detected with the 9in. equatoreal. While sweeping over the same part of the heavens with the 17¼ Calver equatoreal the greater part of these have been re-observed, and the additional observations may be of interest. The power used was 70.

3. Dec. 13. 7·5 orange red = OR^1.

4. Nov. 5. 8·5 pale red, R^3. Dec. 13. 8·5 orange = O.

5. Nov. 5. 7·0 orange, O^2. Dec. 13. 7·0 orange O.

6. Nov. 5. 7·0 orange, O^3. Dec. 13. 8·0 orange O^1.

7. Nov. 5. 7·5 orange red, OR^1, *comes* 10·5, 25″ 90°. Dec. 13. 7·5 orange red, OR^2, *comes* 12·0, 20″ 90°.

8. Nov. 5. 7·0 orange red, OR, very fine, several observations. This star seems decidedly variable between 7·0 and 8·5. It was observed on several occasions by Rev. T. W. Webb, and the following are all the observations I know of:—

1871, March 27. Orange red, 7·0. Webb unpublished observation.

1872, Feb. 2. Orange ruby, 7·5.
1882, Feb. 15. Pale ruby, 8·5 +.
1883, Feb. 15. Ruby OR^3, 8·0.
1885, Feb. 27. Fine orange red, 8·5. Espin.
„ March 7. Fine red orange, 8·0. „
„ Nov. 5. Orange red, 7·0. „

9. 7·0, orange red, but not deep. Several observations in December, 1885. This star is No. 16 of a list of red stars given by me in "E.M." of Feb. 22, 1878. It was observed by Mr. Webb, 1874. March 18, pale orange ruby, 7·0; and again, 1883, Feb. 5, pale orange ruby, 8·2.

10. Nov. 5. 8·5, orange red; Dec. 13, barely orange, 8·5.

11. Dec. 13. 8·3, orange red, OR^1.

12. Dec. 13. 7·5, barely orange.

13. The following are my places for this star (1885):—

L.A.S. *Journal*, VI., 0·8 – 5·45.
Dec. 2. 0·2 – 5·49. Orange.
Dec. 16. 0·4 – 8·0. Orange.

14. Dec. 13. 6·5. Orange O^2.

15. Dec. 13. 7·0. Orange-red, OR^1.

16. Dec. 13. 7·5. Barely Orange.

18. Dec. 13. 6·5. Orange-red = OR^1.

20. Dec. 16. 8·5. Orange-red OR. Declination 3° 2′ 4 S.

25. Dec. 16. 7·5. Orange-red, OR^1.

26. Dec. 16. 8·0. Orange, O^1.

27. Dec. 4. 8·0. Pale-red, R^2.

28. Dec. 16. 7·5. Orange-red, OR^1.

30. Dec. 4. 7·5. Reddish. Dec 16, Orange-red, OR^1. Probably variable.

It will be noticed on comparing these observations with those in the original catalogue, that the larger aperture seems to show the stars of a lighter tint. But, of late, I have made observations almost every fine night of one or other of the following stars:—υ Cygni, ν Cygni, β 535, τ Cassiopeiæ, τ Cancri. These stars are all red of the first class, and so the standard of red has been raised in the revision of the catalogue.

The colour of S Orionis has been singularly disappointing this maximum. I trust shortly to give a second catalogue of red and orange stars detected while sweeping with the 17¼ reflector.

T. E. Espin.

G. N. SPEED.

[25185.]—A CORRESPONDENT, "Gulliver" *(letter 24833, p. 102)*, mentions a run from passing *Hitchin to* stopping at Peterborough in 45 minutes—viz., No. 547, with ten or twelve coaches. I timed a run by the same train (1.30 p.m.) from passing Hitchin to stopping at Peterborough (44½ miles) in 43 minutes, and with fourteen coaches. The engine was No. 666. On that occasion the last 48 miles to Peterborough occupied only 45 minutes. But with the 2 p.m. down Manchester express Peterborough was passed (at ten miles an hour) in 42 minutes from Hitchin; Engine No. 93, with six coaches.

I may add that another time on the train last named with the same number of coaches, and No. 62, the run from King's-cross to Hitchin, 32 miles, was done in 36 minutes, including the ascent of the 12¼ mile bank to Potter's Bar (passed in 16½ minutes) and the six mile bank to Woolmer Green.

Wellington, N.Z. **C. Rous-Marten.**

COMPOUND LOCOMOTIVES.

[25186.]—WHATEVER Mr. Steell (in letter 25153) means by saying "without doubt they are economical," is to me quite incomprehensible. I am afraid that Mr. Steell is one of those people who thinks that because a locomotive is compounded it must be more economical than a simple one. If not, perhaps he will kindly say on what grounds he made this extraordinary statement. In the "E. M." for Dec. 18, 1885, Mr. Steell will find a copy of the Crewe coal sheet, and he will see from that that Mr. Webb's latest type of compounds burn 36·2lb. of coal per mile, and, I may add, that the coal used is best Welsh. He will also notice that the average cost per 100 miles is £1 5s. 4d. I was told a short time ago by a Great Eastern driver that the average consumption of Mr. Worsdell's compound is 28lb. per mile. I may here point out that the compounds burn less coal than the other express engines on the Great Eastern, but they use more oil, and are about the most expensive engines to build now running. Now I will just give the coal consumption of the engines working the heaviest express traffic in England. Let us take, first, the magnificent 6ft. 6in. 4-coupled bogie engines, built by Mr. Drummond, for the North British Railway. These engines work over the worst express road in Great Britain, and their average consumption is 28lb. of Scotch coal per mile. I may add that the boiler pressure is 150lb. to the square inch, and that the feed-water is heated. The bogie engines working the Settle and Carlisle section of the Midland for July-December, 1884, with an average load of 12½, burnt 29·1lb. per mile, while the 800 class on the same section burnt 26·6lb. with about the same load. The average consumption of the Gladstones on the Brighton line is 26lb. of good Welsh per mile. It will be seen, therefore, that even Mr. Worsdell's compounds do not compare favourably with the engines mentioned above; but when we compare Mr. Webb's the sight that presents itself is perfectly disgraceful. I hope we shall hear no more about the compounds being economical. As regards repairs, I may just mention that a Webb compound, 685, Himalaya, which was turned out late in the spring of 1885, has broken three axle-boxes and a connecting-rod up to date. With regard to Mr. Steell's remarks *re* condensing, I am quite aware that it is not absolutely necessary in every case, and, in the case of an express locomotive, it would be an impossibility. But how else are we to get rid of the back pressure, which, at high speeds, is enormous, as an inspection of some diagrams will show? The back pressure is the chief obstacle in the way of producing a successful compound express engine, and I maintain it must be removed somehow. Of course the back pressure does not affect a goods engine nearly so much as an express because the piston speed is so much lower and the diagrams from Mr. Worsdell's engine at 28 miles per hour with a train of 16 coaches on the Brentwood bank are all that could be desired. If the Editor cares to reproduce them, I shall be pleased to send a tracing; for they will add visible strength to my statements that a compound goods engine on Mr. Worsdell's system will, in all probability, be a success, and that a compound express engine at high speeds is so troubled with back pressure that its success is very doubtful. In concluding this rather long letter, I will quote a few extracts from some articles that have appeared recently in the *Engineer* on the subject, and it will well repay any one interested in the matter to read them carefully:—"The mistake that has been made from first to last in compounding the locomotive lies in applying the principle to high-speed engines. It is in goods engines, running at slow speeds, that it is likely to be useful, and to this branch of our subject we shall return, and we believe we shall have very little difficulty in showing that for the Worsdell type of engine there ought to be a large field. We have now, we think, shown that the answers to the four questions with which we started must be, on the whole, unfavourable to the compound system as applied to express engines." . . . "All available evidence goes to show that at hi
compound locomotive is not more effi
powerful than others. There is no a
mony that it is more economical. We b
has originated in a misconception of t
under which locomotives work, and w
tiate it from the marine engine,
express traffic it will do no good. Th
haps, be a saving in fuel, which will
counterbalanced by losses incurred
heads. On the other hand, for slow
it ought to prove well adapted, and
had fitted up a few good engines in
stance, and put them to the slowest
hauling he had, the results obtained
been more encouraging than those he
got; but the Webb type of engine i
for goods trains, so he must have bui
different from the 'Dreadnought,'
express engine or nothing." To which
she is a "monster of iniquity."

G. I

BREAKING OF AXL

[25187.]—HAVING read letter 25
am interested to see the suggestion tha
of axles should be limited. There ca
tion that this is the only safe plan
what should be the limit. I obse
Railway Society considers 200,000 m
and 180,000 miles for steel a safe l
pose this would represent about eight
I trust some of your able readers w
the various strains on iron and st
causes of metals becoming weaker wit
' I understand that in America t
Institute are making experiments in th
and, therefore, hope some American c
will give the result in your column
kind of fracture of iron and steel show
of the metals? I have been told that i
a bit of iron with a jerk it will show
grain, and if slowly, then another ki
iron breaks, I suppose it pulls out in
gets smaller in size. Is this also the cas
to steel? As the failure of material
important feature in connection wi
accidents, I, as a railway man, hope y
will spare no trouble to consider and
question. In conclusion, I may say I co
limit for axles suggested by the Railway
very proper one. **A Railway S**

CRANK AXLES.

[25188.]—I AM much of a disbeliever i
cranked axles with wheels on them, flange
especially, though I do not expect the
will be dissuaded by us from using the
plan is to make the best of the fact of the
lence, and to increase their reliability.

It seems to me that they get pinched a
in the curves in the neighbourhood of poi
at high speeds on the outer rail on c
general. Apart from pinching and the wh
outer surfaces and portions of the web
sooner or later, get into an unreliable a
engendering condition, from the alternating
of the cylinders and connecting or coupling
The early-failing steel axles would prob
take very long to do so under those actions

The thickness of the webs that appears
sary to give the stiffness required to res
axles capable of acting as such, and of trans
the strains from the rails from flange to
when wheels are used, I believe increases t
dency to flaw from the rigidity that resul
the webs from a half-round of the axles to
lar place and form on the pins could be
laminations, I believe the axle would stand
though pinching and guidance would fal
shoulders of the bearings to a proportio
greater extent.

The axle might be freed from pinching
telescopic arrangement in the centre. Ther
course, nothing practical about these plans

Mr. Stretton's plan commends itself to
judgment—I refer to his patent of last
since I gave the matter consideration, though I
not approve of it at first; particulars of
progress with it would be interesting.

My first idea was that the bolts would
be tightly forced in to be of service against
ing, and that they would thus substantially
part of the web and be equally, or, if of
steel, more liable to degeneration and
But on reflection it became apparent
bolts passing through the centre of
regards the usual direction of fr
meet with a minimum and slight
would be unaffected by an
generated in the outer portions
they would form a stand-by
parted.

The cutting of the web
section is of least moment,
countersinks.

ike to suggest to Mr. Stretton that the
be best with fine lathe-cut threads,
of the shank as is possible, though
little, reduced to diam. at bottom;
d fit, but not so tight but that they
iodically removed in the shops by a
for examination or renewal, or for
a good long, covered exposure to a
emperature before testing and re-
tly, that the periods should not be
n examinations.

Together.

OAN AND HAWKS BRAKE.

SINCE this brake was described in the
ECHANIC of Oct. 30, 1885, I have not
criticism of same, at which I am sur-
he first instance, great importance is
the "automatic regulator." This is
, as I believe the Westinghouse Co.
liance which better answers its pur-
as been in use some months, if not
At the Inventions Exhibition the at-
Messrs. Sloan and Hawks' stand told
cessary to have their regulator applied
st loaded pair of wheels in the train,
being the first to skid would call it
Surely the least loaded wheels are not
r. He also certainly led me to under-
only called the attention of the driver
f the wheels skidding, who then had to
ase the brake, a greater evil in my
having one pair of wheels in a whole
l. I hope some other correspondents
ir opinion on this brake.

Upton Park.

ICAN v. ENGLISH LOCOMOTIVES.

THE serious attention of English loco-
eers and builders has recently been
e fact that the export of locomotive
the United States to foreign countries
ery large proportions, and reference
to various statements in favour of the
ngines. It is asserted that "the
comotive is superior to the English,"
rt of the statement we are referred to
of the compounds, the shortness of
19in. Midland engines, and the un-
working of the North-Eastern express
tructed by Mr. McDonnell."
attempt to deny that the engines in
ot give the results in practice which
rs expected; but, on the other hand,
friends must not run away with the
ause a few engines are badly designed
ocomotive stock of this country is
d inferior to their own; neither is it
to compare the working of a few of
rican engines with the worst they can
nd.
can Machinist, in an article upon this
rks that we English are "incredulous
orted superiority of American loco-
ertainly, I do not yet see any proofs
rican engine is better than our own.
will be remembered that about five
e Eames Vacuum Brake Company
to this country an American engine
Baldwin Locomotive Works, Phila-
e writer examined every detail of that
arefully, and also rode upon it; but
ed to discover any points which could
uperiority over the English engines.
hand, it must, of course, be admitted
ocomotives have been built in Eng-
en sent out to foreign countries they
able to perform the work required of
bringing discredit upon English
also damaging English trade. The
fore, is one of great importance, and
ould be spared to thoroughly inves-
rious circumstances connected there-
years ago I made some inquiries, and
e information, from which it ap-
the English maker does not have
ount of fair play which is accorded to
competitor.
nes are ordered from English firms it
omplete specifications and drawings
ed. The builder, therefore, has no
er in the design; he has simply to
ine according to orders, and if he sug-
tain details could be improved he runs
ing told to mind his own business. I
case which occurred a few years ago
was done. Designs were sent to a
me engines; the builder felt certain
ould not perform the duty expected.
as professionally engaged to examine
d that report confirmed the builder's
wever, the engines were constructed,
to work proved failures; this led to
or engines being afterwards sent to
ead of to this country. If an engine
ned it is absurd to blame the builder,
the plans and specifications of others.

Now, the reason why American engines have proved so successful on colonial railways is largely due to the fact that American firms are not only builders but designers; they will only work to their own specifications. The American builder simply requires to know the curves, gradients, speed, and work to be done, and he takes the responsibility of constructing an engine which shall give satisfaction and perform the duty required.

The English maker is constantly working to different designs and patterns, but the American has but a few standard types of engine, and can therefore make their various parts by hundreds, simply fetching them out of the stores as required. It is well known that where any pieces of machinery are required in large numbers, special tools can be employed for particular work, and reduced cost of production follows. I have now shown that in the locomotive competition the American builder, by reason of the liberty of action allowed to him, has a very great advantage over our own makers, who are tied down to hard and fast specifications, which are sometimes incorrect, or not calculated to produce the engine required.

Clement E. Stretton, C.E.,
Consulting Engineer, A.S.R.S.
306, City-road, London, E.C.

FLANGE DEPTH AND RAIL-LAYING.

[25191.]—AS some questioning has lately appeared in the "E.M." on the subject of the flange depth, I may be permitted to make some observations thereon, and at the same time, in particular, to point out what I consider to be a defect in the present manner of laying the rails in position.

Let us examine the matter by considering the question: Would a sufficient increase of flange projection prevent the trains from ever leaving the rails without apparent cause? I should presume that the most reasonable answer must be in the affirmative. At all events, this question should not have been shelved so thoughtlessly as it has been done.

The other matter, and with which I find fault, is that the joinings of the ends of the rails are placed exactly opposite one another on each line of road, evidently through an unmeaning desire for symmetry, though the joinings on the up and down lines do not generally correspond in position. Of course, the want of continuity at the joints is always more or less a defect, and is liable to become seriously so in case the rail should start by the loosening of the bolts. Now, as at present arranged, those defective parts of the rails are presented *simultaneously* to each of the pair of wheels as the train passes over the line.

This appears to my mind as a faulty arrangement, particularly as the conical surface of the acting side of the flange, intended to prevent side friction, has a tendency to throw the carriage towards opposite rails, and, of course, this tendency acts mostly at the joints. I would even suggest that the length of the rails should be made such that no two wheels of the whole train should be on the joints at the same instant of time.

My idea is that the inequalities of the bearing surfaces of the rails should be presented gradually, and not simultaneously to the wheels, as the best means of reducing the jerking, and procuring the equable and safe motion of the trains.

Wolfenbuttel.

RAILWAY COUPLINGS.

[25192.]—I AM very much surprised to notice that the great question of railway couplings does not engage more attention. The Railway Society has £500 ready to give away in prizes, and there are plenty of inventors ready with couplings; yet the trial does not come off.

That society has written to the papers and to the companies, but I hear the whole thing is at a dead stand for want of a bit of line and a few waggons, so in the meantime my fellow-shunters are being killed as usual. This is a state of things that English Mechanics should not allow to continue in a country like ours.

I should like to know if your readers consider that couplings ought to be automatic or not.

A Railway Servant.

WHITE v. BROWN BREAD.

[25193.]—"E. F. M.," in letter 25181, has brought this subject again in "Ours," and with the same old arguments; but the worst part of it is that he has copied the article out of an interested paper, the Pappenheim's *Müller Zeitung*, in which, as it could not be expected otherwise, Dr. Wallace is taken to task for lecturing on and for eating brown bread. But I think "E. F. M." has failed in his object by copying that letter.

Now, from the economical point of view, we can neither gain nor lose by eating the bran or feeding our domestic animals with it. But the question is, Ought we to eat only such food as the stomach can digest? The old argument that the human stomach cannot digest the bran is always brought forward. Does the horse digest the oats and the woody fibres of the grass? No. Neither does the cow or sheep. If it is not necessary to eat a certain quantity of ballast with digestible and nutritive food, then we might extract from our food that part only which the body requires. A few ounces a day would be enough to keep men healthy and strong, and we might then dispense with our intestines. Is it necessary that the bran must be completely digested in order to enable the stomach to draw the nutritive part out of it? As I understood our respected correspondent, Dr. Allison, it is absolutely necessary that the intestines should always contain a certain amount of matter, or that it should pass through them. I have also heard from other great medical men that we should eat some light with heavy food or drink water in order to enable the stomach to do its work. It would be unreasonable to go back to primitive life, especially as we cannot gain anything by it if brown bread is not conducive to health. My own way of living cannot, of course, be adduced as an argument in favour of brown bread; but, as far as my experience goes, I find that, after having eaten the white bread for some time, and being a tobacco smoker, the taste becomes rather insipid; then I find it needful to take something stronger—namely, "Hamburger schwarz brod," which is made of rye, with the bran ground fine. It is the same kind as that served out to the German soldiers, and I find it tends greatly to benefit my health.

J. H. Schucht.

THE BLOWPIPE, &c.

[25194.]—IN my last letter (25106, page 303) there appear two compositor's errors. At line 55 from top, for "browning sublimate" read "*brownish sublimate.*" A few lines further down in same paragraph, instead of "Blowpipe Manual, 1883," read "Blowpipe Manual, 1880."

I see from a paragraph in letter 25150, page 343, that Col. Ross charges me with having "persistently misquoted statements from his books." Will Col. Ross be good enough to point out those "misquoted statements"? I have carefully compared the quotations I made from his books with the originals, and have been unable to find out one single instance where I had "misquoted" from them.

In the next place, as an excuse for evading my challenge, Col. Ross alleges I have used unfair language. I leave this to the judgment of the readers of "Ours" as to whether myself or Col. Ross has most reason to complain, after his biased and unfair criticism of my blowpipe apparatus and the scurrility with which he queried, "Do you sit on the bellows?" Col. Ross's review of my apparatus looked more like a gratuitous advertisement for Mr. Letcher than criticism. Col. Ross's allegations as to my "effusions" I believe to be a mere subterfuge; and his real reason for not taking up my challenge will be found on page 27 of his book, "The Blowpipe in Chemistry, &c.," where, after describing a hot-gas blowpipe apparatus, he makes the following remarks:—

"The above-described apparatus forms the most powerful and useful chemical blowpipe known, excluding, of course, the oxyhydrogen, and such blowpipes as Herapath's, of Bristol, in which the blast is directed from the centre of the gaspipe. *All such* (the italics are mine), as well as the pyrological use of an ordinary Bunsen burner, paralyse and jumble together the chemical effects of oxidation and reduction for which the ordinary blowpipe pyrocone is so justly celebrated, and cannot, therefore, be used here."

The Beaumont blowpipe has blast tube down centre of gas-pipe, and is, therefore, one of the "all such" to which the above quotation from Ross's book applies. From this our readers will plainly see the reason why Col. Ross so persistently reiterated the absurdity that my blowpipe would not give the proper effects of oxidation and reduction. My blowpipe, by its peculiarity of construction, is *par excellence* for producing these effects, which I have fairly proved by comparison, as Col. Ross cannot deny. Instead of acknowledging his mistakes manfully, he retorts with vituperation and unfounded charges. This is a further proof of the extreme flimsiness of his case. After Col. Ross's 25 years' experience with the blowpipe, it appears to have upset his equilibrium to be shown that he is wrong on this point by a mere stripling of barely two years' practical experience in the art of blowpipe analysis. But I have more to follow, which will increase his astonishment. I believe no writer who has written specially of the blowpipe—not even Col. Ross—has ever rationally described the molecular and atomic changes which take place between the assay and the gas flame or process of combustion, or how the chemical effects of oxidation and reduction are effected in the blowpipe pyrocone.

It seems passing strange that this should have been left for my humble self to describe plainly

surely something more than a swell? I
d the second touch spoken of would not be
by the majority of your musical readers.
.e, detest a second touch, and understand
e-organ builders do what they can to avoid
: large pallets. Another consideration is,
g will the second action stand? Owing
iort distance that it works, there is little
r wear. So far, I consider the point at
is far off as ever—viz., the best instrument
: use? Then there is the price of such an
ent as "Country Solicitor" describes; a
pipe-organ, with pedals and swell, would
s be obtained for money. If portability
ideration to him or others, of course the
in has the first place. I have designed an
ent, a harmonium and American organ
d, both actions to one manual. Of course,
ll be both pressure and vacuum bellows,
stops arranged in two sections—viz., those
g the American organs will be in the group
"Great organ"; those for the harmonium
"Swell organ." I propose to have on the
e row 16ft. tone, one row 8ft., and one row
ed in the usual manner. On the harmonium,
8ft. broad reeds, one row 4ft., and half row
sette in the treble, and another half row,
e bass. On the feeders of the A. O. I shall
alve, so that on drawing a stop connected
nese feeders will still continue to work,
: to exhaust the air from the reservoir.
p will also actuate the expression-valve of
onium, and then you have the expression
stops you may have drawn in the swell
I omitted to say there will be two stops,
led "Great ventil," and the other "Swell
With both these closed, the instrument is
draw great ventil: their reeds speak
; to stops; same as expression on swell.
vill be seen we can have from full power
eat to musette and sourdine, simply by
ne stop, and drawing the other. I should
ar what your readers think of such an in-
?

Amateur Organ-Builder.

THE OTTO BICYCLE.

]—MY thanks are due to Mr. Boys and
," for their replies to my queries, *re* the
cle. I had hoped to see a discussion on
s and disadvantages of the Otto. I sup-
is some drawbacks; but the only one I've
ntioned is that it is not very safe except
ienced riders; that it takes a long time to
l "Norman," in letter No. 24625 says that
riders of the Otto go at a fast pace. I
nought it was supposed to be a good
for rough roads, owing to the absence of
; but perhaps unexpected stones, hollows,
able to jerk one off the saddle. If that
, would the pedal-straps hold the feet in
use a bad accident? What pace can be
y a fair rider on the road?
anxious to know all I can about the
before deciding whether to get one, as if
t suit me I think it would take a long
t rid of it. I wrote to the Otto Co. for
s, &c., but they only sent a pamphlet
timonials from various clergymen, and no
n of the machine itself.

South Australian Bicyclist.

R ROLLS FOR TUNE BANDS.

]—THE firm mentioned will only supply
for music rolls in very large quantities
order, and I have, therefore, had to seek
amongst those who really manufacture
: and also have some in stock for a ready
The quality that suits my purpose
th for strength and durability is made
hur and Co., Dalsholme Mills, Glassford-
sgow. It is termed "Manilla web." I
up about six hundred yards, and have
ning to equal it, and though very tough
s, yet it punches clean.
nade no difference in the method of pro-
e tune bands described by me in this
cept in the punching arrangement. In-
a hollow punch carried at the end of a
n I now use a lever press with a solid
ving a central spike for entering the
ted in the band. The punch and arm is
a spring, and the notes can be cut out as
the hands can well be moved.

F. H. Wenham.

NT OF PETROLEUM IN BULK.

—IN reply to "J. W. W.," letter 25173,
o not think his suggestion would answer
etroleum is of an exceedingly penetrating
would find its way through any packing
lay. At any rate, it would substitute a
expensive mechanical adjustment, which
be open to constant inspection, for the
-acting effect of gravity. Of course the
ect might be attained, as it is in the
: milk by railway—that is, by fitting a wide cylinder to the top of the tanks, in which the play of expansion and contraction would occur, and then covering the liquid in this cylinder with a freely playing floating piston. But even this would be less perfect and less under control than the compensation reservoir and pipes which I described as employed in the *Crusader*, and which worked perfectly and involved neither attention nor expense.

Sigma.

THE WIMSHURST INFLUENCE MACHINE.

[25201.]—MY experience with the Wimshurst influence machine may interest others beside myself.

I desired to have some readily available means of producing electricity of high tension, and my cylinder machine required so much coaxing that I was induced to order a Wimshurst machine from one of the makers who advertise in your columns.

It seemed almost too much to expect all that was promised of it in such a damp climate as ours, and when I got it home I was scarcely at first disappointed when I failed to get a spark. I wrote to the makers, who expressed great surprise, and suggested that I could not have put it together properly; but, after much correspondence and renewal of brushes, scraping of sectors, &c., I eventually gave it up as a bad job. However, I continued to read such favourable accounts of the machine in your paper that I determined to sift the cause of failure in my own case, and I wrote to Mr. Wimshurst about it.

That gentleman, with the greatest courtesy, made several suggestions, which I put into practice, with no better result, and as he further offered to examine the machine for me I sent it to him.

It certainly had occurred to me that possibly the quality of the glass used for the plates was at fault; but I could hardly believe that work turned out by professed electricians, in apparently a superior manner, could be defective in such an essential particular.

However, Mr. Wimshurst tested its conductivity by applying the knob of a charged Leyden jar to different sectors, and, to use his own expression, he found the electricity "simply ran away."

Thus my failure arose entirely from the bad quality of the glass.

New plates were put into the machine, and its performances with these have fairly astonished me.

There is no saying what practical applications high-tension electricity may receive in the future, and now that I have experienced the surpassing advantages of the "Wimshurst" machine, I feel confident that the clumsy and capricious frictional machines are things of the past; but I would warn all those who look for success with the admirable "Wimshurst" apparatus not, as I did at first, to condemn it until, at any rate, they have tested the quality of the glass and varnish employed in its construction.

There may be other matters of equal importance, such as the spacing of the sectors—which appear to do best when made of tinfoil—and choosing wire of sufficient fineness for the brushes; but, these once attended to properly, the machine seems to leave nothing to be desired, either in simplicity or in being readily available at all seasons.

My opinion is that Mr. Wimshurst has achieved a great success in having invented such an excellent machine.

W. T. B.

OPTICAL, &c.

[25202.]—"PRISMATIQUE" asks (letter 25160) if, when an illuminated puncture is viewed, "would that be a spurious puncture because we see diffraction rings round it"? I think I can make this clear to him.

It is neccessary that a small aperture be used to look through, at either a bright point as the sun reflected from a convex surface, or another minute puncture held in front of a bright light; then the disc and ring phenomena become apparent. Let him make several punctures of different sizes to put nearest his eye, and view the point of light through them—a distant gas-light will do, and a very pretty sight it makes to view a row of lamps in this way—he will find that the smaller the aperture he looks through, the larger the disc he will raise, and, no matter what the shape of his distant light (or small aperture, if near him), he will always get a round disc if only his viewing apparatus is small enough. Thus, it is *not* a spurious puncture, but it *is* a spurious disc, raised solely as the result of limiting the aperture of the eye. As the aperture enlarges, the spurious disc diminishes, and the real shape of aperture viewed can be distinguished. If an object having sensible surface be viewed with a minute aperture, these discs overlap; but if aperture is enlarged, discs diminish, and detail becomes visible.

If "Prismatique" will puncture closely a piece of paper, and place it in front of a gas flame some feet away, then view it through a fine needle hole, the surface punctured will show no signs of any punctures, but appear equally illuminated. On making his viewing hole large, the detail of the punctures will be visible. I think he will thus see that the spurious disc is more spurious than the image of watch-dial through same glass, although the image of dial is made up of spurious discs, most certainly.

Will he kindly explain why the micrometer is of no use if there is no sensible diameter to any star? Surely the distance apart of two stars is measurable, although they remain points.

I hope I am not hypercritical in regretting my inability to detect "Prismatique's" point in his observations on railway track and points of needles under Dr. Dallinger's microscope. Nor do I know how or where to put a watch so as to look no larger than a shilling. I should like to know how a telescope cuts off the irradiation, or how it is possible to cut off irradiation at all?

Why is it absurd to imagine magnifying an object some millions of miles in extent in the same way a watchmaker magnifies a delicate spindle centre? Of course, one cannot use a single lens, or put it under a microscope; but if this is what is meant the remark is without point or meaning.

I think "Prismatique" means to dissent from Mr. Calver's statement that we cannot magnify a star; but do not feel sure.

I ask him to believe that I only make these remarks in order to obtain clear ideas and exact statements of them in place of loose and unconsidered writing.

Edwin Holmes.

THE SCREW QUESTION.

[25203.]—WHILST the question of the mandrel-"nose" was under discussion, and the interchangeability of chucks, it was almost universally admitted that it was not possible to insure interchangeability so long as the set of the chuck depended upon the screw alone. This is admitted by Messrs. Holtzapffel and Evans amongst others, and it was this which gave rise to the family of transfer-chucks, to Dr. Edmunds's model mandrel, and to the other schemes put forward by correspondents in your journal. No one, however, so far as I am aware, has advanced any *reason* for this supposed impossibility, which should, after all, have been the primary question. The difficulty must, however, prove that some inequality remains in the best and most carefully-cut lathe-nose. In what does that inequality or imperfection consist?

I venture to submit that the set of a chuck would not be influenced by a looseness of fit nor by badness of fit, as when male and female threads do not coincide; but it would be greatly influenced by the very slightest amount of drunkenness of the thread.

The simplest example of this will be what we find if we fit a turned box-lid by a screw cut "flying" with a chaser. Almost invariably, if the screws fit pretty tightly, the lid does not go up evenly all round the edge. It screws up to the shoulder one side, whilst you can see a crack or space opposite, proving that one or both (male and female) screws are "drunk." Those who are satisfied with appearances will now simply take up the chaser and deepen the thread till the lid fits loosely enough to go up to the shoulder all round. It looks right now, but is, of course, only held up at one part of the circumference. It is easy to conceive that the screws might be small and the shoulders of the fitting large, and this would much increase the difficulty. Here we have, I think, an explanation of the difficulty of fitting chucks so that they shall be transferable. Suppose a mandrel-nose is cut in a slide-lathe by a fixed tool, the hand-chaser not being allowed to touch it; it should then be as free from drunkenness as the leading-screw of the lathe in which it was cut. But I am told that even the Whitworth lead-screws are not perfectly free from drunkenness. If that be so, then there will be a slight amount of drunkenness imparted to our new lathe-nose. Suppose, now, that a chuck is fitted to this nose which has a correct screw. If that chuck really fits the threads, it will not go up equally all round, but will only take off the red marking rubbed on the mandrel-face on one part of the chuck-face. On screwing-up such a chuck, the pressure on one side of the chuck-face tends to throw the chuck out, more or less, according to the force with which it is screwed up, which is one reason why work returned to the lathe will often run a little "out."

Suppose, however, we scrape the face of the chuck until it goes up true to the shoulder; it will have a solid bearing, but it is now slightly oblique to the centre line of the chuck-screw, and it will only run truly and fit solidly when screwed up exactly to the same angular position.

Now if this be admitted it is easy to see why this chuck, whether scraped or unscraped, cannot be transferred to another "nose." It has been turned up on a nose with a slightly drunken thread, it would only run truly upon another which was not merely equally drunk, but in which the infinitesimal amount of drunkenness of the nose occupied a similar angular position inside the chuck when screwed up upon it—a situation difficult to describe and impossible to attain.

The moral of all this is that if the screws on the "nose" and in chucks were perfectly free from drunkenness, interchangeability would be possible; chuck faces would not require to be scraped, but if they were, no evil would result; no, nor even if a quantity were filed off the face, provided it were again brought true with the screws.

F. A. M.

THE DIVISION PLATE.

[25204.]—Permit me a few words respecting the multiplying and dividing plate figured and described by "Vulcan" on page 363.

The good points about it are mainly, that it could be made in considerably less time and with less trouble than the ordinary plates; and that, with fewer holes, properly set out, it is capable of far greater variety. On the other hand, it has what I consider several bad points. The number 13 seems to me to be an unfortunate one for the intervals in the sub-circle for this reason:—The numbers which the sub-circle, is capable of giving are, first 13, then advancing by thirteens up to 195, with only one extra number—viz., 15, derived from using 1/13ths of the interval number 15. Thirteen is an obviously awkward jump. Had the number 12 been chosen for the sub-circle, and the 12 intervals again been sub-divided from, say, 3 to 14, much greater variety in results would have been obtained. Thus, by using the interval 14, that alone would give as extra numbers 14, 21, 24, 28, 42, and 56. The other high-numbered intervals would also afford similar variety. One other, and the most important, objection to this style of plate presents itself to my mind—viz., any error that existed in the sub-divisions would be multiplied by the number of times the sub-divisions in which the error existed was used to complete a circle.

In conclusion, I may say the idea is quite new to me, and I thank "Vulcan" for the interest it has afforded me in thinking out its possible capabilities.

I should like to hear of the method usually adopted in drilling division plates, so as to insure accuracy in the result.

An English Mechanic.

Newcastle-on-Tyne.

[25205.]—I see that I have omitted in my last to note that the fixed pawl would require to be lifted, say, by a screw, while the plate was being rotated under control of the other pawl. Also overlooked the fact that the spaces in the outer circle would have to consist of a set for each divided circle, such set being similar sub-divisions of the outer circle to the circle they belong, sevenths for the seven circle, and so on; or else each circle would have to be sub-divided to multiply, and both pawls made movable—perhaps the better plan, as more variety could be got with less liability to confusion. This latter would be reduced also by making the holes in the sub-divisions less than the main ones. Moving the pawl is the weak point; but if sliding freely, a good fit, and easily set, I think is practically good.

Vulcan.

ON SPLIT STEEL PARALLEL BEARINGS—TO "ORDERIC VITAL."

[25206.]—In reply to his observations on p. 360, my opinion is that anyone, amateur or otherwise, could much more easily and truly fit up a lathe with a conical collar, whether of gunmetal or steel, and a tailpin, than he could get up a headstock with correct V's and equally good fitting steel dies, as I may term these steel bearings, and then to bore or turn them correctly; and I presume that he is aware that they would not be of the same size after they were hardened. My Britannia lathe headstock runs in apparently a gunmetal conical bushing, and has only required adjusting once, or possibly twice, in two years, although often used to turn mangle rollers out of 7in. timber. But I consider that most lathes are seriously injured by being used for drilling, which throws a very injurious strain on a good lathe. I don't think that any ordinary amateur could make a satisfactory sliding mandrel, and would like to know what single advantage "O. V." claims for the split bearing method, which I saw in "Kennan's" some forty years ago?

A., Liverpool.

SOFT WOOD TURNING.

[25207.]—Allow me, for the honour of my native place, which was not far from King's Cliff, to state that it is situated in Northamptonshire, *and not in N. Hampshire, as in "O. J. L.'s" letter (by clerical or printer's error)*. This village is an *old-established centre* of turning in the softer woods, which abounded in the neighbouring forests, and the "sally," willow, poplar, and beech may be added to the woods I mentioned in my previous letter, though these are the best. Another object in trespassing on your space is to notice the statement of "O. J. L." that hook tools are used generally for bowl turning, and these are not restricted as I mentioned.

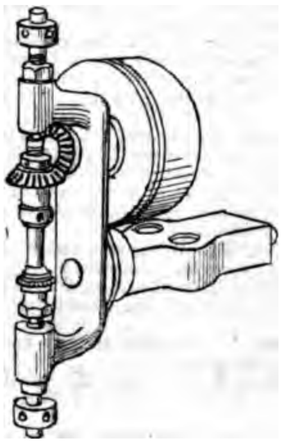
This may be the case, as doubtless "O. J. L." has good grounds for his statement; but my opinion was founded on my own experience and that of the turner I mentioned. The King's Cliff work is well made, but so far as my recollection of many years back goes, the bowls are not very smooth, but show the tool marks prominently. The work might possibly be turned out smooth, but the bowls are made to sell, and they do so.

I believe the difficulty in using these tools (if they are so used) in cross-grained wood is so great that my statement as to confining the use of the hook tool to wood chucked longitudinally is practically trustworthy. I wish it were not, for clean cutting with a gouge is difficult enough.

M. A.

LATHE MATTERS.

[25208.]—I inclose you a photograph of a Universal Cutter by Hines, of Norwich, which your readers may like to see and compare with several others which have lately appeared. It will be seen that the band will run straight up even when the frame is swivelled round at the divided collar. The long centre screws provide for height adjustment, and the circular nuts on spindle for readjusting bevel wheels to proper depth.



F. A. M.

ORNAMENTAL WORK IN THE LATHE.

[25209.]—I am sincerely glad to see lathe matters discussed in "Ours," and living far beyond reach of London, or anywhere with a lathe with overhead motion, I have set about constructing same myself. I am greatly in the dark as to the kind of ornamental work which an overhead motion and fly-cutters will produce, and I am certain that many others as well as myself would greatly benefit by a few designs, with hints as to construction, of ornamental work, say, in brass or hard wood.

From long experience of turning on an ordinary 3in. back-geared lathe with compound slide rest, I can say that my difficulty has been always not *how shall I turn, but what shall I turn.* If we turners were as well supplied with patterns and designs as fret cutters are, there would be no end to the turn off of articles of virtu in our leisure hours. It might, I think, be well for your distinguished correspondents, like H. Evans and "O. J. L.," &c., &c., to remember that everyone (and, in fact, very few) has not back numbers of the "E. M.," and it is evident from the question department that there are still a great many young mechanics who have not digested back numbers. Without any hesitation then on the score of repetition or originality, let us have some descriptions and drawings of turning, since there must be a vast number of turners only waiting for some pattern to copy in order to begin with fresh energy again.

Working Engine Man.

AN ADJUSTABLE OBJECT-GLASS.

[25210.]—The performance on Venus of the telescope lately made by "Prismatique" is in the highest degree satisfactory. With 3in. aperture the definition appeared to be as good as it well could be. The view of Saturn, too, with the same aperture, is equally satisfactory. Ball's division of the rings is well seen. It does not appear, however, as a black space with edges as sharp as in "Herschel's Outlines of Astronomy"; it rather has the appearance, both as to sharpness and colour, of a pencil-mark. The crape ring is not to be seen in the *ansæ*, but where it crosses the ball it is quite conspicuous, and may be well seen with a less aperture. I have seen it with a telescope of only 2¾, but nothing like so well as with the present. This portion of the crape ring seems to have been seen 200 years ago by Campani, but its meaning was not understood. It is only lately that it has been found to be a portion of a dark ring. Belts were seen, and on 2nd Jan. there were four stars in the field at same time, probably not all of them satellites, but the faintest was well seen. The shadows of ball on ring and of ring on ball were not seen at all; but the planet is so placed that they hardly would be. The views of both planets admirable.

Among close doubles may be mentioned ι Cassiopeiæ, 4·5, 7, 9, at dist. 1·9" and 7·5" (fine, but not easy, 3·7in., Webb). 12 Lyncis, 6, 6·5, 7·5, at dist. 1·6", 8·6". The close pair in each of these is easily seen to be not single; but it requires the eye to be in the best position possible, especially with the latter, to see them divided. Perhaps a person with younger sight than mine might see it steadily. Such objects as ε Lyræ are easily seen if weather is at all favourable.

The telescope well bears the usual testings recommended to purchasers of instruments, for colour and spherical aberrations, and for diffraction. The spherical was corrected by the formula given in our last number, p. 360.

Acting upon the hint given by "F.R.A.S." on p. 359, I may add that the observations were made with a fine achromatic eyepiece by Wray, giving a power of about 170, and also with one by "Prismatique," which is of a peculiar construction, I believe, and is also an excellent one, with a large field, and good definition up to the edges. Power, about 135.

W. G. Penny.

HOW LONG DOES A BUTTERFLY LIVE?

[25211.]—To the entomologist this query is pretty well understood, the British Rhopalocera being limited to 67 species. Eight species are known to pass the winter in the egg state, twenty-five as caterpillars, ten as chrysalids, and ten as butterflies. Some doubt is attached to the winter condition of the other species of the ten hybernating species. I have captured eight of them in the spring. The exact time depends upon the weather. In 1846, being an unusual forward spring, on Feb. 28 of that year I observed *Gonepteryx rhamni* (the Brimstone), *Vanessa urticæ* (Small Tortoiseshell), and *V. polychloros* (Large Tortoiseshell); but in ordinary seasons about the middle of March, or, as I might say, the first week of mild weather, with sunshine and temperature about 56° Fahr. these three mentioned above emerge from their winter quarters to enjoy the sunshine in company with *V. Io* (the Peacock), and live on until May, so that we can say these butterflies enjoy a life of eight months, though the greater part of their existence is passed in a state of torpor. The ova of this species are deposited on the common nettle. The larvæ are full fed about the middle of July, and the imago emerges in August. *V. Atalanta* (the Red Admiral) and *V. cardui* (the Painted Lady) appear in September, seldom reappearing until the last week of May or the first week of June of the following year. *V. Antiopa* (Camberwell Beauty) I captured the first week of April, and *Colias edusa* (Clouded Orange) the first week of May, all hybernated specimens. I may add that hybernating butterflies kept in confinement and subject to alternate heat and cold, die before the usual time allotted to them.

Epping. **J. L. English.**

THE FERROUS OXALATE DEVELOPER—ERRATUM.

[25212.]—At p. 342, I am made to say that "the oxalate *has to be* added to the iron solution." It should stand, "the oxalate *has been* added to the iron solution."

This is an important point. If the iron solution be poured into the oxalate solution, no deposit takes place. If the oxalate be poured into the iron solution, a thick precipitate, difficult to redissolve, is formed.

S. Bottone.

STAY BUSKS.

[25213.]—I am very pleased to see the comments of "X. Y." upon my letter of October last. The thin divided busk he speaks of is now only used in the commonest makes. In starting, it will be well just to see the purposes these are supposed to be used for. Some say they are necessary support: others wear them so as to reduce width of the body at the waist, and I th generally agreed they are necessary to r bearable, through having to wear the skirts. Without stays, the ticular band seems to cut into the difficulty is now being got over solid busk is being used with an inverted hook at the bottom; the skirt band has a hole in the centre of it, and passing over this hook is supported in front, buttoning in the usual way at the back. It will be noticed, by fastening the skirts by this method, the size of the waist is much reduced, all the bands being below it; besides, the whole weight of the skirts is transferred to the stays, and thus distributed over the body. "X. Y." speaks of a "saw plate" busk that is absolutely rigid. I may inform him for a long time now they have been. He should see some of the best makes with their solid broad busks made from ¼in. shear steel, that will not bend in the slightest degree, and are so long that the wearer cannot possibly sit down properly; the bottom of the busk would rest on the seat, causing the top to press firmly against the chest, unless the wearer sat most upright.

The object of having them so deep I cannot imagine, or why they should not bend. If "X.Y." will look in the *Draper* some short time back he will there see an account of a draper's assistant who had to wear a pair of these stays nearly a day for a lady customer, to see how a costume looked when worn over them. She pitifully describes the misery she endured in being laced so tightly, and the discomfort of not being able to stoop or sit down comfortably for the length of the busk. Certain I am of one thing, that is, busks have to stand some enormous strains, judging from those sent me for repairs, and I wonder more serious accidents are not heard of from their breaking. Frequently entire new laceholes and strengthening pieces have to be placed in the back after a young lady has been to a ball, showing how tightly they have been laced, and the strain on them.

I fail to see the advantage of having busks of different lengths and widths suggested by "X. Y." Ladies would not trouble to fasten any particular one in "so as to have their stays laced close." Good-fitting ones always will lace close, and divided busks for any lady of importance are becoming things of the past. Before long I feel sure something will have to be done to lessen the weight of stays, some of them having steel and whalebone sewn alternately in as closely as it is possible to get them in. This, together with a solid, broad, and deep busk makes them very wearisome to wear. "X. Y." says he does not wish to enter into the tight-lacing controversy; but I may tell him since "improvers," to keep in the centre of the back, must be fastened securely to the bottom lacing holes at the back of the stays, stays are worn laced tighter than ever, or the wearer is subject to great discomfort through the side to side motion of the "improver," causing the stays to sway on the body.

A Provincial Staymaker.

Leamington, Jan. 1st.

EXPERIMENT ON SPECIFIC HEAT AND CONDUCTIVITY.

[25214.]—IN letter 25150, p. 342, Col. Ross asks Mr. Grey if he is aware that when wax-coated cylinders of iron and bismuth are placed on a hot plate the wax melts on the bismuth cylinder first. I can only say that if Col. Ross and Mr. Grey *are* aware of this, some people appear not to be so. I recollect seeing in *Nature*, some time in 1882, a communication (from a Mr. Madan, I think) stating that when proper contact was secured by soldering the cylinders to the hot plate, the wax invariably melted on the *iron* cylinder first; and pointing out, by reference to the tables of specific heats and conductivities, that such must theoretically be the case, in spite of Prof. Tyndall's assertion.

E. R. P.

Cleaning New Rubber Corks and Tubing.—New rubber corks and tubing are always coated with more or less sulphur, and perhaps also some of the "filling" that is often added to them (which is often powdered soapstone). Mere washing in water will not remove this coating, especially from the inside of tubing. It is best gotten rid of by boiling the goods in a solution of one part of sulphide of sodium and two parts of caustic soda in 10 parts of water. The tubing should be lifted out of the liquid occasionally, and carefully re-immersed, so that new liquid will pass throughout its bore. After having been thoroughly boiled in this manner, the goods are carefully washed in water. If the tubing is previously treated with warm water and thoroughly kneaded or beaten, so as to loose the coating adhering to the inside, the above described cleaning-process will be much more thorough.

Soap to Cleanse Silk.—Heat 500 grammes of cocoanut oil to 35° C. (95° Fahr.), and then add 250 grammes of caustic soda. Heat 250 grammes of white Venice turpentine, and add to it the soap; mix well. Cover and leave standing for four hours; then heat anew, add 500 grammes of ox-gall and stir well. Break small some perfectly white dry tallow soap, and add to the mixture sufficient make it solid. When cold, cut in pieces.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[57360.]—**Chronometer Balance.**—The question to be answered is: Does the time of oscillation of the balance vary with the weight or the mass of the wheel? And it is one I should like to see answered satisfactorily. After reading "Wen's" replies, I think the answer is "the mass"; but I am by no means certain. Why was the question asked if the weight has nothing to do with it? And why is a balance different to a pendulum in this matter? I thought a balance was better than a pendulum only because it acted in any position.—LEICESTER.

[57360.]—**Chronometer Balance.**—The vibrations or oscillations of pendulums do not depend altogether on weight; length affects them more than weight. The oscillations of a pendulum are of equal duration, whether in full or in gentle swing, so that whether a pendulum wags an inch or a foot it does it in the same time; and so it is with a watch balance (except that of a verge). So that if a verge watch be dirty, the dirt gives no extra speed, only indirectly. If the earth rotated once in eight hours, its polar diameter would be 85 miles less, and its equatorial diameter 68 miles greater; the gravity and temperature would be so equalised that chronometers would not vary perceptibly in any part of the globe; and any imperceptible variation would be due to lunar influence. "F. C. H." is incorrect when he attributes oblation of earth to 'fugality; 'fugality is only another name for gyrative diminution of gravity, and this diminution gives rise to polar excess, and hence a polar oblation, hence, again, an equatorial projection; therefore, "J. W. T." was right in ascribing oblation to centripetalism, or undiminished gravity.—COVENTRY TOM.

[57360.]—**Gravity and Chronometer Balances.**—Surely it is time to end the nonsense which has been running for weeks about the effect of the difference between polar and equatorial gravity on watch balances. The gentleman who is doing his best to depreciate "first-class honours" in some unrevealed tripos or subject had better learn the first-class truth from some elementary book on mathematical mechanics that mass is not weight. In the universal language of such books, M is mass (not volume or size) and Mg (or mass × gravity) is weight. Also he should learn that the time of pendulums depends on the ratio of Mlg (or the *moment*, l being the length) to Ml^2 (or the moment of inertia, assuming the pendulum to be a *simple* one); but that the time of a balance depends on the ratio of the force of the balance-spring to Mk^2, or the moment of inertia of the balance—which is not truly a balance if it is affectable by gravity. Indeed, no balance is, so long as it is horizontal, whether really balanced or not. The liability of watches to gain or lose in certain variable circumstances has nothing at all to do with these propositions, any more than with the multiplication table. I need hardly say that all this is explained in my book on "Clocks and Watches," and no doubt in plenty of others, which it is too much trouble to refer to just now.—EDM. BECKETT.

[57360.]—**Chronometer Balance.**—I have not cleaned many watches, my experience being that of a student of mechanism only, so I cannot speak with authority on the important subject of their general condition on arrival in the hands of those who have. Very probably the comparatively rapid motion of the balance-wheel throws off the dirt on to the other parts, and thus arrives in a comparatively clean state, and vibrating more quickly. I surmised as much from "F. C. H.'s" sweeping assertion, the which my own observation gives me what I consider sufficient grounds to contradict; that I did so with some "fizz-bang" was for the sake of amusement; as was also the paradox in the apparently flat contradiction. My early attempts, and those of others I met, generally resulted in making the watch lose largely, and that from stiffness in the escapement, I believe; and also in shortening the time of running several hours. It appeared probable to me that "F. C. H." had been doing likewise. If "our friend" (with an address) will kindly look at his heading, he will see that it is more particularly the balance we are talking about, a fact which seems to have escaped him. It is still my opinion that a uniform reduction of frictional "weight" would have the major effect on the quickly-moving balance, and that that effect would be a more rapid vibration; that the increased movement would be more than compensated for by the accession of control by the hair-spring and the quicker motion. Possibly the effect might be *nil*, and in actual instruments vary; but it seems pretty clear to my mind that though a break such as friction decreases the movement each vibration, the slower motion has the major effect. When a balance-clock has the misfortune to cross my path, I intend trying the effect of oiling with castor, the balance first, and the whole after. If watches or clocks that are losing from a dirty balance, never cross the watchmaker's path, it appears to me they have mine. The reason that is "simple enough" does not quite amount to a reason. I have a French bedroom clock at times that is a very decided loser when dirty, the pendulum being on pivots and rather exposed. There are pendulums and pendulums, and it would not give much trouble, perhaps, to find one, or a balance even, that errs so as to gain with increased movement. I am tolerably certain they have been constructed.—WEN.

[57578.]—**G.W. Engine.**—I was told at Swindon that No. 9 engine had a 26in. stroke, not 24in. as stated by "F. J. P."—NONO.

[57750.]—**Tramway Points.**—Drop points have the groove leading into deeper than that leading from the double line (see Fig. 1.) The sudden drop is very bad for the springs of engines and cars. Sometimes the lines are arranged as in Fig. 2, in which case the engine will naturally keep in the straight line. In another method the point is riveted to the point-plate in the position shown in Fig. 3. The engine, coming from the double line, will push the point aside, and then allow it to snap to again. Sometimes the point is hinged and kept in position by spring or balance-weight.—BOWLING.

FIG. 1.

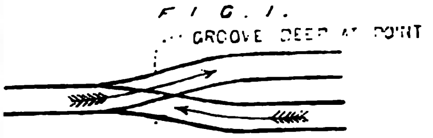


FIG. 2.

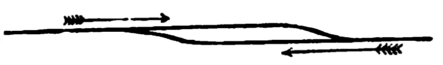
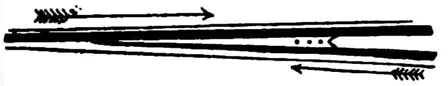


FIG. 3.



[57740.]—**Free Reeds—Tuning.**—I have no wish to enter into any unprofitable controversy with N. E. Child; but I should like to reply to some of the remarks made by that gentleman on p. 366. N. E. Child confuses "reed makers" with "reed-organ builders," and his statement that "few, if any (here he seems to be in doubt), reed-organ builders make their own reeds"—this statement merely helps to confirm a similar statement by me in a previous reply. N. E. Child need not "boast" of his having "filed and voiced more American organ-reeds than G. Fryer could carry." Probably he has, and no doubt the present writer can say the same, only he don't profess to be able to voice reeds up to the standard excellence and perfection of the voicing found in the instruments manufactured by the leading and long-established American firms. If N. E. Child would favour the readers of "Ours" with a chapter on voicing, it would be highly appreciated, although he need not think that such a chapter would add in any way to my present knowledge in matters of reed-organ construction, though I make the proposition. I do not know for certain whether there are two correspondents by the name of G. Fryer contributing to our columns; but I do know that at least one of the individuals is frequently favoured with injurious insult and rash and unjust criticism. If talented correspondents would employ their time in giving practical information to the readers of "Ours," instead of wasting space by finding fault with others, the readers of the ENGLISH MECHANIC would benefit thereby. N. E. Child is also wrong in his suspicion that I "did not know what a tuning-bellows was like until I read a description of it" (well, well!) on p. 332. When I spoke of the tuning-bellows (described by N. E. Child) as a "mysterious piece of machinery," I was merely indulging in similar expressions as that of a gentleman in a previous communication. It may probably benefit the querist for me to say that if reeds are tuned under a certain given pressure of air, the reeds are apt to vary in the tuning when submitted to a different pressure. The fact of the reeds varying in the tuning when removed from the tuning-bellows to the instrument is not to be wondered at, for the is certainly then a difference in the conditions under which the reeds are put in vibration. An inexperienced player will often put the reeds temporarily out of tune by bad blowing. Too great a pressure of air on the reeds affects the tuning, because the force of air does not allow the reeds to give out the required number of vibrations per second. On the other hand, an insufficient supply of air tends to flatten the reeds, because the force of air is not enough to cause the reeds to give out the required number of vibrations; consequently the reeds, under these conditions, sound slightly out of tune. If a stop of an American organ is only partly drawn out, the reeds sound slightly flat, because the mute, under these conditions, is not raised sufficiently to allow the required amount of air to cause the reeds to sound in unison with another stop which is fully drawn. The Sourdine stop is another example of this. Some tuners tune harmonium reeds when the reservoir is half-full. I prefer to tune the reeds when the reservoir is nearly full, for I find by so doing the reeds stand the extra pressure and do not vary quite so much under the various degrees of pressure to which harmonium reeds are subjected when using the expression stop. I will enter more fully into the subject when I send the instructions on the making of a tuning appliance.—G. FRYER.

[57771.]—**Coupler to Harmonium.**—I must refer "F. A. C." to some eminent pipe-organ builder, "Uranium," for instance, if he requires a reply to his question on p. 366. As regards octave couplers to harmoniums or American organs, it is but the bare truth to say that octave couplers do produce a "heavy" touch on the keys of any instrument in which they are employed. In the best and higher class of American organs, the touch is rendered heavier by the resistance of the power of one spring, in addition to that actuated by its own key, and in large instruments this matter is certainly of some consideration; but because I state this fact I do not wish to condemn the application of octave couplers to reed-organs. When "F. A. C." asserts that "it is not easy to add one of these couplers to an instrument already built," I quite agree with him, and for that reason I advised the querist (on p. 344) to let his harmonium remain as it is. In this particular case, I considered the application of a coupler not worth the trouble required.—G. FRYER.

[57894.]—**To Mr. W. H. Eaves.**—In accordance with your last advice, I have reconstructed the armature of my machine, and the core now consists of stamped iron rings with wrought strips to form cogs; the size is exactly the same as the former cast one. It is wound with the same wire, and has the same R., nearly—viz., ·48 ohm. There is certainly some improvement, but I wish to ask you if the pole pieces cover sufficient of the armature. At present they each encircle one-third of its circumference, its diameter being 3in., the nearest points of the pole-pieces are about 1½in. apart. Would there be any advantage in screwing on four strips of wrought iron to halve the distance? I notice in the Edison machine the poles nearly entirely inclose the drum.—CARNFORTH.

[57955.]—**Organ Pedal Pipes.**—I have already answered on page 323. If the correspondent does not think it worth while to procure the numbers to which I referred him, he can scarcely expect me to waste my time in copying out the diagrams and text, and then ask the Editor to reproduce what has already been given. Of course, if the numbers are out of print, that would be another matter altogether.—N. E. CHILD.

[57998.]—**Turning Coal.**—Holtzapffel, in Vol. I., says: "The material is cut out with a saw for ivory, but the hand-saw will answer. The pieces are then roughed to the shape with a chopper or a parallel blade of steel about 8in. long, 1½in. wide, and ¼in. thick, sharpened very keenly with *two* bevels at the one end, and used with the hand alone. For making a snuff-box, whether plain, screwed, or eccentric turned, the plank way or surface parallel with the seam is most suitable; it is also proper for vases, the caps and bases of columns, &c. Cylindrical pieces, as for the *shafts* of columns, should be cut from either edge of the slab, as the laminæ then run lengthways, and the objects are much stronger. These latter pieces when prepared should be driven into conical chucks with a *mallet*, as a blow of a hammer near the edge would shiver off a flake lengthways. Cylindrical pieces cut the plank way should be chucked with a *hammer*, that the blow may be exactly central, otherwise the cylindrical piece would perhaps be broken in two transversely. Cement is also very much used for chucking the work. All the tools for cannel coal are ground with two bevels, exactly like the chisel for soft-wood turning, but they are held *horizontally*. A small gouge, from ¼in. to ⅜in. wide, also slightly bevelled off from within, is used for roughing out, to save the finishing tools. *These should be ground with thin and very sharp edges, otherwise they burnish instead of scrape the work. The ordinary tools for ivory and hard wood*, if employed, must be held downwards at an angle of about 20°. These tools are sometimes used with a wire edge turned up in the manner of a joiner's scraper. Flat objects are worked with the joiner's tools and planes; but with these likewise it is better the edge should be slightly bevelled on the flat side of the iron. The edges of cannel coal are harder and polish better than the flat surfaces."—R. R. N.

[58038.]—**Faulty Telephones.**—I conclude these are Bell's telephones, and that you tried them on your line without any transmitter or battery in circuit. I have frequently done the same, though on a shorter line than yours. I got my Bell telephones to talk sufficiently well for me to hear all that was said, but they were not a great success. I got much better results by using electro-magnetic receivers, and working my line with the main current. The telephone I described some few weeks ago in these columns, and which is really the Glasgow receiver disclaimed by Bell, will answer fairly well for quite the distance you name, and, as far as I know, is the only unpatented one we can legally make up and use.—ACOLYTE.

[58082.]—**Cabinetto.**—I am afraid "Querist" won't be able to get what he wants—certainly not from Spalding and Hodge, unless he buys it by the ton, which I opine would be more than he wants. I have myself tried every place I know of to get paper for an orguinette, but was unsuccessful, though I even went so far as to advertise. If he does succeed, I should be glad to know where. Music for the celestina is an immense deal cheaper, by the same maker as the cabinetto.—R. A. R. BENNETT.

[58105.]—**Electro-Motor (U.Q.)—To Mr. Bottone.**—I beg to apologise to this querist, but I had answered this query at the date of its appearance, and can only imagine that my reply must have miscarried. Size of armature, 10in. by 3in.; wire on armature, about 4lb. No. 16; wire on fields, 8lb. of No. 16 on each leg, coupled in parallel. A dozen to fifteen gallon cells would be required.—S. BOTTONE.

[58123.]—**Motor for Electric Mechanical Clock.**—"J. E. S." might be recommended to look up his back numbers. The Leclanché will work an electric motor for, say, a couple of minutes at a time, which is considerably longer than is wanted for a "self-winding" electric mechanical clock.—NUX. DOR.

[58140.]—**Fugitive Printers' Ink.**—When "W. H. S." gets an ink that answers his requirements, I would advise him to communicate with the banks and the Post Office. I calculate they would pay "reasonably" for such an ink as he requires.—NUX. DOR.

[58144.]—**Magnesium.**—"R. B. C." asks some one to tell him how to solder magnesium. Permit me to suggest that he should try for himself. It might be worth his while to try an amalgam or cold-soldering process, and avoid the blowpipe, which might produce rather too brilliant an experiment. Might I ask the querist if he ever heard of magnesium being soldered?—NUX. DOR.

[58145.]—**The City Companies.**—See an editorial "answer" on p. vii., Nov. 20, which looks as if it were intended for you. The companies do not exercise that privilege now, and they never had control over tradesmen outside their boundaries.—S. R.

[58146.]—**Registration of Designs.**—I believe not; but ask the comptroller.—S. R.

[58152.]—**Feedwater.**—The amount of feedwater should slightly exceed the quantity used in producing steam. As to how much should be left for injection—don't understand. The pump is generally worked by an eccentric on the shaft.—FIREMAN.

[58155.]—**Copying Drawings.**—See Stanley's "Drawing Instruments." An eidograph is more exact than a pantagraph for many purposes; but you cannot reduce correctly to less than one third. If that will do, by all means use the eidograph.—T. J.

[58158.]—**Tinning Copper and Iron Pans.**—Clean the pans thoroughly, and rub melted tin over with a wisp of tow. "Clean" means free from oxide; the surfaces may be covered with grease with advantage.—S. R.

[58164.]—**Enamelling Photographs.**—Unsuitable sample of collodion, I should think.—PHOTO.

[58169.]—**Action of Steam on Firebricks.**—This is a purely hypothetical question. Steam has little effect on good firebricks; but really the querist should try for himself.—A. M.

[58179.]—**Joy's Valve-Gear.**—Why does not the querist work out an answer from the working drawings which have been published and exhibited?—T. J.

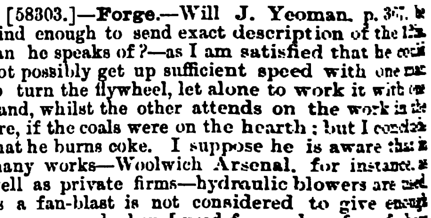
[58260.]—**Leclanche Batteries for Small Lamps.**—They will do very well for occasional use, and for a duration not exceeding several minutes in a half-hour. Your lamp is probably about 4 ohms resistance, in which case, by coupling 12 Leclanché agglomerate blocks in series of 3 each, you will probably have all the current you need. If not, add a fifth set of 3 cells. Couple the zincs to zincs in each of the three, then the carbons to carbons, and couple the 3 zincs of the first set to the 3 carbons of the second set, &c. This is to diminish the internal resistance of the battery. For the same reason you use the agglomerate instead of the porous cells.—OMEGA.

[58262.]—**Microscopical Objectives.**—The importance of improvements in high powers of the microscope is so great that it must be my excuse for recurring to this subject. My question was at least plain, whatever my "notions" on the subject may be, and as "Gamma Sigma" has in no wise answered the query, with the Editor's permission I will repeat it a little more fully—viz., If an objective à l'immersion, of topaz, diamond, or precious stone of high refractive index be constructed, and fairly well corrected, would the difference in the R.I. of the front lens and the cover-glass of the preparation, materially impair its performance with an immersion medium of suitable optical density? It is evident that the construction of such lenses would be difficult, though often suggested by fully competent authorities, as lately by Dr. Royston-Pigott in one of his excellent articles in your columns. The assertion that "it is by no means clear" that a dry lens is to be compared to an immersion, is new to me, from either a professing microscopist or an optician. I have lately been using a dry, and also a homogeneous immersion 1-12th objective, both of Powell and Lealands, and it appears to me that no one using them could say that the former was to be compared to the latter in definition, light, or other optical qualities. It is quite obvious that the immersion principle is only applicable to high or highest powers, and indeed is in no wise required for others. As low or moderate powers up to, say, ⅙ or ½in. are practically perfect, a somewhat large proportion of microscopical observations may perhaps be made with low or medium powers: but in a large number of the most important investigations of the present time, histological, micro-pathological, and other, high powers alone are of any use. If it be a "common error" to suppose that high powers are the "more useful" of the two, it can only be made by a very tyro in the use of the microscope: each class is useful for particular objects, and a comparison between them in general terms is quite misplaced.—HOMOIOS.

[58274.]—**Regenerative Gas Fires.**—I am glad to see, from T. G. Marsh's and "J. G.'s" remarks, that my ideas have been forestalled, and that the regenerative principle is already applied to heating. Would either of these gentlemen kindly say where a description of the fires they use is to be got, with prices?—B.Sc., Plymouth.

[58303.]—**Forge.**—Will J. Yeoman, p. 3[illegible], be kind enough to send exact description of the 12in. fan he speaks of?—as I am satisfied that he could not possibly get up sufficient speed with one man to turn the flywheel, let alone to work it with one hand, whilst the other attends on the work in the fire, if the coals were on the hearth; but I conclude that he burns coke. I suppose he is aware that in many works—Woolwich Arsenal, for instance, as well as private firms—hydraulic blowers are used, as a fan-blast is not considered to give enough pressure; and when I used formerly a fan of about 12in. diameter, it took a 4 h.p. engine to drive it when melting, say, half a ton of metal. I presume that he only uses it to make ordinary tools: but could he make a sound weld in a 2½in. square bar and with ordinary coals?—A., Liverpool.

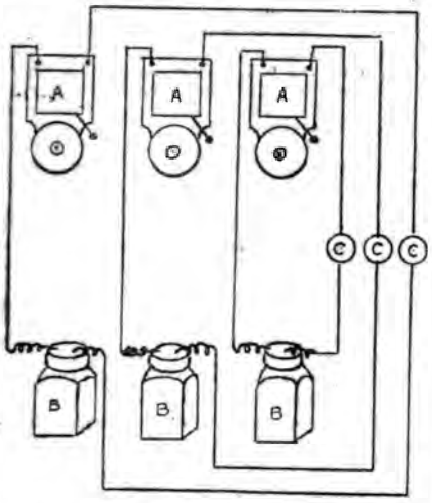
[58315.]—**Electric Bells.**—This is the only way to make a good job of it. You can thus ring 1, 2, 3, or 50 bells, singly or together.—S. BRETTON.



B, Batteries; S, Switch-board; P, Push; R, Relays; E, Vibrating Bells.

[58309.]—**Slide Valve.**—In the one case, we have steam pressure on both sides of valve (? the springs, to keep it tight, would have to be strong enough to resist the steam—stronger (practically), and the pressure on valve's bearing face would be transferred from cylinder chest cover, and a little extra friction (which would be equally divided between the valve-face and the spring-bearings). I don't see any advantages to be gained. Does "Bowling"?—LEICESTER.

[58315.]—**Electric Bells.**—If "A. R. F. K." will connect his bells, as per sketch, he will then



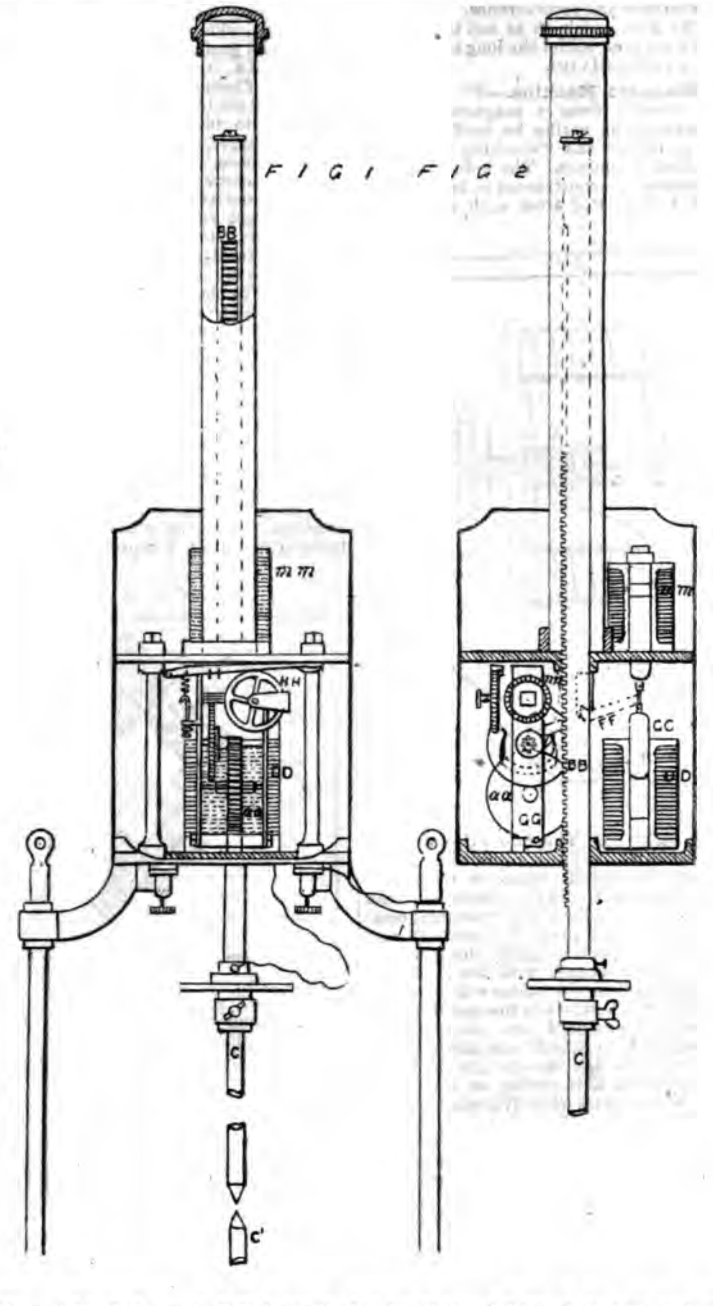
be able to ring them as he requires: A, electric bells; B, batteries; C, push or switch.—C. W. R.

[58340.]—**Compound Interest, Annuities, &c.**—Refer to pp. 219, 246, 265, 289, 314, 341, 367, Vol. XXV., where I got answers to a similar question, and pp. 275, 321, 395, 400, 451, Vol. XXVII., for replies to another query. I should work your problem thus: As you pay back the £50 principal in twelve equal weekly instalments of £4 3s. 4d. each, you practically borrow £50 during the first week, and £4 3s. 4d. during the last week, and both together are equal to borrowing £54 3s. 4d. for one week. You also borrow £45 16s. 8d. for the second week, and £8 6s. 8d. for the eleventh week, which is also equal to borrowing £54 3s. 4d. for one week. The third and tenth, fourth and ninth, fifth and eighth, and sixth and seventh weeks together are each also equal to borrowing £54 3s. 4d. for one week. This gives six equal amounts, into which the £10 interest is to be divided. Then, if £1 13s. 4d. is paid for the use of £54 3s. 4d. for one week, the rate per cent. per annum will be 160·4385 +.—S. E. HUNT, Swindon.

[58352.]—**L. T. and S. R. Engines.**—If the querist means the 10-wheeled passenger tanks, for he names no class, the following are their dimensions:—Grate area, 17¼ sq. ft.; heating surface of firebox, 97 sq. ft; of tubes, 923 sq. ft.; diam. of cylinders (outside), 17in. by 26in.; coupled wheels, 6ft.; bogie and trailing wheels, 3ft.; weight in steam, 56 tons 2cwt., of which 15 tons 18cwt. is on the bogie and 16 tons 1cwt. on each of the coupled wheels. The tanks hold 1,300 gallons. The engines have 200 tubes, 1⅝in. in diam. and 10ft. 10½in. long. They were designed by Mr. Stride, of the L. T. and S. R., and built by Sharp, Stewart, and Co., of Manchester.—W. B. P.

[58344.]—**The Richardson Arc Lamp.**—To "NUN. DOR."—I am sorry to have to contradict your statement that you made on page 369 of last week's number of "Ours." There is none of the above lamps working at Robey's Works, Lincoln; but a letter addressed to the inventor, Mr. A. W. Richardson, the Anglo-American Electric Light and Engineering Works, Stretford-road, Manchester, would receive a reply.—C. W. R.

[58344.]—**The "Richardson" Arc Lamp.**—I have much pleasure in obliging "Pick" with sketch and description of the above arc lamp, which I dare say will be interesting to our electric readers. Fig. 1 is a front view, and Fig. 2 a side view. In the first place a toothed wheel, *a a*, of the clockwork gears into a rack, *b b*, forming the holder for the positive carbon point *c*, the lower, or negative point, c^1, being carried in a fixed holder in the usual manner, and the rack *b b*, together with the whole of the clockwork, is raised to form the arc by means of the main magnet or solenoid, *a a*, the core of which is wound round with coarse wire. The armature, *e e*, of this is fixed in, or attached to, two side levers, F F, the other ends of which carry the frame, *g g*, of the clockwork, and when the armature is attracted by the magnet D D, it raises the rack, B B, and the clockwork, and brings a brake-wheel, H H, in the latter into tact with a brake, I I, as shown on the sketch. e brake-wheel, H H, also acts as a balance eel, having a reciprocating movement like a lance of a watch, and is driven by a verge apement from the *crown wheel*, *n n*, of the clockwork, the weight of the rack, B B, being the motive power. As the carbons burn away the resistance becomes great, and the shunt magnet, *m m*, then overpowers the main magnet and so releases the brake-wheel. This occurs every few seconds, and thus the upper carbon, *c*, is lowered, tooth by tooth, precisely at the speed required, which maintains the electric arc at all times the same size, and thus the light is kept perfectly steady. If "Pick" requires any more information on this matter, I shall be happy to oblige him.—C. W. R.



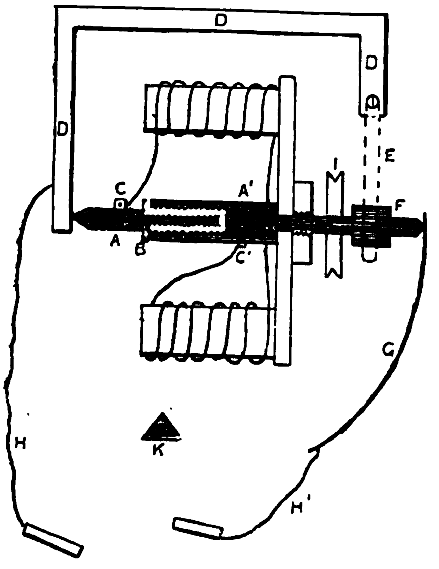
[58354.]—**Steam Cock—Grinding in Steam Valves.**—"Hugo," p. 369, is evidently only acquainted with the methods used for common water cocks, and such like soft ware. Were he accustomed to the fitting of cocks upon steam boilers, he would make them of hard brass; allow no emery to come near them on any account, and if "they required a lot of fitting," he would put them in the lathe to do it, and not put a file upon them under any circumstances if he wants them to be a satisfactory piece of work; it is this kind of tinkering, accompanied by bad brass, which causes so much trouble to those who possess boilers. I think that he will find powdered pumice-stone, and finished with hone dust, a superior job to his lump of loam.—A., Liverpool.

[58360.]—**Jordan's Barometer.**—[With reference to the reply on p. 369, Mr. James B. Jordan writes to explain that the glycerine barometer there described in "no way resembles the instrument known as Jordan's glycerine barometer." Mr. Jordan also forwards a copy of his pamphlet on "The Glycerine Barometer," Stanford, which, however, we noticed at some length in the number for Feb. 11, 1881.—ED.]

[58364.]—**Firebrick Fireplaces.**—The simplest and cheapest way is to mix fireclay with water and well knead it till it is nice and stiff, not too wet or too dry (it takes about ten minutes to work it up into a proper consistency). Brush out the grate with a little water and fill up as required with the clay, pressing it in with the hands, then smooth off with a trowel dipped in water. Let it dry two or three days, then put in fuel and make up a good fire, sufficient to heat the clay red hot, and it is done. I did one thus some years ago, and it stands well; cost 6d. Silicate of soda will make it somewhat harder, but then it cannot be obtained everywhere. The main points are in mixing it well and burning it well the first time it is heated. —W. MALLETT.

[58383.]—**Brass Boiler.**—To braze a boiler properly, you require a gas blowpipe. You can do it, however, on a blacksmith's hearth, or even on the kitchen fire, with care. You require—1st, coarse yellow solder, known as No. 3 in the trade; 2nd, powdered borax as a flux. Mix the solder up with water and powdered borax to a sloppy condition, about one part borax to three of solder. Apply the solder to the seams with a brass or iron wire, hammered flat at one end into a sort of very small spoon. Then, as the parts heat up, sprinkle a little borax on the solder, which will cause the solder to run on flux. Apply the solder to the seams as finely as possible. If you have the gas blowpipe, which must be a good-sized one for a piece of work this size, with foot bellows, you will manage all right. If you have to use the blacksmith's hearth, use a little coke, as well as the "breeze"; get up a nice clear fire, and then lay the boiler on top; watch it carefully, so as not to melt it, and turn it about as the solder runs with a pair of tongs. If you have to fall back on the kitchen fire, you will have a lot more trouble. up the fire level and brisk, and work it the as directed for the blacksmith's fire. You ca it this way with care and perseverance. The thing is to get up the heat quick, so as not to "perish" the solder. In any case, solder the long seam before putting on the ends.—HUGO.

[58384.]—**Magneto Machine.**—TO MR. BOTTONE.—The current from a magneto machine, unless an interrupting spring be used, is hardly perceptible to obtain the "shocking" effect in ordinary medical machines. The spindle, which carries the armature, is constructed in two separate pieces, A and A′, insulated from each other by a screwed ivory collar B. The two extremities of the armature wires, C and C′ are fastened to A and A′ respectively. The spindle turns on centres, in the two brass frames, D and G. Fastened to the outer portion of the spindle A′ is a triangular commutator, or, rather, break-piece F (shown in section at K). On this presses lightly the spring E, which is in metallic contact with the frame D. This spring only touches the corners of the triangular breakpiece F. Now, when the machine is in action, the current produced into the armature passes into C, along D to E, and back through F to A′, and thus completes the circuit into the armature; that is, provided E is resting on one of the angles of F. At the times when E is clear from F, a patient, holding the handles attached to H and H′, receives a violent shock, since the "extra current" produced in the armature by the breaking of the contact at E and F finds no other path than that of passing through the patient. The magnet is not represented in the sketch, to avoid confusion.—S. BOTTONE.

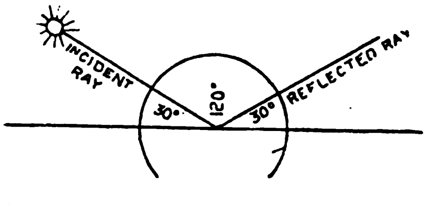


[58389.]—**Spectroscope.**—As the writer of the articles in question, I beg to inform "Alchemist" that the form described is not adapted to telespectroscopic work.—S. BOTTONE.

[58389.]—**Spectroscope.**—"Alchemist" will certainly be able to see a few of the lines in the spectra of some of the brightest stars, as Sirius, *α* Orionis, *α* Lyræ, by the aid of an amateur spectroscope and a 3in. o.g.; but he will not be able to make out more than a few of the most conspicuous lines. For work with a star spectroscope an o.g. of large aperture is indispensable.—H. A.

[58395.]—**Chemical.**—There is no absolutely correct table of atomic weights. How should there be, when everyone thinks his ideas are right, and all the others wrong? I suppose most people consider Roscoe's to be the correct table; at any rate, I would rather trust him than "Bayley" or "Jones." The Science and Art Department take Buckmaster for their model; but he is not so accurate as Roscoe.—R. A. R. BENNETT.

[58396.]—**Light.**—The angle inclosed by the incident and reflected beams, as I understand by "Optician's" query, would be 120°. See sketch.—H. A.



[58405.]—**Elevators.**—"Young Millwright" will find buckets 6in. square an inconvenient proportion. If he wishes to use a belt about 7in. wide the buckets may be 6in. long, but should not exceed 3in. or 4in. wide by 4in. or 5in. deep. They will deliver the grain better if made slightly conical in sections—i.e., wider at the mouth than at the bottom. There is no definite proportion between the size of the buckets and diameter of the pulleys; but 12in. to 16in. diameter will be a convenient size; if larger, the casing will take up an inconvenient space. The belt must be driven fast enough to cause a slight centrifugal force to throw the grain out at the top; but not too fast for each bucket to get rid of its load before it enters the return case. 150ft. to 200ft. per minute will be found to fulfil these conditions. Buckets of the size I have indicated may be placed 10in. or 12in. apart, and so placed will deliver freely; but if the lift is a high one it is objectionable from the weight on the ascending belt making it liable to slip. I should place them so that the load on the ascending belt did not exceed thrice the weight of the empty buckets and belt on the descending side, and then if the belt gets slack, it will not much matter. I do not understand the questions about the angle of the card marked X.—R. R. N.

[58406.]—**Transmitter.**—You do not mention what kind of microphone you want to make. A Bell telephone will do as a transmitter as well as a receiver. I suppose what you want is a carbon transmitter. Fig. 1 represents a simple form of transmitter. *a*, *b*, *c*, and *d* represent four carbon rods made out of electric light carbon—say $\frac{1}{16}$th of an inch in diameter and 1½in. long; file their ends with an old file into the shape represented in Fig. 2.

FIG. 1

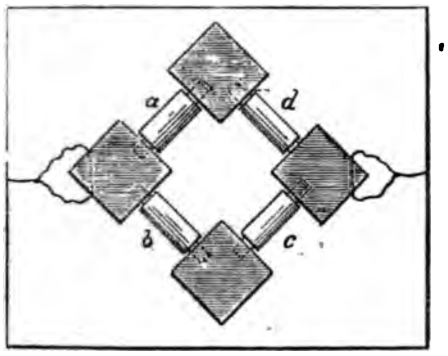
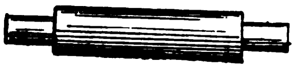


FIG. 2.



Now get a block of carbon—say ⅞th of an inch square, and cut it up into four slices ⅛in. thick. This can be done by using an old knife and sand or an old saw, if you have one. At any rate it will tax your patience. See back numbers, as it is not long ago since cutting carbon was discussed. Fig. 3 represents one of the square pieces of carbon in section, showing how the carbon rods are let into them by means of holes drilled for the purpose.

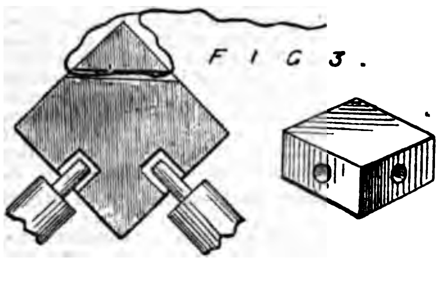
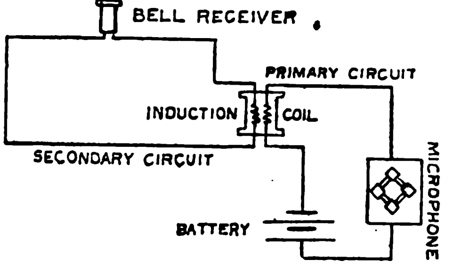


FIG. 4



The hole drilled in the square blo be so large that the carbon rods should rattle about freely. Connect two wires the opposite carbons by drilling hole them, and then passing wires through t and twisting them up. Now mount pieces of carbon on a piece of deal—say, square and $\frac{1}{12}$th of an inch thick, remen insert the carbon rods as you glue the Now mount your piece of deal as a sound and your microphone is complete. If use an induction coil, simply connect phone and microphone in series with you if you use an induction coil, here are nections. You might paste a piece of the opposite side of your deal board to carbons are attached in order to pre breath moistening the glue by which th are attached.—C. L.

[58407.]—**Bunsen Battery.**—TO TONE.—You may expect to light one power lamp with your battery. It will the zincs are consumed, or the acid exha five or six hours. Try to put four 5-can lamps in parallel arc on your dynamo; i bably light them, as the resistance wil Or put a shunt of about 12in. of No. 30 on the main circuit, and take the current brushes to the lamp.—S. BOTTONE.

[58422.]—**Cassegrain and Gregori scopes.**—The small mirrors might be g polished in batches on a large tool, but must be figured separately. If ground the tool should be larger than the mi one an inch and a half diameter the tool say, 2½in. or 3in. diameter. I am now 9¼in. metal speculum, and a small co convex to match; these latter from a p tools 5in. diameter. The small mirro mounted in same manner, and the usual more convenient one. It is quite possibl it in some other method, but the mount be complicated. The eyepiece tube is n fitted with rackwork, because the focussi readily effected by making the small m from the larger one by means of a long ro at the upper end, which works in a nut the back of the slide carrying the arm the small mirror is attached. I cannot better method of forming the central with the hollow tube; and if the centra not cut, I should consider it advisable that operation till the rough grinding is co and in the polishing, cut out the centre the polisher.—J. C. LINSCOTT.

[58427.]—**Twist Drills.**—These drill used in a ratchet brace, and will not break you use them carelessly; and will drill a h half the manual labour the old drills ta cially in wrought iron or steel.—C. W. R.

[58429.]—**Petroleum Spirit.**—If this will refer to p. 332, No. 951, he will find all "Petroleum and its Products." Petroleum is usually understood to mean the fourth dis or naphtha, which comes off before benzolin after the gasoline. In the majority of case doubt, gasoline is sold for it; but, whatever called, these readily vaporising products of p leum are sold only under special conditions are not retailed like benzoline. Gasoline ca purchased in certain quantities, as it is used Fletcher's furnace, and that will answer all purposes of petroleum spirit. I don't know price, but probably from 1s. to 2s. a gallon, acco ing to circumstances.—NUN. DOR.

[58437.]—**Resistance.**—Will Mr. Eaves forgi me if I send an answer to a query addressed him? I have had much experience in this matt as I made many experiments at the time that Edison described his "chalk-cylinder battery (1879) with regard to the resistance of bodies motion. As a general result, I found that the sistance of a rotating armature is considerably than when still. To try this experiment, one only place a Gramme armature in its bearings near the field-magnets) and connect up the brushes with a bridge as a resistance in one arm, and a coil or coils to balance in the other arm. If the armature be rotated, it will be found that the resistance is very considerably less. Of course, battery must be used for these experiments. single-cell bichromete will be found Edison's chalk-cylinder battery has fallen oblivion; but it merits much study, as the ordinary influence which a current has upon friction produced by motion, and vice versa, friction has upon a current, is well brought this instrument.—S. BOTTONE.

[58438.]—**To W. H. Eaves.**—In with your request, I send you sketch ment by means of which you E.M.F. of your dynamo. In the observe that eleven lengths of series connection with the F. the lever, and that number 1 length to 68. The total sulphuretted hydrogen, which will at once produce a brown precipitate or colouration.—SIGMA.

[58469.]—**Chloride of Lead.**—The best solvent of lead is nitric acid. Sulphuric, phosphoric, and muriatic acids cannot dissolve lead, because they form with it insoluble, or very difficultly soluble, salts. Test with sulphuric acid, which will cause a white precipitate insoluble in acids (sulphate of lead), which is rendered black immediately by NH_4 HS. It may be that the zinc present in the lead is being dissolved.—H. H. B.

[58469.]—**Chloride of Lead.**—The chloride of lead formed would be dissolved by the acid, and, therefore, there seems no reason why it should not be dissolved. It is not soluble in weak acid or cold water, so if you added a lot of that it might be precipitated as a white powder; but it would be better to neutralise the acid with solution of ammonium carbonate, which would at once precipitate the lead if there was any present.—R. A. R. BENNETT.

[58470.]—**Breaking Strain of Timber.**—Rule is for breaking weight (B W), loaded at middle and supported at ends = $\frac{4B\,D^2}{L} \times K$; this gives B W in cwts. B is breadth, D depth, L length between walls (all in inches), and K constant for material, which for pines may be taken as 12. Pitch-pine is stiff, but I should not load it more than Memel.—T. C., Bristol.

[58472.]—**Lathe Treadle.**—Yes; it would answer as well, but would not be so steady when a little worn; and I should prefer general arrangement.—T. C., Bristol.

[58472.]—**Lathe Treadle.**—A wheel driven by a pin fixed at its side tends to alter the plane it is set to run in, and wears the hole in bush of wheel, and also pin that it turns on, in a very nasty form, causing it to rattle, and making it unpleasant to drive when worn a time. Better have a crank fitted with screw centres, so that you can compensate for wear when necessary.—F. K.

[58474.]—**Chemical Balance.**—Dry calcium chloride in a saucer put inside the glass case.—R. A. R. BENNETT.

[58474.]—**Chemical Balance.**—Keep a piece of fresh quicklime in the case, and renew occasionally.—T. C., Bristol.

[58474.]—**Chemical Balance.**—The usual method employed to absorb the moisture is to keep in it a small evaporating basin filled with unslaked lime, which is renewed from time to time as it gets slaked.—B.SC., Plymouth.

[58474.]—**Chemical Balance.**—I use chloride of calcium anhydrous for absorbing the moisture from the atmosphere of my balance-case. I find it answers very well. I keep it in a small gallipot.—GEORGE WARD, Leicester.

[58474.]—**Chemical Balance**—Use a saucer with a few lumps of fused calcium chloride. A tray with quicklime will answer; but not so well. Sulphuric acid is risky, not from fumes, but from liability to upset or overflow.—SIGMA.

[58474.]—**Chemical Balance.**—Ordinary sulphuric acid H_2SO_4 is generally regarded as fumeless, though some scientists have professed to be able to prove to the contrary. Nordhausen acid, however, which is a combination of H_2SO_4 with SO_3, fumes strongly. Lumps of pumice-stone saturated with H_2SO_4 is what I should recommend you to adopt, in preference to the loose acid, as there would be no danger from spilling from an accidental jerk. Perhaps even a little common salt would be sufficient, and for its cheapness, could be renewed as often as necessary.—PERCY W. STANLEY, 119, Manchester-road, Poplar.

[58475.]—**Dynamo.**—To MR. BOTTONE.—I should not recommend a Siemens H-type for a 500 c.p. machine. If the armature were laminated on the Jones principle, it might give satisfaction; if not, it will work too hot. To get 500 c.p. out of your dynamo, even if of excellent working capacity, you would require nearly two horse-power engine. The best dynamo consumes nearly one horse-power for every 300c.p. The size of a Siemens armature to give the necessary current, should be at least 6in. in diameter by 18in. long, wound with about 6lb. of No. 16 wire. F. magnets wound with 24lb. of No. 16, 12lb. on each leg, coupled up in parallel. Shall be glad to give you details for a 500 c.p. Pacinotti ring, Gramme machine.—S. BOTTONE.

[58478.]—**Plante Storage Battery.**—To "SIGMA."—As I have not tried the secondary batteries in practical use (though I have examined pretty well every suggested idea experimentally), I should not care to give sizes suited to particular work. The best construction, in my opinion, is a lead vessel cased in wood for protection. The two ends of this may be used as a plate preferably as the spongy lead one rather than the peroxide; against the two sides place wood boiled in paraffin wax. Cut the lead into pieces double the width of the intended plates, and 2in. longer. Then cut these in two, first cutting a strip 1in. wide along half the end at opposite sides, so as to produce two plates, with an inch strip projecting at one end to serve as connection. Now rub the top inch with some cement, making the metal hot, and turn it over a strip of wood or vulcanised fibre as long as the width of the lead tank, so that its ends may rest upon the pieces of wood and support the sheet of lead. Turn the projecting strips up, and insert the plates with the strips alternately at each side, keeping them at suitable distances—say, half an inch apart—by pieces of wood or cork; then unite all the strips of each side together. Reckon the E.M.F. as volt 1·8, and get the number of cells needed to supply the E.M.F. required for the work. I should use 3lb. lead for plates, because lead is so low in price that it would probably replace its cost after years of working; but 1lb. or 2lb. lead would do. The formation would proceed while working, using short reversed charges at first.—SIGMA.

[58479.]—**Telephones.**—It seems to me that your diaphragm is too thin, or too large in circumference, and should not be drawn *dead* upon the magnet by a battery; and, when at rest, $\frac{1}{16}$in. from it at most. Again, if your bobbins are fixed upon the magnet may cause the fault. A piece of soft iron should be fastened to the magnet, and the bobbins to the soft iron. It does not matter where the terminals are fixed. Should you require ony further assistance, shall be glad to give.—T. H. SMITH, Leeds.

[58479.]—**Telephones.**—You cannot expect to get very good results without a battery and microphone in circuit, unless your magnets are very powerful. The ferrotype plates should answer well, but see that they are well fixed at their edges, and as near the magnet-pole as possible without touching. If you use a current, it should not be strong enough to attract the discs till they touch the magnets. It does not matter in the least where the terminals are fixed; but they are, perhaps, more convenient at the extreme ends of the handles.—H. H. B.

[58479.]—**Telephones.**—Ferrotype iron is the right thing to use for these. Your failing to obtain good results may depend upon several causes. 1st. You may have buckled the iron in cutting the discs, or punctured or bruised the discs by marking the centres with the compasses. A buckled or punctured disc will not speak. 2nd. The disc is not equally clinched all round by the cover, or it touches the top cover near the centre, so that it is not free to vibrate. 3rd. The magnets are not adjustable, and are fixed too far from the plates. They should have screw-adjustments, and be first screwed in so as just to touch the plate, which may be known by tapping lightly with the finger-nail; then unscrewed until just clear. It is indifferent where the terminals are fixed. Be careful that your lead wires are perfectly insulated. See also that the listener is far enough away, not to hear you shouting.—S. BOTTONE.

[58480.]—**Weather Chart.**—In reply to "Edinburgh," I would suggest that he returns the chart to the makers, explaining his difficulty, and if they are in any way defective, they will doubtless be exchanged for others. The papers are not so sensitive to light as the ordinary silver preparation, and would not be influenced by gaslight or by exposure, for a short time, to subdued daylight. The action of the sunlight is of course not so intense during winter as in summer, which is indicated by the faintness of the trace; but at any time, when the rays are strong enough to produce a clear image of the aperture on the chart, it ought to be permanently recorded after fixing.—J. B. J.

[58481.]—**Windmills.**—Molesworth gives for the ordinary windmill, with inclined sails—

$$\text{H.P.} = \frac{A\,V^3}{1,080,000}$$

A = area of all the sails in square feet
V = velocity of wind in feet per second.

—T. C., Bristol.

[58483.]—**Conveying Hot Water.**—I am afraid it will be too great a distance (150 yards) to get very hot water from a kitchen boiler; but, as means to that end, use a pipe with a small bore (say, ½in.), and envelop it twice at least with felt.—B.SC., Plymouth.

[58485.]—**Electric Lighting.**—To S. BOTTONE.—In the issue for Dec. 18, 1885, a correspondent under the signature "Japanos" asked me what resistance was to be used with a dynamo having an E.M.F. of 110 volts in connection with 100-volt lamps, each taking 1·5 ampères. I answered that the question was incomprehensible, and this owing to incorrect nomenclature. The resistance of a lamp may be 100 ohms, 50 ohms, &c., but cannot be expressed in volts. It is incorrect even to express the E.M.F. required to light up a lamp in volts, seeing that it gives no data as to the resistance of the dynamo itself, nor of the current required to light the lamps properly. As most lamps of good make require from ·75 to 1·1 ampères to light them well, it follows that the correct way to designate a lamp is to specify its resistance in ohms. From this can easily be calculated the E.M.F. and current required. Let us suppose, as now stated by "Electra" in the Jan. 1 issue, that the resistance of the lamps is 66·6 ohms, and that the current needed in them is 1·5 ampères. Now, 1·5)110(= 73·3, and this is the total resistance required to get this current from the said E.M.F. Now, the difference between 66·6 ohms and 73·3 ohms is 6·7 ohms, and this is the resistance which would have to be inserted if a single lamp were used. If three lamps are used, say, in parallel, then the total resistance falls to one-third of 66·6 or 22·2, and the current becomes nearly five ampères. A correspondingly smaller resistance will now suffice—viz., 6·7 ÷ 3. I trust I have made this clear to you.—S. BOTTONE.

[58486.]—**Painting Lantern Slides.**—If "B. A. F." can possibly come across a professional, and pay him or her a small fee, he will learn the secret of laying in a sky, and a great deal more, in the course of an hour's teaching than by any amount of labouring over printed directions. It is just this laying in of a sky and foreground with the proper depth of colour, transparency, and cleanness that is the great difficulty, and upon the right doing of which the value of a slide depends, but which, when once acquired, renders the painting of slides and glass pictures in general a pleasure. The best medium for water-colours is water-colour megilp; and if "B. A. F." cannot work the Canada balsam, he may be more successful with oil-colour megilp or siccatif; if [illegible] inclined to go on with copal, then drop the varnish and oil and use copal megilp instead. But the best work that is done in high-class slides is with prepared moist colours in tubes, water being the only medium required, the slide, when dry, being finished off with a coat of varnish. For years past I have used those prepared by Rowney and Co., and I could not desire better.—DENS.

[58491.]—**Lavender Culture.**—Here, at Wallington, an enormous quantity of lavender is grown. The lavender is propagated by parting the plants (tearing them asunder, so that each part has a little bit of root) in the month of November. They are put out in rows about 18in. apart, like cabbages, in a well-manured light soil. They must be kept clean from weeds by hoeing. The first year they produce but little bloom; this increases in quantity to the third or fourth year, when the produce begins to diminish. It is, therefore, [illegible] to make fresh plantations every three or four years.—S. BOTTONE.

[58492.]—**Concrete Path.**—Better use Portland cement and small cinders, in the proportion of 4 of cinders to 1 of cement by bulk. Get rid of the fine dust of the ashes as it takes up so much cement. Have it at least an inch thick, and don't make it too wet when laying it.—T. C., Bristol.

[58492.]—**Concrete Path.**—If you want to make a very durable path, it would be better to use slag or engine cinders. Ordinary ashes would not be hard enough. Proportions: Slag or cinders broken to pass 1½ ring, eight parts: hard ashes, sand, or cinders passed through half screen, [illegible] parts; Burham Portland cement, one part. Spread four parts large cinders, then one part sand or fine cinders, then cement. Over cement spread remainder of sand, over this remainder of large cinders, toss dry, wet with water from rose of water-can, toss again, spread to depth of 4in., [illegible] hard, and float up to level with steel float.—C. [illegible]

[58493.]—**Microscopic Objectives.**—"F.H.F." had better obtain a Spencer 1-10in., or a 1-12in. Powell and Lealand homogeneous immersion objective. A higher power lens will show him no more than he can see with a 1-12in. properly illuminated; with Wenham's reflex condenser, Amphipleura pellucida is resolved at once, without any trouble.—NO SIG.

[58493.]—**Microscopic Objectives.**—If there are any test diatoms that you cannot resolve with a $\frac{1}{25}$ immersion, it is to be feared that it is but a poor objective. It must be borne in mind that the *resolving* power of an objective is not a function of the magnifying power, or "shortness of focus," but of the "angular aperture" and perfection of chromatic correction. I have an eighth objective which will resolve any diatom I have tried it on, and yet its magnifying power is only about [illegible] diameters with the A eyepiece. If you will tell me which diatom you desire to resolve, I will tell you what angular aperture you will require to resolve it, and indicate how you may test the angular aperture.—S. BOTTONE.

[58494.]—**Photographic Lens.**—In my experience the books are right, and more than one lens is required. The nearest approach to a universal is Darlot's; it consists of six rectilinear lenses, [illegible] doublets, and by different combinations almost anything can be photographed;

.1 11s. For portraits you should get a 2 A patent llmeyer 3½in. diameter and 10in. back focus. ith this and the rapid rectilinear you will be le to photograph most objects, except street chitecture and interiors, and for this you will reuire still another—a wide-angle rectilinear.—Sc., Plymouth.

[58495.]—**Economical Use of Gas.**—If this erist is "sincerely anxious to know the exact ath," his best plan will be to experiment for mself. It has been frequently stated in these lumns that the gas and the air supply as well ould be hot, and any "scientific lecturer" who serts the contrary should be asked for proof of s statements.—NUN. DOR.

[58495]—**Economical Use of Gas.**—The gas suing from the orifices of regenerative burners is doubtedly in a heated condition. From experients I made some time ago, however, I do not nsider the heating of the gas of much conseence—at least, as regards its influence on the uminating power. The reason that the gas is vised to be kept cool is on account of the trouble at is caused by carbonisation of the gas in the rner, and so stopping up the gas-ways. "Ignoraus" will probably have noticed that regenerative rners, after having been in use some time, have t as shapely flames as when first fixed. This is, r the most part, due to the carbonisation of the s, as above mentioned, and as the burners are ually somewhat complicated, it becomes a matter some difficulty to put them to rights. There is question that the hotter the air can be supplied the flame the greater the illuminating power ill be—i.e., if the air be supplied to the flame in e quantity and manner best suited to the particur quality of gas being used. I trust "Ignoraus" is not under the impression that the simple urning of gas in hot air is attended with great crease in the illuminating power, as this can ardly be said to be the case, and great care has ad to be bestowed in designing regenerative urners to cause the air to so impinge upon the gas s to give the best results.—T. T. W.

[58498.]—**Electric Clock.**—The way to wind the enoids to get like poles facing one another is ne by proceeding in exactly the same way as ough you were winding two reels for an ordinary ctro-magnet for a bell—i.e., wind the wire on h in the same direction, and then, placing the ls in the position they would occupy if the ctro-magnet were bent out into a straight bar, n the beginning of the wire on one reel to the of that on the other. Yes, certainly, both nters turn in the same direction. They are ven by dial wheels as in any other ordinary k. If you think of making an electric clock, I uld advise you to get an old movement; take the barrel and fuzee, and put a ratchet wheel click in place of the 'scape wheel, or you might down the 'scape wheel teeth to take a click. ember, if you make an electric pendulum to seconds, you must use a movement that has a half-seconds pendulum, because the electric ulum obviously only moves the 'scape wheel ard at every other beat.—ACOLYTE.

499.]—**Perfect-Tuned Piano.**—Without nding to answer for other people, I should hat a perfect-tuned piano would be apprecd by a very large number of players and ners; but is it possible to make one to cost no e, and to be no larger, than one with 12 keys e octave? I think not.—N. E. CHILD.

499.]—**Perfect-Tuned Piano.**—Supposing it possible to construct a perfectly tuned piano, ng no more than the same quality ordinary d piano (this is impossible, because a larger ber of hemi- and demi-semi tones would be red), it would not be more appreciated by the al run of musicians; because very few could t the difference between B sharp and C flat, and even if they could, such a piano would stand in *perfect tune* for a week together.—S. TONE.

499.]—**Perfect-Tuned Piano.**—I am des of informing "J. K." that eighteen months I made a section of three octaves of a piano on stem of perfect tuning and stringing; similar, superior in every way, to those shown by smead and others at last year's Exhibition; that section is now to be seen and tested (and ks for itself) that it is at the exact pitch I ng it to so long ago. Strung on my principle a piano would be worth £30 after ten years' and would cost nothing for tuning, as a com- clock key by finger and thumb could tune it ny degree of fineness, as it takes a whole retion to raise middle C a full tone; while a piano of any other tuning would be bad to at ten years' end for more than £20. My piano ld be 3in. higher. More particulars if required. LOCK KEY.

8499.]—**Perfect-Tuned Piano.**—There are rences of opinion as to whether a perfectlyd piano would be appreciated. Some of our ing musicians consider the errors of the equal temperament tuning as unimportant, and they surely ought to be authorities on the matter, while the ranks of just-intonation champions are yearly increasing. The former could, however, have no objection to a perfectly-tuned instrument, provided no extra cost or trouble were entailed; but there's the rub! I remember when first in blissful ignorance I borrowed a tuning-key to make G sharp a better major third in the key of E, and after tuning to a more delicious third than any the tuner had left, how puzzled and disappointed I was on casually touching the chord of A flat major, to hear an excruciating interval in place of a major third. This first set me thinking; and now, after reading all the literature I can get hold of on the subject, I long for just-intonation in place of equal temperament, and so do many more who know the why and wherefore of the matter; and as to those who are in ignorance of any differences, their natural ears would soon pick out the more perfectly-tuned instrument as readily as they now select and applaud the vocalist with the most correct intonation. So if you can construct a perfect-tuned piano without extra cost or trouble, I should say it would be appreciated on all hands. Unfortunately, the piano is so much affected by changes of temperature, &c., that some correction would probably be necessary. This does not apply so strongly to the harmonium.—S. E. HUNT.

[58503.]—**Cheesecakes.**—Take six eggs, or any number in proportion to the quantity you wish to make, take the white of two away, 1lb. of loaf sugar, ¼lb. of butter, rind of two lemons, juice of three; add these together, putting the butter in first; dissolve over an oven, or some gradual heat, and stir till thick; when cool, it is ready for use.—W. FRYER.

[58504.]—**Gas Queries.**—The gauge you have made gives the exact pressure, but I am surprised you should have as much as 3·5in. Can you be mistaken? 3½in. is exceedingly high. You are wasting your gas, which will give best light at from $\frac{5}{10}$in. to $\frac{7}{10}$in. pressure. There is a difference of about $\frac{1}{10}$in. pressure for every 15ft. of rise; pressure in basement would probably be $\frac{2}{10}$ths lower than in upper floor. I have had much experience in use of governors, and find that governor burners are not so satisfactory as governors on the mains. I have been able to effect a saving in consumption of from 60 to 25 per cent. by a judicious adoption of regulators or governors. I will be happy to give you any information in my power on the subject, if you will advertise your address. I am not interested in any form of governor.—C. E.

[58504.]—**Gas Queries.**—"Steatite" is quite right in supposing that the figures, 2·3in. and 3·5in., represent the gas pressures as usually understood. The difference of pressure is about one-tenth of an inch for each 10ft. of elevation; thus on the next floor above where he tested the gas, if a 10ft. story, the pressure instead of being 2·3in. would be 2·4in., and so on, of course, for 34ft. the extra pressure would be ·34in. The reason that gas is supplied at a less pressure during day time, when it is not much used, is to keep down the leakage. The variation, however, is now being felt more than originally was the case, and if gas could be supplied at a uniform pressure, one great obstacle to the use of some of the more elaborate appliances for gas consumption would be removed, and a more general use of them the consequence. Now with respect to the question as to whether a main governor or governor burners are the best to use, a great deal will depend on whether he has much vibration in the building, as, if so, governor burners would be of no service, the continual oscillation of the valve making a very unsteady light. If, however, the burners are not subjected to any oscillation, I think governor burners are quite equal to the best main governors, the principle being, of course, that in the one case the gas is governed for every burner, and in the other for each burner separately. For my own use I prefer governor burners, as very often I require the full pressure at some particular spot without interfering with the rest, and again, they are considerably cheaper, and various sizes can be used according to the light required.—T. T. W.

[58505.]—**Continuous Brakes.**—If your correspondent "Triple Valve" will refer to my letter 50425, Vol. XXXVII. p. 273, he will find all the details relating to the Wood's brake.—CLEMENT E. STRETTON, C.E.

[58505.]—**Continuous Brakes.**—Wood's brake was fully described by Mr. Stretton on page 273, No. 948 (which is in print). The following description of "Webb's Automatic Air-Pressure Brake" I extract from a pamphlet circulated at the Inventions Exhibition, where a model was also shown:—"This invention may be described as consisting of two cylinders of equal length, but different diameters, connected together at one end, and containing a double piston, each end fitting into its proper cylinder. In the centre of the piston is a slot, in which works a solid lever and spindle, carried on the bottom of the cylinder. On each end of the spindle is keyed a double-ended lever, for connection with the brake rods. Running lengthways under the vehicle is the main pressure pipe, having a branch connection to the end of the large cylinder, and in this branch is placed a cock, to cut off the connection when necessary. The ends of the two cylinders are connected through a valve in the larger end of the piston, opening inwards, the piston itself being a hollow casting, having sufficient capacity to act as a reservoir to apply the brakes. When air is admitted into the cylinder from the train pipe, it acts on the large end of the piston, and moves it over towards the small cylinder, at the same time the air passes through the valve in the end of the large piston (which closes against its return) into the small cylinder. In this position the brakes are 'off.' To apply the brakes, the air must be released from the train-pipes, which can be done by the driver or guard opening a cock or valve arranged for the purpose. The acting fluid will then leave the large cylinder, but will be retained by the inlet valve in the small cylinder, and the pressure thus retained will force the double piston towards the large cylinder, and acting through the lever and connections will apply the brakes. One feature in the arrangement is, that as the pressure of the air decreases, the leverage increases." I cannot say if this brake is in use on the L. and N. W. Railway; but if it is, it is another step towards the displacement of vacuum by air-pressure brakes.—UPTON PARK.

[58506.]—**Microscopic.**—For longitudinal sections, take the wood to a carpenter and get him to plane off some of the thinnest possible shavings. On looking through them you will get lots of beautiful pieces for mounting. For cross sections the razor is best, either dry or moistened with turpentine. To make the sections transparent, steep in turpentine or clove oil for a few hours, and mount in Canada balsam or dammar lac.—B. SC., Plymouth.

[58506.]—**Wood Sections for the Microscope.**—Longitudinal sections of most woods can be got with a sharp plane. Transverse sections with an ordinary microtome. Some woods cut better after soaking in water. Many can be mounted dry, such as deal and other resinous woods; others in Canada balsam (hardened and dissolved in benzole).—S. BOTTONE.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, S. Bottone has replied to 58105.

57895. Violin Bow, p. 190.
57905. Yield to Investors, 191.
57906. Bearings for Lathe Mandrel, 191.
57907. Pneumatic Ejector, 191.
57910. Ink for Embroidery Printing, 191.
57914. Furnace for Bending Plates, 191.
57917. Valuations, &c., 191.
67923. Locomotives, 191.
57936. Formula for Object-Glass, 191.
57944. Binary Star Orbits, 191.

58114. Harp, p. 269.
58126. Knuckle Joints, 269.
58129. Hydraulic Rams, 269.
58131. Differential Galvanometer, 269.
58132. Electric Lighting, 269.
58134. N.E. Railway Express Engine, 269.
58135. G.W. Railway, 269.
58138. Engineer's Arithmetic, 269.
58148. Cotton-seed Oil in Lard, 269.
58150. Currier's Query, 270.
58160. Black Boiler Composition, 270.

ON Saturday, the 2nd inst., the employés of Messrs. W. Watson and Sons, opticians, 313, High Holborn, held their annual dinner, at the Holborn Restaurant. The arrangements were most efficiently made and carried out, and a very enjoyable and successful evening was the result. Mr. T. P. Watson, senior of the firm, was in the chair.

Oriental Carpet Manufactures.—Since the opening of the Poti-Tiflis-Baku Railway the export of carpets to Europe from Central Asia has been considerably developed. According to various Armenian journals, French and English agents have established themselves in Tiflis in order to purchase on the spot carpets for export to Western Europe. Consequently some important Persian factories have been opening branch establishments near those points, in order to be in the track of the business. The raw material is still obtained from Persia, as the inhabitants of that country have particular methods for imparting to the wool the fineness and brilliancy for which it is noted.

QUERIES.

[58507.]—**Battery.**—Will any reader, who has had experience with nitrate of soda batteries, be kind enough to answer the following questions? In a cell, the porous pot of which holds half a pint and the outer cell one pint, would it be best to put the zinc rod in or outside the porous pot? How long should a battery of the above size, having three carbons and one zinc rod, last at full power? —ACCUMULATOR.

[58508.]—**Dynamo Tests.**—TO MR. BOTTONE, OR MR. W. H. EAVES.—I have made a small dynamo, modified Gramme type, to light my house, which gives 50 volts and 15 ampères when run at 2,060 revolutions: absorbing 1¼ H.P., it lights nineteen Shippey's 16-c.p. low-resistance lamps very nicely; also fourteen Woodhouse and Rawson 48 volt lamps at 1,980 revolutions. I am now thinking of trying my hand at a 50 or 60-lighter to light part of my woollen mill; but should like to know, from those better versed in the subject, if there is any advantage to be obtained by reducing the voltage and increasing the ampères (or vice versâ)? I have an idea from a Gramme dynamo of this description, that I shall get more effect by running smaller lamps, two in series of suitable voltage, and that I shall get more lamps lighted by machine from same expenditure of power. Am I right upon this point, or not? I have asked two electrical friends, who are supposed to understand the subject, but both differ. Greenwood and Batley, of Leeds, at the recent Inventions Exhibition, stated that they ran 100 50-volt lamps of 16 c.p. each, run two in series from a Jones' 100-volt dynamo, with an expenditure of about 70 ampères. I have looked through back numbers of "Ours," but can find no results mentioned by any of "ours," or does the subject appear to have been fully discussed by our scientific contributors? Is there any advantage in adopting Mr. H. Jones's laminated armatures? Any hints which will enable me to get the best results will be approved by a—WOOLLEN MANUFACTURER.

[58509.]—**To "Sigma."**—I have read with great pleasure your reply to "Puzzled," and it has helped me a great deal. I have a powerful dynamo, which will light six or seven arc lamps, and I have it placed above the slack pulley of a machine from which I can get six or seven H.P. if I require it, and which I can have on an average above six hours daily. Except for the short time the machine is working, this power is now running to waste. Two years ago I cut up a number of lead plates, 12in. by 12in., of 5lb. lead, but hearing such bad accounts of storage batteries, I went no further with them, waiting to see what improvements would be made. You now show that the old plan in such cases as mine is better than the new, and this has given me heart to proceed again. I can run at any speed by altering pulley on dynamo. The dynamo is coupled up in series. How many pair of such plates will I require to light, respectively, six, twelve, eighteen, and twenty-four 20-c.p. incandescent lamps? I intend having slate troughs made, with grooves cut out for the plates to slide into, at sides and bottom, and part of sides and bottom worked out to allow current to travel round. Do you mean by cells each pair of plates, or must my trough have a great number of divisions, dividing off so many plates each? I should like to make it in one or two long ones. Is there any objection to this? Is there any danger, upon turning out all the lights except one or two, of fusing those left? What device can I make when battery is fully charged to switch off dynamo to prevent injuring it?—J. D.

[58510.]—**Water.**—Will any reader of "E. M." answer the following? At what temperature does water become spheroidal? Can it become so under a pressure of 100lb. in a pipe filled with water circulating slowly through it?—W. H. T.

[58511.]—**Moscrop's Recorder.**—Will some of "ours" kindly give short description of "Moscrop's Recorder," used for taking diagrams from engines, &c.?—CRUX.

[58512.]—**Steam Governors.**—What advantage is obtained by having the heavy sliding ball, now commonly used, on the spindles of steam-engine governors, which requires so much greater velocity of governor to raise it? —CRUX.

[58513.]—**To Mr. Bottone.**—I have a 15-candle dynamo. Would you kindly tell me if I could drive it by an electro-motor? What size castings should I want, and quantity of wire on armature and F.M.'s, &c.?—J. NEWTON.

[58514.]—**Fever.**—My brother-in-law had an attack of fever two months ago, occasioned by redundance of blood; and although he weighs about a stone less than he did, yet the slightest activity at work or walking induces feverish heats. I should like to ask if this is likely to prove a constitutional ailment, or whether any of our correspondents can help him, as he has been a real friend to me?—SILVERSMITH.

[58515.]—**Dynamo.**—TO "W. H. E."—Will you kindly instruct me in this? I have made a Gramme dynamo, the pole-pieces of which are bored out to 6¾in. and 3¼in. wide. The four cores of F.M. are 5⅜in. long by 1⅝in. diam. If I cannot procure sheet-iron rings, I will make armature of iron wire, and of size sufficient to get on five layers of wire, which will amount to about 8lb. No. 18, and 28lb. No. 16 on F.M., and connect in multiple arc. Now, I see in your description of a dynamo you have only one layer on armature. Will I be right in my amount and size?—MARINE ENGINEER.

[58516.]—**To Mr. Wetherfield.**—Would you kindly advise me how to act in the following case? I was intrusted with three water-colour drawings to mount and frame, which, when done, I delivered, to the satisfaction of the party. Not being paid at the time, two days after I called for payment, when I was shown one of the pictures with a stain on the drawing. How it got there I cannot tell, unless it be from a knot in the back board. I asked for the picture to get it repaired; but they will neither let me have it nor pay for the framing of any of them. Can I sue for the amount and recover? and am I liable for the damage?—M. B.

[58517.]—**Myopia.**—Will any correspondent tell me what glasses I require for a bad case of myopia? I can read the Answers to Correspondents clearly at 4in. distance from the eye with the left eye; with the right eye only 3in. I always read with left eye only. I can bring them both to the same focus—namely, 4in.; but the letters are very confused. Yet, what seems very strange to me, I can see, with a little straining, this same print at 7in. or 8in. distant by going close to the window, and in bright sunshine a few inches further; in either case only for a few minutes. After the effort I feel a pain across the forehead. With the left eye I can accomplish nothing further than 4in. nor nigher than 2in. I always look at distant objects with the right eye. I have been to several opticians; but cannot get suited. I consulted an oculist at the Edinburgh Royal Infirmary, who examined my eyes and then handed me over to two or three students to fit me with glasses, which they failed to do. I failed to see any difference between an oculist's proceeding and a spectacle seller, excepting the examination of the eyes. I expected to have some information as to what kind of glasses I required. Instead of such information, I was merely tried with glass after glass, until the lot was exhausted. I have searched through eleven volumes of the "E. M."; but can find nothing to suit me, so I hope some oculist friend will be kind enough to help me. I would just mention that the nearer I close my eyelids, short of shutting them altogether, the better I can see; if I open them as wide as I am able, I see nothing distinctly.—ESS JAY.

[58518.]—**Bichromate Batteries.**—Will some reader kindly furnish me with the proportions of the ingredients of the bichromate battery solutions? The solution I am in the habit of using decomposes very quickly, getting black, and therefore has to be changed rather too frequently.—EVAN I.

[58519.]—**Increasing Conductivity of Carbon Plate.**—In Byrne's bichromate battery (Vol. XXVII. p. 306), the principal cause of its great power is attributed to the fact that the negative element is platinum foil soldered to a plate of copper, thus reducing the internal resistance to a very great extent. I would propose treating carbon plates for bichromate batteries in like manner: first electro-gild (a mere film almost) one side of carbon plate, which plate need not exceed ¼in. in thickness, deposit copper thereon, and again solder this to copper plate. Judgment on the above case of "Theory v. Practice" is most respectfully prayed for by—JOS. LEANEY.

[58520.]—**Emigration.**—Could any of your correspondents kindly give information as to the prospects of emigrants (agricultural) with a capital of £200 to £300 in South Africa, especially in the "Orange Free State"; and also in California or Oregon? Is the climate good and healthy, and what are the best times of the year for emigrating? Are there any books giving information about South Africa, like those published by the Governments of the Australian and other colonies?—R. P.

[58521.]—**Batteries.**—TO MR. BOTTONE.—(1) Will you please tell me what the black-brown stuff covering tops of porous pots (and sometimes outer jars of Leclanchés as well) is? Can I use Leclanché carbons (used for a short time in Leclanchés) and porous pots in a Bunsen battery? and, if not, why not? (3) I have seen somewhere that if you add bichromate of potash in small quantities to the nitric acid in porous pots of Bunsens, it stops fuming. Is this true? Does it lower efficiency of cell? (4) How many Bunsens does it take to light 5-c.p. incandescent lamp?—AN ADMIRER.

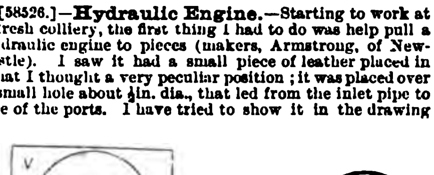
[58522.]—**Diver's Dress.**—Would some practical reader kindly inform me how to repair a diving dress? I have a pair of new cuffs to put on one dress, some patching and a new helmet collar to put on another one, and am at a loss how to proceed. If this meets the eyes of Messrs. Foster and Williams, or any of their workmen, they would confer a great favour by replying to—A BATTERED HELMET.

[58523.]—**Link Motion.**—I should be glad if some reader would show the method for setting out the link motion of an engine, and also the proportions for making the same?—CHARLES JOHNSON.

[58524.]—**Melting Brass in Cupola.**—I have some gun metal castings to make, weighing about 12cwt., to be machined all over. Having no reverberatory furnace, I shall have to melt the metal in a cupola. I should be obliged if some reader would give his experience as to the best method of melting the same. Whether it would be best to ingot the metal before putting it in the cupola, or to melt the copper first and add the tin and spelter before casting.—W. F.

[58525.]—**Oxide of Iron.**—Will one of "ours" inform me if the oxide of iron which is used for purifying gas undergoes any real changes during the process, or is it only a simple filter?—W. J.

[58526.]—**Hydraulic Engine.**—Starting to work at a fresh colliery, the first thing I had to do was help pull a hydraulic engine to pieces (makers, Armstrong, of Newcastle). I saw it had a small piece of leather placed in what I thought a very peculiar position; it was placed over a small hole about ⅛in. dia., that led from the inlet pipe to one of the ports. I have tried to show it in the drawing as well as a novice in drawing can do. L is the leather flap, and V an ordinary slide-valve. I inquired of my mate what it was for, he having worked the engine for seven or eight years. He told me he did not know, nor the enginewright either; only he knew it would not work unless these leather flaps were in good order. There are three single-acting engines connected to one crank-shaft; but by altering the ports, which is done by a lever, the engine can be run either way.—PUFFING BILLY.



[58527.]—**Legal.**—Agreement to take a house at £60 rental, and keep the house in good tenantable repair, and so leave it at the end of the tenancy. This was signed by a widow lady, and there is the name of a witness and a 7s. 6d. stamp on the agreement. The widow has always paid the rent, the receipt being in her name. time arrives as to the state of repair, it tur the agreement was not signed by her, but by passed on as her signature. Shall be glad to k law stands in a case like this.—J. W. T.

[58528.]—**Hot-air Engine.**—TO MR. J. —I want to make a hot-air engine, about ½-h been a very long subscriber to the "E. M.," refer to back vols. Will you kindly give me t instructions to make the above? I don't quit how it works. Please say the different sizes &c. I can use smith's or carpenter's tools an —A YOUNG ELECTRICIAN.

[58529.]—**Amyl Alcohol.**—Will a fello the "E. M." help me with a simple means of the presence, and its quantity, of essential whisky, or improperly rectified corn spirit? is employed on the Continent which, when mi spirit to be tested, and warmed over a lam imparts a straw colour to a fairly clean sample deeper shade if the impurity exists to any are a series of accompanying glass plates of var colour indicating the value of the reaction. T with its simple test tube, a spirit lamp, and the is so dear as to be outside the reach of many, will be very glad to know what it is, or to lear reagent with a similar reaction.—CYGNEL.

[58530.]—**Organ Query.**—Will some of good enough to inform me what is the smal space the following would take up? Also, w opinion of the specification? Is it too large f 30ft. by 25ft.? Whether, for the sake of space to have the great organ divided and placed eac swell of solo organs, or to have all three org back in a line? The pedal organ, open 16ft., I behind, the pipes lying instead of standing up cost of pipes only? Great organ: 1, Bourdon 2, Open Diapason, 8ft.; 3, Dulciana, 8ft.; pal, 4ft; 5, Cornopean, 8ft. Swell organ, 6, 8ft.; 7, Salcional, 8ft.; 8, Flute, 4ft.; 8ft. Solo organ, 10, 11, 12, 13, four 8ft. stops, t in separate swell box. Pedal organ, 14, Bo tone; 15, Violone, 16ft. open. Couplers, &c. solo to great, solo to swell, swell and great to p and great superoctaves; manuals, C C to C³, pedals, C C C to D, 27 notes.—SARDONYX.

[58531.]—**Pure Chalk Caustic Lime.**- make small quantities of above for chemical p to obtain it in as fine a state as possible. I that the best way to proceed is to burn the cha and re-burn the finest portion. I have done thi feel certain that the final product is caustic it does not evolve heat on the addition of wat it do so? I have got it red hot, and allowed i all night in the furnace. Any information re amount of heat and time required to effec result will be thankfully received by—DANDIE

[58532.]—**Physics.**—Will any reader be k to solve me the following? With what veloci mètres per second must a leaden bullet strike its temperature may be raised 100° by the collisi ing all the energy of the motion which is des spent in heating the bullet?—W. G. B.

[58533.]—**Iron Tank.**—We have an iron several holes rusted through the bottom. T leaks, we have cemented the bottom, to a dep 2in., with equal parts Portland cement and sa still drips at the holes. Is there any more cement we can coat it with, or what must be done

[58534.]—**Metal Moulds for Vulcan** "DENS."—Could you oblige by stating modus o vulcanising with moulds of grain tin? I an with plaster-of-Paris, but find the plaster ad rubber, thus destroying the appearance of the face; also the marking of the palate. Any i will be esteemeed a favour by—DENTIST.

[58535.]—**Seams in Boilers.**—I should any expert on boilers would give me the form culating the strength of seams in boilers. For have two boilers, same in dia., thickness of plate. rivets; but the distance from centre to centre one is 1⅞in., and in the other 2⅛in. As both cannot be equal in strength, how must I proce strength of each?—PUZZLED.

[58536.]—**Window Letters.**—Can any rea me what is the best cement for the above? Th my shop window are put on partly with red partly with white. The latter is a constant trouble.—OPAL.

[58537.]—**Bisection of a Triangle by a Line drawn through a Given Point or Without it.**—Is there any practical solu problem? I know Burchett 297, and McDowel the former is incomprehensible and the latter — —W. T. L.

[58538.]—**Mathematical.**—I understand ratio of the circumference of a circle to its dia also the base of the Napierian system of loga each of them been calculated to some hundreds of decimals. I should be much obliged if any the ENGLISH MECHANIC would supply me wit of the above quantities, correct to as many de as possible; also with any quantities, either numbers or series, identical or approximate to —RATIO.

[58539.]—**Centrolineads.**—Will some inform me which is the most useful size of ce for general use, and is it necessary to have PERSPECTIVE.

[58540.]—**White Wood Furniture.**—Is book that gives instructions for making com wood furniture, such as kitchen dressers and ta hand stands, &c., or information that would he is going to try to make such articles for sale? is the best elementary work on wood-turning?—

[58541.]—**Storage Battery.**—Will favour by replying to the following? when these batteries are fully charged possible to keep dynamo working afte so do damage? Does the solution [illegible] be particular in asking for walnut, as "nut oil" is usually expressed from the Arachis, or ground-nut.)—X. Y. Z. (Something of the kind is frequently advertised in the "Sale" column. It is doubtful whether anything of the kind is of much use in seawater.)—BLOWPIPE. (A common silver solder is made of equal parts of fine silver, composition, and white arsenic. "Composition" means an alloy of 2 copper, 1 zinc. Different sorts of solder can be made of silver, shot copper, and pure spelter by varying the quantities, and by substituting composition with arsenic or tinsel for the copper and spelter.)—T. W. MAYCOCK. (See Hints Nos. 4 and 5.)—THOS. J. O'CONNOR. (A work on the "history" has yet to be written. There are several descriptive textbooks, and some historical matter in the cyclopedia articles. 2. The *Phil Trans.* is the record of the Royal Society, Burlington House, W. 3. *La Nature* is published by G. Masson, 120, Boulevard St. Germain, Paris.)—[illegible] T. (Take exercise with dumb-bells or Indian clubs, and avoid the artificial supports.)—AN ANXIOUS QUERIST. (You can make a hydrate of magnetic oxide of iron by dividing a freshly prepared solution of sulphate of iron into three equal portions, two of which are acidulated with sulphuric acid and heated to the boiling point; when boiling, nitric acid is added gradually as long as its addition causes the evolution of nitric oxide. The remaining third part is then poured into the hot liquid, and a solution of carbonate of soda—washing soda—or ammonia is added in slight excess. The solution and precipitate are boiled together, and the black oxide is formed as a heavy crystalline powder. Your questions are not definite enough except the third, and that is answered by saying that "excess" is used in the ordinary sense that is, more than is required to produce the precipitate.) MIM. (See indices. Queries asking for full instructions to make a medical coil come regularly about once a month.)—LAKESIDE. (Make a Daniell.) BICHROMATE. (See the articles which have appeared on the subject. It is impossible to answer such questions shortly, and to reply fully would involve the writing of several columns, which you can already find in back numbers.) SCOTT. (Surely you can hinge the inner edge of the board so that the depression of any part of the other edge will make contact, or the board can be supported on springs at each corner, and there may be several "contacts.") LEO. (A cascade bichromate will be as good as anything. The best plan is to add the acid by degrees until the salt is thoroughly exhausted. See many hints on the subject in back numbers.) HUGO. (Full and explicit directions for nickel plating have been given more than once. See pp. 96, 117, 139, Vol. XXXIX.) J. W. WILSON. (If the wire is fused, the only remedy is to unwind and make good. 2. We pointed out the "accident" on p. vii., Dec. 25. The figures should read, "1·25in., nor less than 1·32in.") H. JONES AND CO. (Thanks. On p. 358 we have given the subject as much notice as it is worth at present.)—ZENO. (Tannic acid is tannin, of which there are several kinds. Gallo-tannic acid is extracted from gall-nuts, but the astringent principle is found in many plants. To answer the question definitely, it would be necessary to know the nature of the raw material.)—J. A. T. (Not of sufficient interest for the space it would occupy, especially as a diagram would be required. See the Astronomical Notes on p. 355.) E. L. F. (The Doty, the Silber, and the Duplex of the well-known types, and one sold by Defries and Son, the trade name of which we forget. See p. 215 last volume for much useful information on the subject. The Empress lamp gives a good light, and dispenses with a chimney; see p. 396, No. 840.) J. P. P. (Yes; but we do not know who makes the machines, or the price of them. Such a query should be inserted as an advertisement in the Wanted Column.) CHAS. A. PALMER. (Use gold size in the paint if it is wanted with a gloss; turpentine if gloss is of no importance. For portmanteaus, mix the ground colour with a little oil, more turps, and add gold size.) GEO. WARD. (We believe there is a Society of Public Analysts, but we have not heard anything of it lately. The secretary of the Chemical Society and of the Institute of Chemistry will inform you what is "required" of candidates for admission.) WATER RAT. (Procure a little book on "Hot Water Heating," by F. A. Fawkes, published by B. T. Batsford, High Holborn, W.C.) HUDDERSFIELD. (Change with "paraffine," and use one of the enamel varnishes sold by dealers, or paint it.) MINE AGENT. (There is no other way than to repeat words in their presence, and keep on until the birds take notice and answer.) A. R. MORRISON, J. W. THOMPSON, Salem, Ohio. (In type.)

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Microscope. [illegible]

Compound Slide-Rest [illegible]

[illegible] **Tools** [illegible]

Hand **Lockstitch Machine** [illegible] Exchange [illegible]

Kangaroo Bicycle [illegible]

Sewing Machines—[illegible]

Musical Box [illegible]

Wanted, **Books on Lathe Work**. [illegible]

Wanted, **Photo Apparatus** [illegible]

The last [illegible] "**English Mechanic**" [illegible]

Electric Scarf Pin [illegible]

[illegible] "**English Mechanic**" [illegible]

A pair of **Transmitter Coils** [illegible]

"**Cassell's Shakespeare**" [illegible]

[illegible] "**English Me**[illegible]

[illegible] **Engine** [illegible]

Wanted, "**English Mechanic**" [illegible]

Newton's three or four-wick **Refulgent Lamp** required, 4 wick preferred. Exchange Books on Chemistry [illegible] requirements.—GEO. A. MILNE, Norton, Malton.

Large quantity of well-bound **Books**, chiefly religious and scientific; list sent. Will accept useful exchange. Offers requested.—HENSHALL, Folly-lane, Swinton, Manchester.

23 dozen selected **Microscopic Slides**, including micro-photos, by Dancer, Manchester, mahogany case [illegible] value £15. Exchange to £4, or value of 4s. 6d. dozen.—R.M., 185, Lansdowne-place, Bolton.

Electric Lighting &c., 6 cell double [illegible] Bichromate Batteries by Eaton, 1½ gallons capacity each [illegible] good lifting arrangement, runs 120 hours. What offers?—T. M., St. Lawrence-road, Brixton.

Wanted, **Gas Engine**, 1½ or 2 man-power; will give new Safety Bicycle in exchange for same.—J. IBBETT, [illegible] Penge.

Wanted, first-class **Slide-Rest Lathe**, about 4½in. centre. Will give good gold Jewellery in exchange.—LOVELL, Will-street, Hunter's-lane, Birmingham.

Dynamo, 800 c.-p., nearly ready for winding; take £1 exchange to £4. Engine or lathe.—C. HAIGH, Alderley Edge.

Lathe Bed in wood, 6ft. long, iron standards, 2ft. high, fitted, cost 25s. Exchange for Mechanic's Tools or offers.—JAS. TAYLOR, Ilminster.

Wanted, good **Launch Hull**, about 20ft., also [illegible] Silent Otto. Exchange high-class Biunial and accessories.—ECONOMY, Billingsgate Dock Wharf, Greenwich.

Will exchange single 6in. **Headstock** and Back Centre, for hand bench Drilling Machine, cost £2, or offers.—T. ANDERSON, 1[illegible], Lansing-road, Sheffield.

"**Engineering**," Vols. XXXVII., XXXVIII., XXXIX., and XL., [illegible] per Vol. Also Ward and Lock's "Technical Journal," first nine numbers, [illegible] clean, complete and unsoiled. Exchange anything useful. F. RAYNER, Sherwood, Nottingham.

Several volumes of "**English Mechanic**" [illegible] in exchange. Wanted, Bicycle Sundries or parts of Lathe.—E. C[illegible], Sherborne, Dorset.

Good Value Offered (cash or instruments) for all kinds of [illegible] repairable Scientific Appliances.—[illegible] Science Depot, Chandos-street, near British Museum. Established 1862.

Lathe Heads, 6½in., very strong, clamping bolt, [illegible] Exchange 4in. slide rest, [illegible]

Heavy 3-in. **Flywheel**, 4ft. 6in. cranked spindle. Wanted [illegible] Lathe-wheel [illegible] crank.—J. B., Pymmes Park, Edmonton, N.

3½in. centre **Lathe** slide-rest, with 4in. universal chuck, nearly new. Exchange offers.—H. RODGERS, [illegible] street, Bermondsey.

Offers wanted for new 6ft. **Gas Bags and Lime** Light Boxes [illegible]—[illegible] road, Birmingham.

Splendid horizontal model **Slide-Valve Engine** [illegible] turned columns.—DICKINS, [illegible] Salisbury.

Above **Engine**, fitted with tubular copper boiler [illegible] safety valve, gauge cocks, turned [illegible] Exchange good Lathe.—[illegible] Windsor-street, Salisbury.

Wanted, best **Carbon Plates**, with terminals [illegible] Exchange for two-quart Bunsen's [illegible] Offers.—[illegible] Warrington.

Wanted, **Grove's Battery**, a quantity of [illegible] Exchange [illegible]

To be exchanged, one pair of **Globes**, terrestrial and celestial [illegible] and all in first-rate condition [illegible] 3, Franklin-road, [illegible]

Lathe Wheel [illegible] turned [illegible] ENGLISH MECHANIC [illegible] Wolverhampton.

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[illegible] **Influence Machine**—Sole Manufacturers [illegible]—KING, MENDHAM and Co., Bristol.

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Tallow, Lard Oil (substitute for), Gas Engine, Gallipoli, Curriers, Cloth, and Boiled Oils. Practical recipes.—Below.

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Planes, new. London malleable iron and gunmetal finished, or ready for inside fittings; all kinds.—LUNT'S.

Vices, bench, parallel steel jaws, to open 3½, 9s. 6d.: ditto 4, 15s.; ditto 4½, 21s.—LUNT'S.

Tools every description. See illustrated catalogue, 90 pages. Send 4 stamps.—A. S. LUNT, 297, Hackney-road, E.

Small **Fly (Screw) Press** wanted, screw about 1in. diameter, stroke about 2in., roughest sketch, with dimensions, to—EVANS, Leigh, Lancashire.

Repousse Work.—Before commencing send for particulars as to tools required to—A. FRANCOIS, Birmingham.

Model Steam Engines.—Thirty different patterns illustrated in my new catalogue, price 2 stamps.—A. FRANCOIS.

Spectacles, Magneto Machines, Microscopes, &c., at remarkably low prices, see catalogue.—A. FRANÇOIS, Ryland-road, Birmingham.

Separate Parts of Engines can be obtained from A. Francois. For prices, see catalogue, third edition.

Belting.—A quantity of new solid woven cotton belting, will sell cheap, quality guaranteed, also rubber belting. State wants.—T. R. PAXTON, Workington.

To Amateurs.—**Lathes, Tools, and Appliances** made and repaired at most moderate prices. Skilled workmanship guaranteed. Practical lessons given in hand and slide rest turning. S. KING, Engineer, 6, Laxton-place, Munster-square, Regent's Park.

Watches.—Country tradesman, sick and embarrassed, has been relieved of entire stock; must realise quickly. Silver jewellery, jet, watches; selection on approval to any amount of cash sent, returnable all or part. Plain figures, cheap.—PRINCIPAL, Grammar School, Tuxford, Notts.

5½in. **Reflector,** Calver mirror, equatorially mounted, £14.—Particulars from W. S. FRANKS, 1, High-street, Leicester.

A bargain.—One dozen pure nickel silver **Teaspoons** post free 40 stamps.—J. BLAIN, Carlisle.

Woollen Cloths for men and boys' suits, ladies' jackets, &c., direct from the Manufacturers. Patterns post free.—C. ARROW, Woollen Manufacturer, 310, Piece Hall, Halifax.

Pitman's Shorthand.—Hints to learners, by certificated shorthand writer, 5 stamps.—WM. NUTTALL, Irwell-street, Ramsbottom, Manchester.

Model **Vertical Engine** for sale, 1in. cylinder, with pump, price 35s.—S. DE RITTER, 6, Wallwood-street, Limehouse, London, E.

Mesmerism.—Complete written instructions, success guaranteed, free, 1s. 6d.—W. THOMAS, 22, Clarendon-road, Anfield, Liverpool.

Oboes and Clarionets of a superior class may be had from J. SHARPE, Oboeist and Musical Instrument Maker Pudsey, near Leeds.

Half H.-P. **Horizontal Steam Engine.** fitted with governer and pump.—Particulars, with lowest price, to R. WILSON, 51, Courthill-road, Lewisham, S.E.

Whitworth and several other **Lathes,** auction, by Wheatley, Kirk, and Co., at Jackson and Graham's-yard, Upper Ogle street, January 7th.

***Gauges** for getting angle of screw-cutting tools,* 13 *stamps each.—W. GYNGELL, Oldbury-road, Tewkesbury.*

***Microscope,** with three object-glasses,* test object *and forceps, in polished box, 10s.—S. CLARKE, Kirton-in-Lindsey.*

New **Appliances and Tools for Lathes.**—BRITANNIA CO. are always open to manufacture.

Milling Appliances for fixing on ordinary slide-rest and lathe, price £6.—BRITANNIA WORKS, Colchester.

The improved **J. K. P. Lathe Chuck.** noticed in ENGLISH MECHANIC in October, price 50s. each.—BRITANNIA CO.

Lathe for boys, 55s. complete, with stands; larger, 75s., 85s. Steel Mandrels.—BRITANNIA CO., Colchester.

Engineers' Lathes, 8 and 12ft. beds, as supplied to British Government, superior quality, moderate price.—BRITANNIA WORKS, Colchester.

Several second-hand **Lathes,** similar to those exhibited at our London showroom, 99, Fenchurch-street, are in stock at Colchester.

Catalogues of Lathes, Castings, odd Parts, sixpence. List of second-hand lathes, 2 pence.—BRITANNIA CO.

Small **Motors** (hot-air), as exhibited at Inventions Exhibition. 2 stamps for circular.—BRITANNIA WORKS, Colchester.

Easy Terms of Payment only to those who give first-class reference or security. BRITANNIA CO.

To save Post. send Postal Order to cover amount. Surplus returned.—BRITANNIA CO., Colchester.

Lathe and Tool Makers to British and Foreign Navies, and to the Royal Small Arms Factory.

250 varieties of **Lathes,** for every trade and every trade and every fancy.—BRITANNIA CO., Colchester.

Splendid **Royal Orguinette,** with 42 tunes, equal to new, price 70s.—GOWER, Hook, Winchfield, Hants.

Croquet in stand, with 8 mallets, balls, &c.; price £1.—GOWER, Hook, Winchfield, Hants.

Halse's **Medical Coil.** good condition, worth £4; will take £2 (3 powers).—HENRY FELLOWS, 19, Church-street, St. Alban's, Herts.

Greenhouse, "Excelsior," span roof, 6ft. by 8ft., inside fittings, and portable wood basement, complete, £7.—HORLEY.

Hand Light (patent No. 13,276, A.D. 1885).—The "Handy," 7s. Catalogue, 1d. stamp.—HORLEY.

Raspberry Canes.—"Semper Fidelis," 12 canes, 1s., free; 100 for 5s.—HORLEY.

Red Currant Trees, "Raby Castle," 6 trees, 1s. free; 100 for 7s. 6d.—M. E. HORLEY, Toddington, Beds.

Porter and Burnham's **Picture Frame Vice,** cost 22s. 6d., never used, cash 15s.—F. BETTERIDGE, Eton, Bucks.

Tricycle, Stassen's. Telescopes from 38in. to 28in. lamp, &c., cash 13 guineas.—F. BETTERIDGE, Eton, Bucks.

Universal Trade and Amateur Supply.—Lecture requisites; light, heat, air, water, geology, engineering, chemistry, photography, &c. Wholesale and export.—CAPLATZI.

Frictional and **Induction Machines.** Plates, Cylinders, Stands, Conductors, Glass, Vulcanite, hundreds of Lecture Accessories. Their parts.—CAPLATZI.

Lantern, Telescope, Electric Machine, Dynamo, Coil, and Lathe Making. All Parts, Fittings. Cheapest in the market by far.

Schools and Students will find immense stores of Scientific Apparatus complete, and Parts Physics, Chemistry, Astronomy, Geology.

Batteries.—Thousands lighting, experimenting, medical, depositing. The Universal Four-Cell Case, 15s. Convenient, durable, and economical.

Wires.—Cheapest stores. New and second-hand. Great reduction in price. Paraffin, Vulcanite, Reels, Brasswork, Size, Resistance, and Testing Tables.

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Magic Lanterns, Slides, Microscopes, Kaleidoscopes, Oil and Lime Burners, Retorts, Bags, Bottles, Condensers, Lamp Reflectors, Lantern Bodies.

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Presents.—50 Microscopes, 100 Accessories, Objects, Cabinets, Powers, Condensers, Stands, Books, exceptionally low prices—2s.-£10.

Chemistry. — Outfits for Lecturers, Laboratories, Copper Troughs, Gasholders, Stills, Baths, Porcelain. Many Balances. Platinum, 2-thirds price.

For Hire.—English, Foreign, Ordinary, Historical, and scarce Apparatus in Electricity, Optics, Photography, &c. Easy terms for lecturers and bazaars.

Catalogue, 2d.—**Capalatzi,** Science Depot, Hire and Exchange, Chenies-street, Tottenham Court-road, near British Museum.

Dorrington's **Water Motor** for amateurs. Complete Castings, 15s. Drawing, 2s.—A. DORRINGTON, West Gorton, Manchester.

Gas Engine Castings, ¼ man power, horizontal, 42s. The "Little Compact." 35s. Drawings, 5s. Lithos of both, 4d.—A. DORRINGTON, West Gorton, Manchester.

Half horse-power Horizontal **Engine Castings,** 12s. 6d. Drawing, 18 stamps. Litho, 2 stamps.—A. DORRINGTON, West Gorton, Manchester.

Double 2in. cylinder **Horizontal Engine Castings.** 21s. Forgings, 12s. Litho, 2 stamps.—A. DORRINGTON, West Gorton, Manchester.

Bench Drilling Machine Castings.—No. 1, 3s. 9d. Drawing, 6d. No. 2, 7s. 6d. Drawing, 1s. 6d.—A. DORRINGTON, West Gorton, Manchester.

4½in. **Fan Castings,** 3s. 6d. per set, including drawing. Drawing separate, 4 stamps.—A. DORRINGTON, West Gorton, Manchester.

Valve Diagram, showing the method of determining the lap on slide valves to cut off at any part of stroke, 6 stamps.—A. DORRINGTON, West Gorton, Manchester.

To **Amateurs.**—Is there a demand for a Band Saw Attachment for Lathe? If so, please write to—A. DORRINGTON, West Gorton, Manchester.

Dorrington's new and enlarged **Catalogue,** 2 stamps. Note.—All castings and forgings guaranteed. No rubbish; and as a proof, I will send a large list of selected unsolicited testimonials free on application.—A. DORRINGTON, West Gorton.

Lathe Heads. Slide-rests, Beds, Standards, Wheels, Chucks, Appliances, rough, machined only, or finished. See List.—W. R. SMELT.

Turning, Boring, Screw-cutting, Planing, Patterns, Forgings, &c. Low prices for good workmanship. Estimates free.—W. R. SMELT.

Models of Machinery and Inventions to scale or sketch. Best work and finish. Estimates free.—W. R. SMELT.

3½in. back-geared **Foot Lathe,** compound slide-rest, hand-rest, chucks, &c., splendid tool, £8. Photo., 2 stamps.—W. R. SMELT.

Enlarged, Revised Price List, 1 stamp.—W. R. SMELT, Engineer and Tool Maker, 7, Goldsmith's-row, Gough-square, E.C.

Gramme Dynamos, laminated armatures, compound, wound, 10-light, £10. To be seen working.—H. JONES.

Price List of Dynamos in the rough and finished, speed wire required; notes, volts, amps, one stamp.—H. JONES.

Jones's patent laminated low-speed **Armatures.** Ordered Machines to be seen working.—H. JONES, 45, High-street, Lambeth, S.E.

Fretwork.—New Catalogue of Wood, Machines, Saws, and Designs, nearly 300 illustrations, post free, 4d.

Fretwork.—Complete Outfit, 12in. frame, 48 Saws, Awl, File, 4 designs, and sufficient Fretwood, 3s. 6d., free.

Fretwork.—12ft. planed Fretwood, 3s. 6d. Fretwood 3d. square foot.—J. H. SKINNER and CO., East Dereham, Norfolk.

Incandescent Carbon Lamps, low resistance, 3s. each. Fairy Lamps, 3s. 6d. Platinum Lamps, 1s. 3d., post free.—TODD, 14, Wentworth-road, Manor Park, Essex.

"**The Dynamo.**"—S. Bottone's new book is again in print. Copies sent post free, 2s. 6d.

S. Bottone has on sale the following articles for amateurs:—

Am-meters, from 5s.: Voltmeters, 5s.: 1 Ohm Coils, 2s. 6d.; Galvanometers, plain, 2s. 6d.: Astatic, 5s.; Tangent, 10s.

Dynamos, 10, 20, 30 candle-power, £1 10s., £2 10s., £3 10s.; castings for ditto, 5s., 5s. 6d., 6s. per set.

Wheatstone Bridges from 5s. Resistance Boxes, with 9 plugs, £2. List 1½d.—S. BOTTONE, Stanley-road, Carshalton.

French Polishing, Staining, Painting, and Varnishing. 122 recipes or trade secrets, with full instructions and details, post free, 1s.—TOMLIN, Highfield-terrace, Barnsley, Yorkshire.

Bench **Drilling Machine Castings,** complete, 3s. 6d.—TOMLIN, Highfield-terrace, Barnsley, Yorkshire.

Half horse-power Horizontal **Engine Castings** (complete), brasswork and forgings, 12s. 6d.—TOMLIN, Highfield-terrace, Barnsley, Yorkshire.

Model **Engine Castings,** all brass, complete, 2s. 6d. set.—TOMLIN, Highfield-terrace, Barnsley, Yorkshire.

Designs, Price List of perfected Engines and Castings, 1 stamp.—TOMLIN, Engineer, Highfield-terrace, Barnsley, Yorkshire.

"**Tradesman's Ready Calculator,**" containing upwards of 4,350 calculations, post free, 1s.—I. TOMLIN, 28, Highfield-terrace, Barnsley, Yorkshire.

Electric Bells.—A good reliable Bell, 2½in., 2s. 9d.: 3in., 3s. 6d. Send stamp for description.—PHILPOT, 235, Thomas-street, Camberwell.

Batteries, Leclanche, large size, 2s. Pushes, 9d. Best Wire, 9d. per dozen yards.—Address above.

Water Motors. — 32s., 42s.; horse-power; £9: Half, £6; Quarter, £4; Eighth, £3.—THOMAS WHEELER, Pinner.

Fan Castings.—Improved Registered Designs; sets 3in., 3s.; 6in., 4s.; 8in., 5s. Drawings, 4d.—WHEELER, Engineer.

Lathe Heads Castings, 4½ centre, back-gear, weight 24lb., only 5s. pair.—WM. WITHAM, 40, Parker-cres. Barnsley.

Electric Bells, 3in. gongs, platinum contacts, in polished mahogany cases, 6s. each.—G. MILBOURNE.

Bell, as above, powerful battery, and 50ft. of insulated Wire, 9s.—G MILBOURNE, Twyford, Berks.

Rubber Stamps—Highest workmanship at moderate prices. Latest novelties, designs, &c., free.—A. H. PASHLEY, 150, London-road, Sheffield.

Tricycle, made for cripple to work with hands; also Steam Boiler, 2-horse.—CLEGG, Heywood.

Microscope, by Newton, London, ¼, 1, and 3in. objectives, cost £25, for half-price. Seen by appointment.—W. D. 25, Tyneham-road, Lavender-hill, S.W.

Launch Engines for sale, double and single, various sizes.—JOHN MIDDLETON, 16, Hope-street, Glasgow.

Lathe, back-geared, 4in. centres, strong and good, £5 10s.—JOHN MIDDLETON, 16, Hope-street, Glasgow.

Lathe, 7in. screw-cutting, 6ft. bed, treadle, &c., for sale.—JOHN MIDDLETON, 16, Hope-street, Glasgow.

Slide-Rests, 4½in., 5in., and 6in. 2½in. centres for sale.—JOHN MIDDLETON, 16, Hope-street, Glasgow.

Electromotors, with Siemens armatures, from 5s. Castings from 1s. 6d.

Models of Gramme, Siemens. Edison, Brush Dynamos from 10s. 6d. Castings—Gramme, Siemens, 1s. 6d. Edison Brush, 2s. 3d.

Galvanometer Cards. 4in. enamelled, divided in degrees, 6d. Parallax mirror for same, 6d.

Scales and Mirrors for reflecting galvanometers 1s. each. List of parts of galvanometers, &c., 1 stamp.

Every description of **Testing Apparatus** for science teachers and students.—G. BOWRON, 97, Crawford-street, London, W.

Achromatic Astro **Telescope,** 4in. object-glass, brass tube dew-cap, finder, rack, polished box, three eyepieces, no stand, price £14.—T. K. MELLOR, Huddersfield.

Nickel silver **Pen and Pencil,** stamp any name, post free, 2s.—WILLIAM SHEPARD, 45, Oxford-street, Derby.

Crucible **Cast Steel,** 7-16 to 15-16 dia., short bars, 15s. per cwt.—GILBERT, Oxford-road, Sheffield.

Howard's Universal Hair Restorer prevents the hair combing out, and restores it to its natural colour.

Howard's Hair Restorer removes scurf; does not stain the skin; post free, 2s.—HOWARD, Prestwich, Manchester.

"**English Mechanic,**" 25 volumes, 1873 to also a quantity of the "Engineer," 1860 to 1867.—MONA, ton-square, New North-road.

Cheap Batteries, two equal to three Leclanché 1s. 6d. each.—COLUMBINE, 2, Carlisle-street, Soho, W.

which may very well be of hard wood, the object being to provide the cheapest possible contrivance for planing small [illegible] needed in model making. F[illegible] shows a profile of the slide with [illegible] the back, which goes in the slot of the [illegible] Fig. [illegible] In Figs. 9 and 10 are two views, the [illegible] in section, of a very simple way of making a substitute for the [illegible] planer, by which the tool is [illegible] to lift a little during the return stroke. It is planned to do away with [illegible] the ordinary rest with W[illegible] or similar holder. A plate of iron [illegible] like Fig. [illegible] substituted for the usual [illegible]. This carries a pair of pointed steel screws, the ends of which enter conical recesses drilled in the sides of the tool itself, which [illegible] slightly bent up, as seen [illegible] very slight lift will suffice [illegible] fit the slot sidewise. F[illegible] this apparatus is intended [illegible] be held with sufficient [illegible] and the [illegible] on the pillar screwed down [illegible] will also sufficiently secure the [illegible]. This part can easily be [illegible] designed [illegible] a more perfect method [illegible] will be convenient in most cases [illegible] the central pillar. T[illegible] work without being [illegible] but not nearly so well, and [illegible] to fracture. For the feed [illegible] must take place after each stroke [illegible] action is, of course, the best and [illegible] applicable; but a very even feed is obtainable by attaching to the sliderest-screw [illegible] wheel and spring—the latter arranged [illegible] over each cog with a perfectly audible [illegible] such click after each stroke will indicate a fine feed, and two or more [illegible] one. The right hand will be occupied with the feed, while the lever is worked with the left. The above is, I think, the most inexpensive design that can be made, and, for the purpose intended, will be found effective. It is also much simpler than one that is actuated by crank or gears, and there is absolutely nothing to get out of order.

O. J. L.

ARE THE SALTS OF COPPER POISONOUS?

MOST persons, remembering what they have heard about the necessity for cleansing copper cooking-utensils, and of the danger of eating unnaturally green pickles, will be inclined to answer the above question in the affirmative; but those acquainted with the literature of toxicology are aware that much doubt exists on the point. It may be taken for granted that, even if copper salts are harmless, most people would prefer preserving green peas without the addition, for there is always the risk that the "canner" may put in too much, and "harmless" or "poisonous" are terms which depend for their true meaning to a large extent on "quantity." In most if not all the textbooks of chemistry the cupric salts (cuprous salts are mostly insoluble in water) are stated to be poisonous in the animal system, producing violent and irrepressible vomiting and purging. With albumen they form, however, an insoluble compound, nearly inert, for which reason white of eggs is an appropriate antidote when copper poisoning is suspected, or if albumen cannot be obtained, it is usual to administer milk or sugar mixed with iron filings, in order to reduce the cupric to cuprous salts or to the metallic state, when the copper becomes inert and harmless. A few years ago Mr. C. H. Piesse, the public analyst for the Strand district, was called upon to analyse some samples of canned green peas, and he certified that they were adulterated with some compound of copper, probably an albumen compound, which, in his opinion, would be likely to prove injurious to health. The Strand Board of Works accordingly summoned the vendors, and the Court decided in favour of the plaintiffs, the opinions expressed by Mr. Piesse being supported by several eminent medical men, but opposed by no less an authority than Dr. Pavy. *Since then the sale of preserved food tinted* green with copper salts has been practically [illegible] throughout the entire kingdom, and [illegible] the copper was added only for [illegible] it is obvious that no one [illegible] by the suppression. The scientific [illegible] has, however, again been raised by Mr. Piesse himself, who calls attention in [illegible] the recently published investigations [illegible] M. [illegible], professor of toxicology in the University of Ghent. The latter has administered [illegible] of copper to rabbits and [illegible] grains, without producing [illegible] symptom of serious injury—all the animals bearing perfectly well the ingestion of the copper salts. M. D[illegible] then [illegible]—the verdigris of the copper [illegible]—and at first the animals [illegible] acquired a complete [illegible], which was administered in daily doses for periods varying [illegible]. Similar results were [illegible] the oxide, and the [illegible] administered in doses of [illegible] grains—indeed the [illegible] was borne with the [illegible]. Salts of copper have, in fact, been employed for therapeutical purposes by many [illegible]—at all events—[illegible] even when the daily dose [illegible] grains, and the late Dr. [illegible] immunity from cholera [illegible] in copper and brass, was [illegible] the therapeutical value of [illegible] its salts. It so happened that [illegible] was suffering from [illegible], which disappeared under the action of the copper salt, and rightly enough [illegible] attributed to the copper; for success in [illegible] suffering from impetigo [illegible] has been attained by the [illegible]. M. [illegible] has since extended [illegible] treatment to all forms of scrofulous [illegible], administering to [illegible] grain of the sulphate [illegible] succeeded in cases [illegible] the copper salt until [illegible] at longer intervals. In this way a young child has taken about forty grains of the sulphate without the least inconvenience.

As Mr. Piesse observes, the accuracy of the [illegible] that copper compounds are poisonous has been severely shaken by M. D[illegible]'s experiments, and the question demands further investigation; for although copper salts may not be poisonous in the generally accepted meaning of the word, the predisposition for poisoning by them is far more common than would appear to be the case from M. [illegible]'s investigations. It must not be forgotten [illegible] that several authorities have always held that preserves in general, vegetables, &c., prepared by a salt of copper are not dangerous. Dr. [illegible] says not in the least; and it is to be supposed that cases of "poisoning by copper" may have been due to [illegible] and unsuspected causes. Therefore it would be advantageous to learn what is the whole truth in connection with the "poisonous" copper salts.

ELECTRICAL INSTRUMENT-MAKING FOR AMATEURS.*—VII.

By S. R. B[illegible]NE.

§ 17. BERTSCH'S MACHINE.—Though this is not the best form of continuous-action electrophorus, yet as its construction is extremely simple, and leads to a thorough comprehension of the principles on which the more efficient forms are dependent, it will be advisable for the student to make it. The Bertsch machine may be made with the rotating plate either of glass or ebonite. Both forms will be described, beginning with the glass plate form, as the mode of mounting a glass plate on a spindle is generally regarded as a "poser" by amateurs.

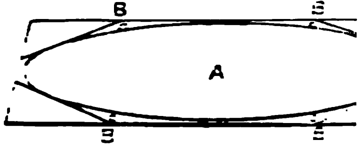
§ 18. *M[illegible] Plate.*—There are two methods open to the amateur—viz., by drilling a hole through the glass of sufficient size to take the spindle, and screwing or cementing two cheeks against the glass plate; or by cementing two cheeks, one on either side of the glass plate, exactly central and opposite one another. These cheeks having the spindle (of w[illegible] are two halves) inserted at their cent[illegible]

§ 19. To drill a glass plate requ[illegible] patience than skill, though both ar[illegible] In the first place, the glass must be [illegible] exact circle, and its centre marked.

To do this the amateur should proc[illegible] piece of brown paper, and with the [illegible] strike out a circle of the size of wh[illegible] tends his glass plate to be. (A very c[illegible] size for most electrical machines is 1[illegible] meter.)

Keeping this marked paper as a [illegible] our student cuts out a similar circle [illegible] stout millboard. He then places [illegible] plate upon a *perfectly flat* table, wit[illegible] board disc over it. A small dab of [illegible] cement applied to the glass, wil[illegible] millboard to the glass so that it [illegible] move during the cutting of the ci[illegible] operator now traces with a diamond [illegible] cutter a circle all round the millb[illegible] being careful not to press so heavily [illegible] the glass, or so lightly as not t[illegible] practised ear, the peculiar *whist*[illegible] the glass is being cut, and when only [illegible] The circle being thus traced on the [illegible] the diamond, the millboard guide i[illegible] and the corners of the glass cu[illegible] permit the curved pieces being pull[illegible] The four diagonal cuts must, of co[illegible] quite close to the periphery of the ci[illegible] the glass. A cursory examination

FIG 7



will render this clear. A represents [illegible] first traced on the glass: B the four [illegible] cuts, which enable the quadrantal se[illegible] to be detached. To insure the glass [illegible] where it is cut and nowhere else, a [illegible] is necessary. Firstly, the operator [illegible] that the glass is really cut, and not scratched. To know this, when he has [illegible] his line or curve with the diamond [illegible] he must turn the glass over and exam[illegible] line on the other side. If it looks like [illegible] white line, not penetrating [illegible] it is but a scratch. If, on the contrary, [illegible] as a glistening crack right through, it [illegible] cut. By gently tapping with the [illegible] wrong side of the glass a [illegible] quently be converted into a [illegible] sary to raise the glass from [illegible] the extremity while tapping, and [illegible] on the spot only where it is [illegible] to decide the fracture. When the line [illegible] a glistening fracture in its entire length, by holding the glass plate between [illegible] and thumb of the left hand, with the [illegible] uppermost, and the cut close to the [illegible] operator will find no difficulty in [illegible] diagonals and afterwards the [illegible] ments, by a steady downward pressure [illegible] right hand, applied to the other side [illegible] line. Should any pieces refuse [illegible] truly, they may be "nibbled" off [illegible] the wards of a key, or the slots in [illegible] cutter. When the circle has been [illegible] faction, the edges should be smoothed [illegible] ing; but as this is best done when [illegible] mounted on its spindle, the directions [illegible] mode of grinding are deferred until [illegible] of mounting has been described. The [illegible] disc must now be placed on drilling-table [illegible] structed specially for this purpose [illegible] as shown in Fig. 8, in a flat board [illegible] thick, [illegible] long, and [illegible] From each extremity of this board [illegible] standard [illegible] about 3in. wide [illegible] or 12in. high. There are [illegible] joining these upright standards [illegible] one at the top, and one within [illegible] bottom. These cross pieces have [illegible] hole perforated through the [illegible] over the diameter of the desired [illegible] glass (generally ½in. in diameter). Through these holes passes a copper tube, [illegible] meter and 14in. long. Around the [illegible] tremity of this copper tube is a [illegible] flange of lead, [illegible] weighing, say, at [illegible]

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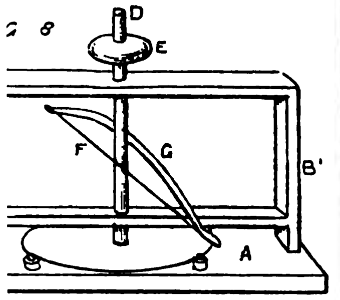
; this tool, the lower extremity of st be "upset"—*id. est*, made irre- broadened a little by hammering This must be done to prevent the split. To work this drill, the glass ed in its place by means of three rews with its marked centre just entre of the copper tube, a small ordinary emery is poured into the ibe, to which are added a few drops rpentine as a lubricator. A gut- ow passed once around the tube, and each end to a tolerably stiff bow, *g*. bow backwards and forwards com- reciprocating rotary motion to the is, aided by plenty of patience and y and turpentine, will cut a clean in the glass. This having been next step is to cement the spindle

The spindle may be from ¼in. to eter, and should be furnished with eeks or washers (consisting of cut in half), which fit them pretty ie of the cheeks should be glued to (nearly at its centre) with Kay's similar acetic glue.* When quite



firm, the surface of the cheek painted over with "bicycle tire d the glass plate immediately the spindle into its place. The should now be treated in the same at is to say, treated with "bicycle ts face, and the portion of the spindle ss plate thickly brushed over with

The upper cheek must now be to the spindle and pressed tightly he glass, the whole being left un- or some hours until quite set and will illustrate the appearance of

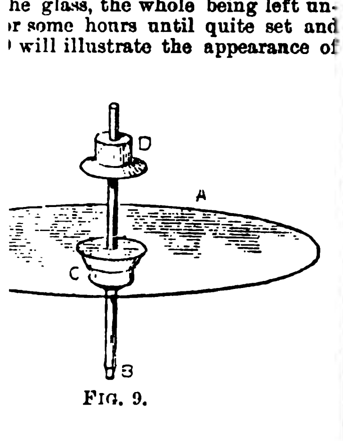


FIG. 9.

ien the spindle and lower cheek fixed. A is the glass plate, *b* the ie lower cheek, cemented, D the , ready to be pressed down. The he spindle and the nature of its will depend on the use to which l hereafter be put. In the present glass plate being 18in. diameter, should be (a steel rod) at least id should have a shoulder turned i end to the length of about 1in.

spindle and glass-plate are emented together, a small wooden 1½in. diameter, similar to those er blinds, must be cemented close nity of the spindle, just before the his serves to take the band or gut, which motion is communicated to .

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[*] cement is made by soaking good glue in quite soft, pouring away the water and glacial acetic acid to cover the glue. A render the whole liquid, when it should be ttle kept corked for use.

FIG 1

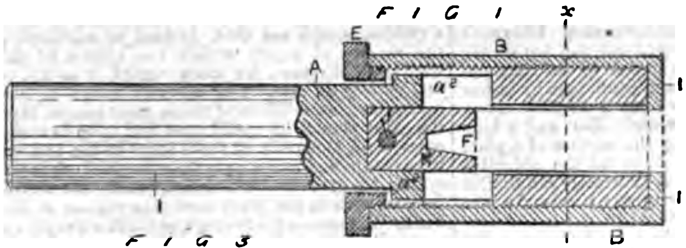


FIG 2

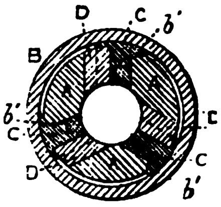


FIG 3

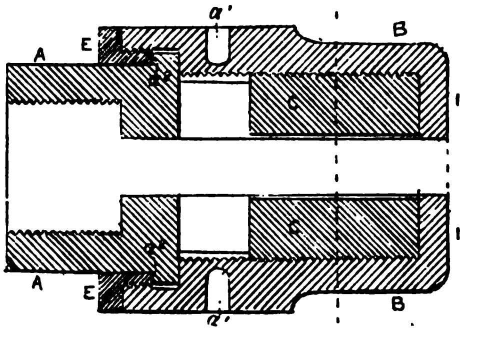
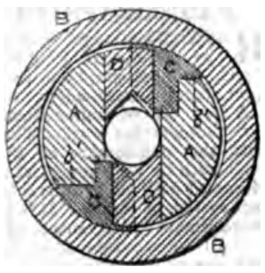


FIG. 4.



THE GRAHAM DRILL AND LATHE CHUCK.

THE chuck shown in the figures has been patented by the Graham Manufacturing Company, of Galt, Ontario, Canada, and is intended for use in the lathe or drilling machine to hold either the drill or the work. Fig. 1 is a longitudinal section view of the chuck in combination with a bar provided with a mortise. Fig. 2 is a cross sectional view of same on the line, *x*, *x*, of Fig. 1. Fig. 3 is a longitudinal sectional view of the improved chuck when constructed without a bar provided with a mortise. Fig. 4 is a cross sectional view of same on the line, *z*, *z*, of Fig. 3. A, is the body of the chuck ; B, the parallel sleeve provided with a screw thread extending throughout the whole of its inner face ; C, C, the slides provided with a screw thread on their outer faces ; and, D, D, the jaws. The body, A, of the chuck may be secured to a lathe spindle in any suitable manner, but it is preferably secured thereto by a screw thread meshing with another screw thread direct on the lathe spindle as shown in Fig. 3, while in Fig. 1 the body of the chuck is left blank at one end, so as to permit of it being turned to fit the hole of drill or lathe spindle. The parallel sleeve, B, is provided at the front end with an inward flange, I, which covers the front end of the slides, C, and jaws, D, for the purpose of preventing the jaws, D, from moving parallel with the slide, C. As shown in Fig. 3, this parallel sleeve, B, is provided with sockets, a^1, in which a lever is inserted to revolve, B, which gives a motion back and forth lengthwise of the chuck to the slides, C, C, and these slides, C, C, moving back and forth cause the jaws, D, to move to and from the centre of chuck according to the direction in which the parallel sleeve, B, is revolved. E, is a nut engaging with a shoulder, a^2, on the body, A, of the chuck and screw-threaded into the sleeve, B, to retain sleeve, B, in proper position on the chuck. K, is a short bar of metal in which a mortise, F, is formed. This bar of metal is fitted, driven in, and secured in the inner end of the chuck by a pin, J, passing through the body of the chuck, as well as through the bar, K, which, provided with a mortise, F, for the purpose of holding drills fitted to the same, which holds the drills when at work, and takes the strain of the drill or other boring tool off the jaws, D, D, which are only for the purpose of centering the drill and holding it in position, or the mortise, F, may be formed in the body, A, of the chuck across the socket of the chuck at the inner end ; but the mortise, F, is very much more readily and easily formed by first cutting it in a short bar of metal, K, and securing it at the inner end of the chuck socket. The mortised bar, K, is not always required in chucks of small sizes or when used for light work, as the jaws, D, D, are sufficient to hold the tool or other article to be turned. The jaws, D, D, and slides, C, C, are made with one or more flanges on their adjacent sides; between these flanges are grooves, the flanges of one being made to fit in the grooves of the other. These flanges are formed on the adjacent sides of the jaw, D, and slide, C, at any required angle, according to the pressure necessary to firmly hold the jaw to its work. The slide, C, is constructed with a flange, b^1, on the upper edge, in order to give an increased area of wearing surface to the screw thread formed thereon, which engages with the screw thread on the inner face of the sleeve, B.

Heretofore the jaws of chucks have been made with one incline on their outer face, which requires the jaw to be much wider at one end than at the other, whereas in this device one or more inclined flanges are arranged on one side of each jaw, which gives the same size in cross section throughout the length, thereby enabling a chuck to be made of much smaller diameter, which is of great importance, and an advantage to drill chucks when working in confined positions.

THE MICROSCOPE IN THE WORKSHOP.

PROF. ROGERS, in a paper read before the Boston meeting of Mechanical Engineers, referred to the use of the microscope in the workshop. In the ordinary operations of the workshop, he said, the lathe and the planer are the primary tools, while the caliper, with the graduated scale, is the secondary tool. Let us take the most simple case. It is required to turn down a piece of metal to a given diameter. In order to make the assumed case as simple as possible, we will assume the required diameter to be an even inch. The caliper is set for this unit of length, either from a graduated scale or, more accurately, from an end-measure inch with parallel faces. The setting in the latter case is done by the sense of feeling. We thus introduce an additional element of complexity, since sight is at once the primary sense and the ultimate test of a given limit of extension upon which the workman must rely. When the market is supplied with graduated scales from which any required length may be taken by the sense of feeling, it will be in order to defend the practice of relying upon this sense as a final test in measurements of extension. As a differential test, it is both useful and accurate. As an absolute test, it had better be abandoned. It is a makeshift at best. Assuming that the caliper has been set to an exact inch, the workman turns the piece of metal to the required size by a series of approximations, with the ever-present risk of going beyond the required limit. During the final part of the operation he stops the lathe to test the diameter with his caliper. He then takes another chip, stops, tries, starts, stops, tries, until the subtle and ever-varying sense of feeling satisfies him that he has obtained the correct diameter. But, after all, the uncertainty in the setting of the caliper remains, and this uncertainty is generally greater than that which would be found to exist in the comparative trials of the diameter. If, now, we increase the required unit, and especially if fractional increments are added, the problem of transferring a required length from a scale to a caliper becomes a most serious one. Only one other objection remains to be overcome. It is the common impression that the delicate adjustments of the microscope which are continually demanded

—especially the adjustment for focus—can only be made by the most delicate and sensitive means. No impression could be more erroneous. Give me a small lead hammer and I will set the top of my comparator to a given line in half of the time and with greater precision than it can be set by means of a screw movement. Give me a vertical movement by means of an eccentric disc and a long lever-arm, and I will bring the surface of a plate weighing 100lb. into the focus of the objective quite as quickly and quite as accurately as a similar adjustment could be made in the hands of a professional microscopist.

PHOTOGRAPHING THE STARS.

REFERRING to the splendid work recently done by the Messrs. Paul and Prosper Henry, of Paris, in photographing portions of the starry heavens, a "correspondent" of the *Times* writes:—

A new era of stellar astronomy will open with this photographic work. The problems connected with the architecture of the heavens, hitherto dealt with by very imperfect methods, will now be discussed with all the advantage of at least a perfect system of survey. It is impossible, indeed, to overestimate the advantage of a system of charting over all the methods of statistical research which astronomers formerly employed. William Herschel in his first method counted all the stars which one and the same telescope—a very powerful one, 18in. in diameter—would show in different directions. He could only take a field of view here and a field of view there, not many hundreds in all, his son and worthy successor in the work making similar observations in the southern hemisphere. No peculiarities of arrangement, nothing, in fact, but the roughest features of stellar distribution, could be recognised by such a method as this. It showed, however, how vast the number of stars forming our Galaxy is, and it satisfied Sir W. Herschel that the assumption by which he had proposed to interpret his numerical gauges was inadmissible, the stars not being strewn throughout our galaxy with any approach to uniformity. Herschel's second method, commonly confounded with his first (insomuch that one may often find even men like Arago and Humboldt mixing up in the same paragraphs the results of both methods of observation), was entirely different. He now no longer trusted to the use of the same telescope, turned in different directions, to tell him (after mere counting) the depth of our galaxy of stars in those directions; he turned different telescopes, gradually increasing the space-penetrating power, in the same direction, to tell him, by the power required to resolve the whole field of view into stars, the probable extension of the system in that direction. Herschel made many observations on this method, but in his advanced old age, when these observations had been gathered together, he did not recognise the absurdity of the result to which they tended, on the assumption he had employed. He found regions of the star sphere, for instance, wherein stars of all orders were richly strewn, from those visible to the naked eye down to the faintest which his most powerful telescopes could show, and fainter orbs yet, whose lustre could only be recognised as milky nebulosity (resulting from the combination of the light of many stars separately undiscernible). Around these rich regions were regions comparatively poverty stricken, regions deserving the description applied by the younger Herschel to the spaces around the Magellanic clouds, of which he wrote that "the access to the nubeculæ is on all sides through a desert." If his assumption had been correct, these seeming clouds of many varied orders of stars, brought into view successively with increase of telescopic power, would be long cylindrical star-clusters, or rather spike-shaped projections of star-strewn space, hundreds of times longer than their thwart breadth, and chancing by some strange accident to have their axes directed exactly towards our place in the star system. Unlikely, one may almost say incredible, in a single case, this peculiarity would be utterly impossible in several; and the clouds so to be interpreted (if Herschel's assumption were retained) are many. Obviously we must reject this porcupine theory of the stellar system, with the solar system for the "pole" of all the stellar spines. We see that the rich cloud-like regions are real clouds of stars of many varied orders, and that in each case where Herschel had assumed (though only tentatively) that he was penetrating further and further into space, he was in reality only analysing more and more scrutinisingly a complex cloud of stars. His position might be compared to that of an observer trying to gauge our solar system from a distance, who might naturally assume at first that the giant planets were much further away than the sun, the terrestrial planets much further away than the giant planets, the asteroids than the terrestrial planets, the meteorites than the asteroids, the small meteors than the meteorites, and the still smaller particles in comets' tails than meteors; such an observer, as soon as he recognised the association of all these objects into a system, would see that, instead of attributing the variety of aspect within the system to the variety of distance, he must regard it as due to real variety of size. The meteors which he had interpreted as millions of times more remote than the giant planets he would now find to be in many cases close alongside of those large bodies and, on the average, no further away than the chief orb in the system, the great controlling sun. In like manner the faintest stars in the great clustering regions of the Milky Way are, on the average, no further away than the leading orbs in the same star-clouds (which, be it noticed in passing, is by no means the same as saying that the fainter stars of the stellar depths are, on the average, no further away than the more conspicuous). The assumptions made by the elder Herschel, though shown as his work proceeded to be mistaken, did not prevent his accumulated results from being most valuable. But the validity of statistical methods was shown to be doubtful. The assumptions of Wilhelm Struve were still more improbable antecedently, and still more thoroughly discredited by the evidence. He took a zone of the heavens 30° wide, assumed that the stars (down to the eighth magnitude) might be supposed to be first compressed along the mid-line of that zone, and then strewn out uniformly in 24 sectors, into which he divided the circular area inclosed by that mid-line. This naturally led to a result having no validity whatsoever.

The fault of all such statistical methods is that in effect they depend on a process of averaging, by which, even if the initial assumptions were trustworthy, the significance of all the actual peculiarities of stellar architecture would be concealed. We want to have these peculiarities emphasised rather than hidden. Charting alone can do this effectually. But who can pretend to chart the whole heavens to any great depth around our solar system? Struve used in his statistical inquiries about 70,000 stars, and Mr. Proctor has shown in a single equal-surface chart 324,000; but what are they among tens of millions of stars within the range of Herschel's gauging telescopes? That single chart required first seven years of observatory labour by Argelander and his assistants, then 400 hours of charting by Mr. Proctor; yet it shows only stars down to between the ninth and tenth magnitudes, and even in regard to these is affected by all the variations arising from the "personality" of the different observers. The proposed photographic survey would extend very much further into surrounding space, would be far more trustworthy, and would be entirely independent of "personal equation." The idea is a magnificent one, and it may be hoped that the astronomers of all nations will help in carrying it out.

COCA AND COCAINE.

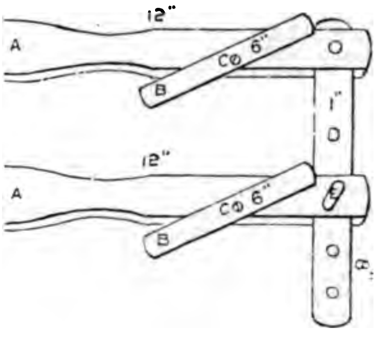
M. BIGNON, Professor in the Lima (Peru) School of Pharmacy, in *Les Nouveaux Remedes*, says:—In fresh or recently-dried coca leaves that have undergone no fermentation there exists only one inodorous, crystallisable alkaloid, cocaine. Coca leaves, exhausted of cocaine, when submitted to the action of alkalies at 100° C. (212° F.) yield upon distillation a new volatile base, having a strong odour, hygrine. Hydrochloric acid acts slowly upon cocaine, decomposing it partially. Solutions that are not neutral undergo a commencement of decomposition. There are few alkaloids so sensitive as cocaine to physical and chemical action. Coca leaves dried in damp weather, or pressed into sacks before completely dried, undergo a fermentation that destroys the cocaine. The fresh leaves, or leaves freshly dried in the open air in fine weather, with frequent turning and sheltered from moisture and dew, yield easily 8 grams per kilogram, and the fine sorts can give 10 grams and upwards in exceptional cases and on the spot where they are grown. The anæsthetic properties of the alkaloid are attenuated in the salts, the best therapeutic results are always those that are obtained with the pure alkaloid. Prof. Bignon adds: Contrary to generally accepted opinions, I believe that the irritation produced by the alkaloid is due to the cocaine, and not to hygrine. . . . I believe, also, that the dilatation of the pupil is the property inherent in cocaine and attenuated in its salts. I believe that solutions which do not produce this dilatation have undergone a commencement of decomposition, and contain a derivative body, unfortunately easily produced, which is very soluble in water and uncrystallisable. As to the composition of this body, I confess I am ignorant, although it seems to resemble a glucoside. A Peruvian Indian chews about three hundred to five hundred grams of coca in a week, the coca containing five to six grams of cocaine per kilogram. He therefore absorbs two to three grams of cocaine per week, the daily dose being from thirty to forty centigrams. Taking into account the tolerance acquired through a habit taken up in early childhood, a dose of ten centigrams per day should be considered a good average for internal administration. Coca contains the cocaine in the state of an inert salt, which is without special therapeutic properties. The employment of coca by the Indians . . . . has been badly observed. . . . The Indian never chews coca alone; he mixes it with lime and ash—that is to say, with strong bases that isolate the cocaine. It is in this the anæsthetic properties and the numbling effect upon mucous membrance of the stomach that he seeks are found. None of the special properties attributed to the leaves really exist; the leaves are neither nutritive nor tonic, and they possess no other properties than those attributed generally to aromatic resinous plants. For general external use (burns, catheterism), and even for eye maladies, cocainated petrolatum seems to me preferable. For internal use and spray I would employ five per cent. alcoholic solutions of the alkaloid.

LONGEVITY.

IT has been said, with some degree of reason, that the maximum age attainable by man has risen somewhat during the present century over that recorded in former ages. In judging of such a statement some allowance for error must be made. The exact statistical calculations of our day should not, in fairness, be marshalled against the round numbers of less accurate traditions. The fact remains, nevertheless, that the limit of 70 years is now very frequently passed. Fourscore may even be reached by some without excessive labour and sorrow, and we have among us nonagenarians who carry on with still respectable proficiency the activities of their prime. Such effective longevity is a bright spot in the history of our advancing civilisation. Its comparative frequency, and its association with different physical types, suggests a certain generality in its origin, and encourages the hope that it may be, in some measure at least, dependent on personal conduct. It has been stated that no such condition can influence the length of life after middle age. After that period inherited vital force is the only potential factor. To some extent this may be granted. If we fix an average of conduct, and suppose that a number of persons conform to it, we should certainly find the purest and most powerful constitutional types outlive the others. For instance, a gouty tendency does not enhance the prospects of old age. A rheumatic one is little better in this respect. The scrofulous are heavily weighted in the race of life by the chances of several infirmities. Nervous persons, again, are wiry, and may live through much trouble in virtue of their elastic tenacity. Then there are nondescript diatheses, which, except in their remote history, present no definite physical bias. Theoretically, these are most likely to furnish, under ordinary usages, the old man of a given time. It will be at once evident, however, that these are general statements, and that an unlikely individual will often exceed his own expectation of life, and by care, or from the suitability of his circumstances, will reach old age. In weighing the value of constitutional tendencies, moreover, another nearly related quality should be considered. This is disposition. The mind of a man must be more or less of the nature of his body, and accordingly we expect to find, and we find, that mental habit reflects in preferences, variations, rate of action, and the like, the type of processes in the lower tissues. So far, disposition is merely a part of constitution, and cheerfulness, hope, apathy, or gloom are only expressions of physical change. That all such qualities react upon the body in such a way as to influence its vitality is undoubted. On the other hand, they may certainly be overruled by the action of the will, so as to be no longer mere bodily impulses, but trained servants of a governing intellect. They may thus acquire a compensatory value in correcting faults of constitution, and strengthen in proportion the tenure of life. This brings us to the sphere of intelligent effort. There can be no doubt, in our opinion, that there is much room for exercise of private judgment and energy in seeking the prolongation of one's own life. If there is any known diathetic fault, this implies a law of well-being which will repay in a gain of vitality the man who recognises it and guides himself accordingly. The doctrine of the survival of the fittest does not work itself out by blind chance, or without evident design, even among the lowest forms of life. Much less is it to be believed that man is unable so to adjust his circumstances to his needs as to continue to live after a certain mean period. The weaker will sometimes prove himself the more tenacious of life by observing rational methods of living, of which the more robust is careless. Moderation has probably more to do with success in this respect than anything else. To eat sufficiently, and drink stimulants sparingly, to alternate work with adequate rest, and to meet [illegible] heartily, will afford to every one the best chance of arriving at a ripe old age.—*Lancet.*

LDER FOR PHOTOGRAPHIC PLATES.*

ND a sketch of a small contrivance for ding plates whilst being cleaned. It grips e well, and, when required, releases it im- ly ; and it can be constructed so easily. It



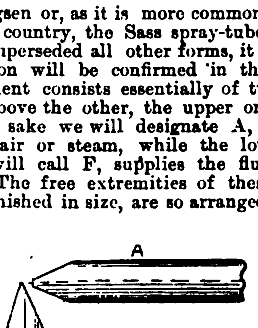
of birch, and the cross-piece of mahogany, strips which hold the plate ; the little peg nade of box. In cleaning the plates, I find vantage to use a strong solution of washing l hot water, and, after soaking some time, to plates well over with a pad of curled horse ch as is used in stuffing chairs, &c. This way the collodion film very easily, and is it for the gelatine films. A good rubbing uted nitric acid completes the operation, ves a chemically clean glass plate for collo-gelatine emulsion.

brass screw should be loose, to allow of to grip plate when the handles are pressed .

iption : A A, two handles ; B B, two strips l with rabbets to hold plate, fitted to with two brass screws, C C ; D, cross-th holes in it to shift handles ; E, piece to andles.

PRINCIPLES INVOLVED IN CONSTRUCTION OF SPRAY-ES.†

Bergsen or, as it is more commonly called this country, the Sass spray-tube, having lly superseded all other forms, it is to this ention will be confirmed in this paper. trument consists essentially of two tubes ne above the other, the upper one, which ity's sake we will designate A, carrying sed air or steam, while the lower one, ve will call F, supplies the fluid to be l. The free extremities of these tubes, liminished in size, are so arranged in rela-



ach other that the stream of air issuing passes at a right angle across the tip of F. on of the spray-tube depends upon the fact possesses a considerable degree of adhesive- different particles adhering to each other little tenacity. We are familar with this in viscid fluids, and to a less degree in ter, a drop of which can be drawn along a the finger ; but we are not apt to think of longing to the atmosphere or to gaseous Yet it is owing to the fact that the air or hich escapes from A clings to and drags the air at the extremity of F that a vacuum uced in F. Into this vacuum the fluid d in its turn is caught by the current from ispersed in the form of spray. The greater city of the air-jet escaping from A the will be the exhausting force exerted upon herefore the greater the efficiency of the . As the velocity of the stream of air is at its centre, where it is least retarded by friction, it follows that the axis of the opening of A should be exactly on a line with the extremity of F. The pressure being the same, the character of the spray will depend upon the relative size of the openings of A and F. Increasing the former permits more air to escape, and gives a larger volume of spray with a greater carrying force and more power of penetration. Increasing the latter results in a larger consumption of fluid, forming a coarser spray, and, if carried too far, results in dripping. A large opening for A with a small one for F gives a large body of very fine spray. A small opening for A with a large one for F gives a small body of coarse spray. A successful application of spray to the throat or to the posterior nares often requires that it be effected as it were by surprise, and before there is time for reflex action of the muscles. Hence it is necessary that spray should be formed the instant the air-valve is opened : for if the arrival of the liquid at the point of F is delayed appreciably after air begins to issue from A, reflex contradiction will have been excited by the contact of the air with the mucous surface before any spray is produced. Now, no fluid will reach the point of F until all the air in F is exhausted, and the amount of air and the length of time required for its exhaustion will be in proportion to the length and the calibre of the tube. Hence these should be reduced to a minimum in spray-tubes intended for making quick applications. And, as there is nothing lost in any case by this construction, it may as well be made the general rule for all tubes. With a properly constructed spray-tube, comparatively slight air pressure will suffice for all purposes. Increase of pressure will compensate in a measure for defective construction of tubes, but it brings with it its own inconveniences, such as mechanical irritation of the surface to which the spray is applied, waste of compressing power, &c.

USEFUL AND SCIENTIFIC NOTES.

◆

Carriage of Petroleum on Italian Railways.—The Italian Government have recently sanctioned the use of tank-cars on the railways for the carriage of petroleum in bulk, and it will now be possible to effect a considerable saving in time and freights, not only from the ports of Genoa, Venice, and Leghorn, but also to towns in Switzerland and Southern Germany.

Digestibility of Cheese.—The digestibility of cheese depends a good deal, according to Klenze, on its physical properties. All fat cheeses are dissolved or digested with great rapidity, because the molecules of casein are separated only by the fat, and so the solvent juice can attack a large surface of the cheese at one time. Whether the cheese be hard or soft does not appear to matter, and there is no connection between the digestibility and the percentage of water present in the cheese. The degree of ripeness and the amount of fat have, however, considerable influence, for both these conditions render the cheese more friable, and so allow of intimate contact of the juice. Cheddar took the shortest time to digest (four hours), whilst unripe Swiss cheese required ten hours for solution.

Carbonic Acid in the Air.—The amount of carbonic acid in the air has recently been measured by MM. Spring and Roland in a series of 266 determinations in the course of one year, the place being at Liége, in Belgium, having on one side a busy centre of the iron industry and on the other an agricultural district. The average obtained was 5·1258 parts by weight and 3·3526 parts by volume in 10,000 parts of air. This is considerably more than the air of Paris contains (4·83 and 3·168 respectively). Besides the plentiful carbonic acid from those ironworks, there is a large emission of the gas from the ground, which is rich in coal ; indeed, cases of local heating often occur, with withering of the plants. To the relative abundance of carbonic acid the authors attribute the greater heat of Liége as compared with the surrounding regions, as the gas strongly absorbs heat-rays and limits radiation by night. A return of cold in May is thought to be due to the unfolding leaves diminishing the amount of CO_2, so that the nightly radiation is increased. The amount of CO_2 is considerably increased by a fall of snow (to 3·761 ten-thousandth parts by volume), except when the earth is already covered with snow. Cloud also gave an increase (3·571). The winter months gave a greater amount than the summer. The difference between day and night was but slight, nor had temperature nor rainfall a decided effect; but the rain in thunderstorms increased the amount. As to wind there were three maxima—viz. with north, north-west, and south-south-west winds, corresponding, apparently, to the directions of industrial centres. The CO_2 diminished in high winds and increased with a high barometer. These researches are the subject of a recent memoir to the Belgian Academy.

SCIENTIFIC SOCIETIES.

◆

ROYAL ASTRONOMICAL SOCIETY.

THE January meeting of this Society was held on the 8th inst. at Burlington House, E. Dunkin, Esq., F.R.S., President, in the chair. J. E. Evans, Esq., Training College, Dinidigal, Madras ; George Ford, Esq., B.A., Christ's College, Cambridge ; Jacob Gerhard, Lohse, Esq., Scarborough ; William Irving Page, Esq., Wimbledon-common ; Captain George Charles Parker, H.M.'s Indian Marine, Kurrachee, India ; Julian Tripplin, Esq., Belle Vue, Heathfield-gardens, Chiswick, W. ; and Mons. E. J. Trouvelot, Observatoire de Mendon, Seine-et-Oise, France, were duly elected Fellows of the Society.

Capt. Noble asked to be officially informed whether Dr. Collett, of Leicester, was a Fellow of the Society. A person named "Collett," with the letters M.D., F.R.A.S., after his name, was advertised in a Sussex newspaper as giving a testimonial for an American patent medicine.

Mr. Knobel said that there was no Fellow of the Society of that name, and he inquired what Capt. Noble proposed to do.

Mr. Talmage said that some time ago a person who was not a Fellow of the Astronomical Society was advertised as about to deliver a lecture in the neighbourhood of Walthamstow, and the letters F.R.A.S. were appended to his name. He wrote to the lecturer and told him that he should attend the meeting and announce that he was a fraudulent individual. The lecturer replied that a mistake had occurred, for which he was extremely sorry ; it was not his fault, but the printer's. Mr. Talmage replied that he would accept the explanation on that occasion ; but he should watch for his advertisements, and if he saw the letters F.R.A.S. again appearing, he would follow him over England and denounce him wherever he appeared.

Captain Noble said he was not prepared to follow Dr. Collett over England ; but he thought it might be worth while for the Society to expend 5s. in inserting an advertisement in the county newspaper, in which the original advertisement had appeared, stating that there was no person of the name of "Collett" who had a right to use the letters F.R.A.S. He, therefore, moved that the secretary be instructed to take such steps as may be necessary to announce the fact that Mr. Collett, of Leicester, has no connection with the society.

The motion was seconded by Admiral Sir Erasmus Ommanney, and after some little discussion the motion was put to the meeting, and carried by a show of hands.

Dr. Copeland, Mr. Leeson Prince, Mr. Lister Kaye, Mr. Thomas Wm. Backhouse, Mr. Henry Pratt, Major Fellowes, Mr. W. S. Franks, and Mr. G. H. With were formally admitted Fellows of the Society, Mr. Ranyard acting as proxy on their behalf.

Mr. Ranyard said : I should like to say that I do not think it at all necessary that this form should be gone through before Fellows of the society can vote and exercise their rights as Fellows. These gentlemen signed a notice with regard to the election of the new council, and some doubt has been raised as to——

Mr. Knobel : I rise to order ; I do not think that Mr. Ranyard has any right to go into this question.

The President ruled that Mr. Ranyard was out of order in speaking on a subject that was not before the meeting.

Captain Noble said he did not see any reason why the question should be burked. It was a matter of considerable importance whether Fellows who had not gone through the empty form of being admitted by proxy could vote with respect to the management of the Society. He saw no necessity for such admissions.

Mr. Roberts read a paper entitled "Photographic Maps of the Stars." He said that in 1883, he had made experiments as to photographing stars with ordinary portrait lenses varying between ⅝in. and 5in. in diameter. The lenses were by various makers, English, French, and American. He had obtained the best results with a lens of 2in. aperture by Lerebour, a French optician. The cameras were mounted on the axis of his 20in. reflector, and the results obtained were compared together, and with plates exposed in the focus of his 20in. reflector. Admiral Mouchez proposed that exposures should be made of from one to three hours, but he ultimately determined to make exposures of only 15 minutes duration in the focus of his silver-on-glass reflector, which enabled a much greater number of pictures to be taken in the course of a night than with the longer exposures suggested by M. Mouchez. He had already taken some 200 plates which covered the region in the neighbourhood of the Pole, and reached to N. P. D. 69°. This would correspond to a map on twice the scale of Argelander's, and would include much smaller stars. His reflector was of 20in. aperture and 100in. focus. He showed on the black board a series of discs, proportional

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nos. Gulliver, in the *Photographic News.*

ndrew H. Smith, M.D., read before the Ame-yngological Association.

in diameter to their radiation discs of Polaris when exposed for 1s., 2s., 4s., 8s., 16s., and 32 seconds, 1m., 2m., 4m., 8m., 16m., and 32 minutes. With the latter exposure, the patch corresponding to Polaris is so large that it overlaps the companion. It follows from this that there is an advantage in not making the exposure too long, or the images of small stars in the neighbourhood of larger ones will be obliterated by their radiation discs of the larger stars.

Mr. Knobel: Perhaps it may be convenient to take another photographic paper before there is any discussion on Mr. Roberts's paper. We have received a letter from Messrs. Paul and Prosper Henry, of the Paris Observatory, inclosing some beautiful photographs. They write on January the 5th: "We have recognised by means of photography the existence of a new nebula in the Pleiades. The nebula is of a spiral form, and surrounds the star Maia. On one side it extends to a distance of two or three minutes of arc from the star, and though it has been possible to obtain three different photographs which show the image of the nebula, we have not up to the present time succeeded in seeing the nebula in our telescopes. The photographs which show the nebula were taken on the 16th of November, and on the 8th and 9th of December, with exposures of three hours. We also are permitted to send some photographs of Saturn which have been enlarged 44 times from the original negatives, and show the crape ring, as well as markings on the ball of the planet.

Mr. Ranyard said: I should like to express my very great admiration for these photographs by the Brothers Henry. The definition of the markings on the ball of the planet Saturn is something equisite, and far beyond anything which has been obtained by anybody else. The dark narrow band in the equatorial region, which, though not very conspicuous at the last opposition, was seen by several observers, is well shown, as well as the dark polar cap. The latter is almost better than it can be seen with the eye and a large telescope under favourable conditions. It will be noticed that although the delicate differences of brightness on the ball of the planet are so well shown other features that require sharp definition are not so striking, the great Cassini division in the rings is perhaps the most striking feature to the eye when the planet is observed in the telescope; but in the photographs it is only indicated by a dusky line, which is not so conspicuous as the dark equatorial belt upon the planet. The differences of brightness of the inner and outer ring are very strikingly shown, and appear more conspicuous than as seen with the eye. With regard to the beautiful photograph of the new little nebula in the Pleiades Mr. Wesley has been good enough to look up for me this evening one of the old photographs of the Pleiades taken by Mr. Rutherford, of New York, which is in the possession of the Society: but I have not been able to detect any trace of the nebula around the star Maia upon it. Mr. Rutherford's photograph was taken with the wet collodion process, and although small stars are shown, it does not by any means include all the small stars which are shown on the photograph of the Brothers Henry. No doubt the light of the nebula belongs to the violet actinic region of the spectrum, which does not make much impression on the retina.

Col. Tupman said: I should like to ask Mr. Roberts whether he has any means of controlling the pointing of his telescope during the exposures, and correcting the errors of driving of his clock.

Mr. Roberts: I have been photographing hitherto at no great distance from the Pole, and therefore have not needed such correction. My clock will go sufficiently well for fifteen minutes.

Mr. Lecky: From an illustration in *La Nature* of a week or two ago, it would seem that the Messrs. Henry have a twin telescope mounted alongside the photographic telescope, by which they control the pointing of the instrument.

Mr. Common: I should also like to express my great admiration of these photographs by the Brothers Henry. I think they are the most marvellous things we have yet seen in celestial photography, and they show that there is a great future before us. I believe that by experience we shall be able to get more planetary detail on Saturn, Jupiter, and Mars by means of photography than with the eye. I was enlarging one of my own photographs of Saturn the other day, which I took in 1879, when the ring appeared like a line across the planet, and I was very much struck with the amount of detail that came out on enlargement. I think that if the Brothers Henry would apply their attention to taking photographs of the planet in an enlarged image, giving, of course, a little longer exposure they would obtain still further detail. There may be difficulties in the way: but I think that these photographs are a very good omen for the future. With regard to Mr. Roberts taking his photographs without any means of control over the going of his clock, I think he is trusting too much to the skill of the mechanic; at present, it is almost impossible to get a clock that does not want watching.

Mr. Ranyard: As to Mr. Common's suggestion with regard to enlarging the diameter of the planet before it is thrown upon the photographic plate, I have made some small experiments in that direction, and have taken some photographs of Saturn and of Jupiter, with an enlargement of five diameters; but they are not so satisfactory as photographs taken in the primary focus. In addition to the chromatic errors introduced by the enlarging lens, there is the difficulty that an exposure of 25 times the duration is needed for the enlarged image, and that increases errors, due to the unsteadiness of the atmosphere and the difficulty of driving.

The thanks of the Society were returned to Mr. Roberts and the Brothers Henry.

Mr. H. H. Turner read a paper entitled "Notes on Mr. Marth's Intersects." Mr. Marth has given in the *Monthly Notices* a diagram by which many of the elements of the planetary orbits can be recognised by simple inspection. The curves in the diagram are traced by the intersects of the planetary orbits, with a plane at right angles to the Ecliptic, which revolves about an axis passing through the sun. The curves corresponding to the orbits of the planets moving in ellipses, are unsymmetrical curves of the fourth degree. By a simple change of co-ordinates Mr. Turner transforms these curves into conic sections, the advantage of which is that conic sections can be more easily calculated and laid down, and that the approximations of the orbit of one planet to another can be as easily recognised in the conic section curves as in the curves of higher degree more laboriously laid down by Mr. Marth.

Mr. Knobel then read a paper by the Earl of Crawford on the "New Star in the Constellation of Orion," which exhibits a very remarkable channel spectrum as well as bright lines.

Mr. Maunder said that he had seen the spectrum of the star on two occasions, and was able to identify it as a very fine specimen of Secchi's third type of star spectra.

The meeting adjourned at ten o'clock.

WESTERN MICROSCOPICAL CLUB.

THIS club met on Monday week at the house of Dr. J. W. S. Meiklejohn, F.L.S., 105, Holland-road. The subject for the evening was the group of marine invertebrate animals known as the "echinoderms," to which the star-fishes and sea-urchins belong. The various forms were well illustrated by fossil and recent specimens, and by microscopical preparations. Professor C. Stewart, Curator of the Royal College of Surgeons' Museum, kindly acted as demonstrator. The very early appearance of these in geological strata and the number that then remained all their lives attached by a stalk to the ocean-bed were noticed. The present forms were described as having a calcareous skeleton, consisting of plates or spicules, interlocking more or less with one another. These furnish the microscopist with exceedingly beautiful and curious objects. External to this calcareous skeleton is a covering composed of three layers, by means of which the vital processes are carried on. They possess an internal stomach and a water-vascular system. This stomach some species, when disturbed, have a curious habit of casting out; it, however, is in a short time renewed without causing the death of the animal; others will throw off their limbs and break into numerous fragments upon very slight provocation. Reference was made to the very various and beautiful forms of external organs they possess; these consist of spines, suckers, and "pedicellariæ." The last are small, stalked bodies of an ovoid form, having at the apex a pair of teeth, which snap at and seize any small particles that come in their way. This action they keep up long after death, so that formerly they were mistaken for parasites. Now their action is supposed to be for cleansing purposes. The changes in their development from a free swimming ciliated embryo through the "Pluteus" or larval form and the stalked condition of some of the forms were expatiated on.

Messrs. Gwinnell, Karop, Stewart, E. and R. Swain, Stokes, and Hart-Vinen contributed microscopes and objects. A special set of slides from the Naples Scientific Aquarium, illustrating principally the larval forms, were exhibited by Mr. H. V. Tebbs.

The next meeting of the club (to which ladies are invited) will take place on Monday, Feb. 1st, at the house of Dr. J. H. Gladstone, F.R.S. Subject: "The Growth of Metallic Crystals."

THE Chinese and Japanese Governments are translating and publishing at a cheap rate many of the best English textbooks. Most of Professor Tyndall's works, for instance, have been translated and printed in Chinese, and are issued at a merely nominal sum.

SCIENTIFIC NEWS.

FROM Dun Echt Circular No. 106 we lear that Dr. H. Oppenheim has calculat an ephemeris and elements of Comet Fab from observations made at Paris, Berlin, Bil and Hamburg. The elements are T. = 18 April 4·180, Berlin M. T.; π—☊ 127° 29′ 10 ☊ 36° 12′ 1″; i 80° 52′ 49″, mean equinox 188 log. q 9·79386. The ephemeris for Berlin mi night gives:—

	R.A.			N. Dec.	
Jan. 16.	23h.	31m.	39s.	21°	47·8′
18.	23	30	30	21	59·2
20.	23	29	27	22	11·6
22.	23	28	30	22	25·0

The brightness is slowly increasing.

Dun Echt Circular No. 107 gives the foll ing elements of Barnard's comet from pla obtained at Dresden, Hamburg, and Berlin computed by Dr. H. Oppenheim. T = 18 May 3·205, Berlin M. T.; π—☊ 119° 41′ 1 ☊ 68° 20′ 20″; i 84° 20′ 24″, mean equinox 18 log. q 9·67934. The ephemeris for Be midnight is:—

	R.A.			N. Dec.	
Jan. 16.	2h.	39m.	30s.	11°	3·0′
18.	2	36	3	11	26·5
20.	2	32	44	11	50·4
22.	2	29	35	12	2·5

The brightness is slowly increasing.

Dun Echt Circular No. 108 contains a tra lation of a code telegram from the *Scie Observer*, Boston, giving the following pa culars of comet Brooks. The elements are Mr. S. C. Chandler, jun., from observations ma on Dec. 28, 30, and Jan. 1. T = 1885, Nov. 29 G. M. T.; π – ☊ 39° 58′; ☊ 262° 42 42° 35′, mean equinox 1885; log. q. ·04210. T ephemeris for Greenwich midnight is—Jan. R.A. 21h. 13m. 36s.; N. Dec., 13° 3′, brighn decreasing.

From observations of the spectrum of Ga Nova Orionis by M. C. Wolf, it would app that the new star is of the so-called tempor class—a variable like Mira (Omicron Ce The Nova is almost precisely due north of Alp Orionis, and distant about 12° 46′.

We have received the reprinted part of *Scientific Transactions* of the Royal Dub Society containing the paper by Dr. O Boeddicker on the Changes of the Rad tion of Heat from the Moon duri the total Eclipse of October, 1884, measured at Birr Castle Observatory. T paper contains tables and plates of curves, a is accompanied by a note from the Earl of Ros Opportunities for making observations of t kind occur rarely, and it has been determin to make these notes public at once, though satisfactory conclusion can be drawn fr them.

The Lalande prize of the Paris Academy Sciences has been awarded to M. Thollon his map of the solar spectrum. The Damois prize for a memoir on the theory of the Satell of Jupiter, has been reserved, no paper hav been sent in. The Valz prize has been awa to Dr. Spörer for his researches on sunspo

The death is announced of Dr. John Draper, professor of chemistry in the Uni sity of New York, eldest son of the late I John W. Draper. He was born in Virg in 1835, and graduated at the Unive of the city of New York in 1857. ha for a year prior to this held the office of h physician and surgeon of Bellevue Hosp In 1858 he was appointed analytical che in the New York University, a position h tained for 13 years. In 1860 he assume Professorship of Chemistry in the Coope stitute, but relinquished it in three years: in 1862 he served as surgeon in the U States Volunteers, and was on General W staff at Harper's Ferry when that place rendered. Prof. Draper was widely and fav ably known as an author, several of his w on chemistry holding an important amongst textbooks. His last work, an vanced textbook on Medical Physics, was lished a short time before his death.

The annual general meeting of the Ass tion for the Improvement of Geomet Teaching will be held next Friday, Jan. 1 11.30 a.m., at University College, Lond President, Mr. R. B. Hayward, will d address at the afternoon sitting, commencing at 2 p.m., on "The Correlation of the Different Branches of Elementary Mathematics." The reading of the paper will be followed by a discussion. Visitors interested in the objects aimed at by the association are invited to be present at either of the meetings.

Prof. R. S. Ball, F.R.S., commences a course of three lectures, at the Royal Institution, on "The Astronomical Theory of the Great Ice Age," on Tuesday, Jan. 19, following on Jan. 21 and 23. The lecture on the last mentioned date will deal with the changes in the eccentricity of the earth's orbit around the sun, and the probable effect on the recurrence of glacial epochs. The fee for this course is one guinea.

Mr. W. W. Fawcus, of Gateshead-on-Tyne, has written a letter to the members of the Bewick Club, which contains some pithy sentences to be remembered by all who either beg or have the power of giving. Mr. Fawcus writes to the members thus :—"To the Bewick Club.—Gentlemen,—It is with regret that I learn that you are applying to the Corporation for pecuniary assistance. If there be a class that is well off as a rule, it is the class that indulge in a taste for the fine arts; and if there be a class that is well paid when they produce anything of merit, it is the artist. You should consider that the Corporation to whom you are applying for funds draws its income in the shape of rates partly from people who have to struggle for a bare existence. If you cannot carry on your society profitably, it must either be that you mismanage your finances, or that the article that you produce and offer to the public is not good enough. In either case the remedy that you propose of putting your hands in other people's pockets is likely to increase the evil instead of curing it; for if you cannot manage that which is your own, how are you likely to manage funds that are not your own? You should remember that as soon as you accept public money your independence is gone, and the mere asking for it is a blow to your self-respect. . . . If you will consult the life of the great man whose honoured name you bear, you will find that your proposal is contrary to his teaching and practice. He was not the pampered product of a department, but the healthy growth of that individual liberty and independent endeavour that has produced all truly great character and art in this world."

At the meeting of the San Francisco Microscopical Society on Dec. 9, Mr. E. J. Wickson read an elaborate paper on the "Dodder," a name applied to a genus of parasitic plants including about eighty species. The botanical name is *Cuscuta*, from an Arabic word signifying a tangled thread. This peculiar plant has no leaves, unless some minute scales found on the stem be considered as the rudiments of such. Its germ has no apparent cotyledons, but is merely a thread-shaped embryo, coiled like a watch-spring in the seed, which is a mass of albumen. This material nourishes the young dodder shoot until it can lay hold of a host plant. If it reaches none, it soon dies; but if it succeeds in fastening itself upon a foster plant the earth attachment speedily withers and dies and may be found hanging from the thrifty stem which is now drawing its nourishment from its host. The fact that this parasite is provided with already elaborated food explains one of its most striking characteristics—viz., the entire absence of leaves. It also explains the absence of chlorophyll, for the principal function of this green substance is connected with the formation of starch. After recounting a number of interesting facts which have been revealed by botanical, chemical, and microscopical study of this parasite, Mr. Wickson drew attention to the great importance to the farmer of obtaining pure seed of clover, alfalfa, flax, and such other plants as are subject to the ravages of the dodder. Under the microscope he exhibited the seeds of alfalfa and of dodder, and showed that owing to the marked disparity in size, those of the latter could be removed by careful screening. It appears that there are five species of Cuscuta found in California.

Mr. Edward Harford, secretary of the Amalgamated Society of Railway Servants, has compiled a number of "Suggestions for Safe Railway Working," which can be obtained at the Society's Offices, 306, City-road, E.C. The "suggestions" embody points which have often been dealt with in these columns.

The first train passed through the Severn Tunnel on Saturday last. It was a coal train from Aberdare to Southampton, and passed through the tunnel (4½ miles) in 19 minutes. The Board of Trade permit is unnecessary for goods traffic; but after the official inspection passenger trains will run at once.

On Thursday last, the 7th inst., a collision occurred at Manor Park, on the Great Eastern Railway. It appears that an express, due to leave Liverpool-street about five o'clock p.m., was stopped by the Westinghouse-brake in consequence of the branch pipe from the main pipe to the triple valve under the tender breaking; not by a hose-pipe between the carriages as stated in some papers. The tender-brake was shut off, the brake on the train released, and a start was about to be made, when a local passenger train ran into the rear of the express. The line is supposed to be worked on the absolute block system; but, certainly, upon this occasion the block system did not maintain that "interval of space" to which reference is so often made.

S. Tegima, Minister of Education, Tokio, Japan, has obtained leave to have translated into Japanese Professor Guthrie's "Syllabus of Instruction in Elementary Practical Physics," as pursued at the Physical Laboratory of the Normal School of Science and Royal School of Mines, South Kensington. The Japanese Government proposes to introduce this system of practical instruction into the elementary schools as well as into the normal schools of Japan. Professor Guthrie has promised to write a preface to the translation.

Chasing Screw Threads.—One of the oldest of methods of forming a screw was to start the thread by a single point cutter and finish with a chaser of several points or teeth. It has been conclusively proved by demonstrative tests that our operating—reproducing—screws in general use are defective in uniformity of pitch, and very accurate machinery and very careful methods have been built and introduced to remedy the defect. These means are quite expensive, and this expense has deterred some shop managers from adopting them. One of these mechanics, a thinking workman, has tried a reversion to an old method, with modern improvements. He claims that he can chase a thread with almost mathematical exactness, sufficient for the requirements of fine machinist work. His method is not peculiar, except in the care taken as to details. He uses a single point screw cutting tool to start and seat a thread, as is usually the method. Soon as the thread is defined, he puts in a chaser having perhaps six, eight or ten threads, each of them a cutter—that is, each of them left sharp at the top. This is run squarely along the thread, the after teeth cutting or scraping something more than the leading tooth. The chaser forms the thread, but for a final finish he puts in a chasing tool only the first or forward tooth of which is a cutter, the others being merely followers and guides. With this arrangement he claims that the error of the first tool cutting may be rectified, or at least reduced, by the following teeth of the chaser, which have a bearing on six, eight, or more teeth simultaneously. Perhaps his theory is faulty, but it has been proved by experiment and practice that he has made an improvement on the ordinary method of screw-threading.

Dead Black for Optical Instruments.—Those who are the possessors of optical instruments have, at some time or other, been in need of a "dead black" paint or varnish for brass work, such as tubes, diaphragms, &c. All the formulæ and recipes given in the books are unsatisfactory because of the vagueness. The following can be relied upon to give a first-rate dead black, and it is easily made: Take two grains of lampblack, put it into any smooth, shallow dish, such as a saucer or small butter plate, add a little gold size, and thoroughly mix the two together. Just enough gold size should be used to hold the lampblack together: about three drops of such size as may be had by dipping the point of a lead pencil about half an inch into the gold size will be found right for the above quantity of lampblack; it should be added a drop at a time, however. After the lampblack and size are thoroughly mixed and worked, add twenty-four drops of turpentine, and again mix and work. It is then ready for use. Apply it thin with a camel's hair brush, and when it is thoroughly dry the articles will have as fine a dead black as they did when they came from the optician's hands.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

RECKONING LONGITUDES FROM THE PRIME MERIDIAN—IN "MEDIO" PERICULOSISSIMUS IBIS—PROPORTION OF FOCUS TO APERTURE IN AN ACHROMATIC OBJECT-GLASS—A PATENT ABUSE—THE LIVERPOOL ASTRONOMICAL SOCIETY.

[25215.]—IN an article in the *Standard* of the 31st ult. on the "Science of the Year," the following sentence occurs apropos of the International Prime Meridian Conference at Washington on Oct. 1, 1884:—

"It was also resolved to count longitudes, not east or west of this meridian, but continuously round the circle in one direction, from 0° to 360°, going in a westerly course."

Can any brother reader inform me upon what authority this statement is made? Because in an official report of the Conference now lying before me I find that Resolution III. "That from this meridian longitude shall be counted in two directions up to 180°, east longitude being plus and west longitude minus," was carried by 14 votes to 5, six delegates abstaining from voting altogether. I have before given expression in these columns to my opinion of the great advantages which would accrue from reckoning longitude right round the 360° of the earth's circumference (letter 23461, Vol. XL. p. 176), so that this sentence I quote has rather excited my curiosity. The reckoning, though, should be in an easterly and not a westerly direction.

By the way, talking of this record of the science of 1885, here is another paragraph which appears in the article from which I made the previous quotation, and which I confess I read with sincere delight:—

"Psychical Research" is very much where it was last year, except that one useful result of the investigation undertaken by the Society for its advancement has been to put to utter rout the Theosophical delusion—the last part of the journal containing the most conclusive proofs of Madame Blavatsky having played the part she was always suspected of playing upon her dupes."

Medium after medium has been detected, culminating with the ignominious exposure of Miss Florrie Cook by Sir George Sitwell and Herr von Buch; and now, if we may believe the chronicler, the arch-priestess of those unfortunate lunatics, the "Theosophists" has been found to be as mere vulgar a cheat as any of them. I wonder how poor Mr. Sinnett feels now that his idol has tumbled down into the mud?

There is one sentence in the letter (25160) of "Prismatique" on p. 369 which I should like to see set up in the same type as its heading. It is this: "The proportion of 15in. of focal length to 1in. of aperture is the 'real best' for astronomical o.g.'s." I earnestly trust that people who grow crazy over "Dumpies" with all the evils attendant on aberration, spherical and chromatic, the necessity for deep eye-piecing, &c., will ponder these words of true wisdom and profit by them.

I am very glad to see that a committee, consisting of the late Solicitor-General, the Earl of Crawford and Balcarres, and the Baron Henry de Worms, M.P., has been appointed by the Board of Trade to inquire into the duties, organisation, and arrangements of the Patent Office. Notably do I hope that that true student of science and thoroughly practical man of business, Lord Crawford, will address himself to the discovery of the manner in which patents are granted for things "as old as the hills," and known to everybody. I need not travel out of the columns of the ENGLISH MECHANIC for an illustration of this, inasmuch as we learned at the beginning of last year from "Invicta" (letter 23809, Vol. XL. p. 491) that "a leading Liverpool firm" had "positively taken out a patent for a double ring of figures, whereby we get 13 under the usual 1, and 24 under the well-known 12," the fact being that this arrangement had previously been described some years ago on several occasions, in these very pages, for example, by Dr. Blacklock (letter 18527, Vol. XXXIII. p. 89), and other correspondents before him.

Taking, as I have done *ab initio* a warm interest in the progress of the Liverpool Astronomical Society, I learn with regret, and something like dismay, that Mr. W. St. Q. Gage, one of its vice-presidents and its Special Observer, is about to proceed to India. It is but too recently that the Society was deprived of the valuable services of Mr. Gage's predecessor in these offices, the Rev. T. E. Espin; and I further hear, though I am loath to believe it, that Mr. W. S. Franks has seceded from the Society. Finally, its quondam indefatigable officer, Mr. W. H. Davies, appears to have retired from the secretaryship, and a gentleman named Appleton to reign in his stead. Now, it was to such men as these and their peers that the Liverpool Astronomical Society owed its inception; and it was their fostering care, and hard, honest, personal work which raised it to the position of a real power in the scientific State. If though it is to be thus deprived wholesale of those who have formed its very backbone, one cannot but be a little nervous and anxious about its future, and it therefore seems to me to be urgently necessary that the utmost care should be taken in filling the vacancies so unfortunately created with men at once competent and willing to preserve those traditions by which the Society has attained its present position of usefulness and authority. I shall look forward both anxiously and curiously for the next list of officers and council. Instituted originally as a local association, it has lengthened its cords and strengthened its stakes until it now embraces among its list of members names of amateurs in all parts of the kingdom. That it should lose this catholic character and revert to a mere limited society composed of dwellers in the city whence it takes its name, would be simply deplorable, and a distinct loss to astronomical science in Great Britain.

"L. S." (query 58558, p. 393) appears to imagine that the various rocky strata have been deposited horizontally round the globe like the coats of an onion, and have remained undisturbed since. The real fact is, though, that in a large proportion of cases they have been so highly inclined or tilted that we pass over their *edges*, and not their legitimate surface at all. By the "thickness of stratum," geologists mean the depth between its two bounding surfaces, a quantity measurable with comparatively little difficulty when we view the strata edgeways.

As, for the first time since the establishment of the Royal Astronomical Society, the Fellows at large will—or may if they choose—be enabled this year to have a voice in the election of their officers and council, I have thought it might be not uninteresting to compile in a tabular form a few instructive statistics of the services rendered by the gentlemen who have condescended to govern us during the past year. It may enable Fellows in distant parts of the country to decide how far certain of them are deserving of support in the election which will take place next month.

Name of Present Office Holder.	Number of attendances at Council Meetings during the Past Year.	Number of Papers sent to the Society during the Past Year.
Mr. Dunkin	6	None
Professor Adams	4	None
Professor Cayley	4	None
Dr. De la Rue	6	None
Mr. Stone	6	3
Mr. Common	6	None
Mr. Knobel	6	2
Colonel Tupman	6	5
Dr. Huggins	4	None
Captain Abney	5	None
Sir G. B. Airy	0	None
Mr. Rand Capron......	3	None
Mr. Christie	5	1
Mr. Downing	4	3
Mr. Glaisher	3	None
Dr. Hind..................	2	1
Mr. Knott	5	None
Mr. Maunder............	6	1
Professor Pritchard ...	2	3
Mr. Ranyard	6	1
General Tennant	6	None

With regard to the above table, I would point out that it has reference to the twelve months just concluded. Had I made it comprise the beginning of the session in November, 1884, Mr. Stone and Colonel Tupman must each have been credited with another paper, and Mr. Common and Professor Pritchard with two each. Again, the paper with which I have credited Mr. Christie was really Mr. Maunder's work; "communicated by" the present Astronomer Royal. I think it only right that the Fellows of the Society should see the *de haut en bas* way in which they are treated in the matter of communications by many of the gentry who have so long elected and re-elected themselves. Notably are the possessors of that (most dubious) "dignity," the Fellowship of the Royal Society, offenders in this respect. If ever they have anything worth communicating, it presumably goes to the other side of the Quadrangle at Burlington House; assuredly it never reaches the Royal Astronomical Society. To dine at the Club, and to annoy and interrupt the merely scientific Fellows by coming in, more or less noisily, when the business is about one quarter over at the evening meetings, they appear to regard as quite sufficient honour done to the Society. It is for the Fellows generally to say whether they possess as low a view of its dignity themselves.

I hear that the MM. Paul and Prosper Henry have sent—or are immediately about to send—specimens of their marvellous photographs of the planet Saturn to this country. Might I venture to suggest to them that one copy, on a sufficiently large scale, should be presented to Dr. Hind, the superintendent of our English *Nautical Almanac*, as a means of correcting the very eccentric relative dimensions of the Saturnian system which annually appear in that work? We are wholly dependent upon our French and American *confrères* for any and every correction that is ever made in its erroneous data.

A Fellow of the Royal Astronomical Society.

THE NEW BROOKS COMET.

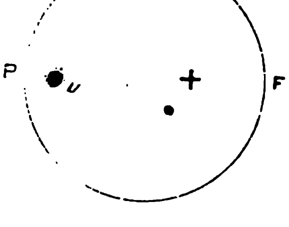
[25216.]—LAST Saturday evening, Dec. 26th, it was my privilege to discover another new comet. It was also independently observed by Barnard, of Nashville, on the following evening, Dec. 27th. At the time of my discovery the comet was about 5° southward of Altair. It is quite a bright telescopic comet—brighter and apparently larger than the one found by me in August of the present year—with a conspicuous condensation, eccentric to the coma. It may be observed with telescopes of 3in. or 4in. aperture. Its elements and orbits have not yet been computed.

William R. Brooks.

Red House Observatory, Phelps, N.Y.,
Dec. 29, 1885.

μ GEMINORUM—THE NEBULA IN THE PLEIADES.

[25217.]—THIS evening, whilst observing Saturn with my 12in. Calver mirror, I turned the telescope on μ Geminorum, which is now in such close proximity to the planet, and after a little careful scrutinising, found an additional *comes* to the well-known 13 mag. at 80″. The accompanying diagram shows the position of the second companion (which I have marked with a +) with sufficient accuracy, to enable anyone to pick it up in clear weather with adequate optical means. I estimated the magnitude to be 14—15; it was obvious with a power of 500, especially when the primary was kept out of the field. Will Mr. Sadler kindly say if this star has been noticed before, as I find no mention of it in "Celestial Objects"?



I have to thank those correspondents who have, in response to my remarks calling attention to the "Merope nebula," sent us their notes on the same. On several occasions since I wrote I have looked at the Pleiades, but had not once succeeded in seeing anything of the nature of a nebula, and was beginning to think with Professor Pritchard that its existence was very doubtful. Last night, however, the air, after the snowfall, being exceptionally clear, I saw the nebula most distinctly immediately the telescope, armed with a low power, was turned on the Pleiades. So obvious was it that I cannot understand how its existence could have escaped the notice of the Oxford observers during the whole time their attention was devoted to the stars in this group, more especially as the two large telescopes they used were but a fraction of an inch larger in aperture than mine. The late lamented Prebendary Webb states in "Celestial Objects" that it has been seen with less than a 2in. aperture, and yet was invisible in the 11in. achromatic at Copenhagen. It appears almost as if the lustre of the nebula varies, or that its visibility depends on the state of the atmosphere, exceptionally clear weather and absence of moonlight being essential to its visibility. I think, from what I saw (and I formed the opinion independently), that the statement in "Celestial Objects" that both Goldschmidt and Wolf considered the "Merope nebula" to be a projection from a diffused nebula encompassing the Pleiades is true to fact, and a careful scrutiny on a favourable occasion will show it to be so.

Will some of our astronomical readers kindly confirm? Any notes, I am sure, would be interesting and useful.

Forest Gate, Jan. 6. **W. Goodacre.**

THE VARIABLE STAR B I 16 LEPORIS.

[25218.]—MR. I. W. WARD, of Belfast, wrote to me on December the 29th, in reference to the star P ι Leporis. This led me to refer to my observation books, and to the back numbers of the ENGLISH MECHANIC. I first called attention to the star in "Ours" of Feb. 22, 1878. This evoked an interesting letter from Mr. Gore. Owing to a misprint in my letter, where seconds of arc are printed for seconds of time, Mr. Gore has been misled, and mixed up the observations of the star P ι Leporis with the star N. of it. Wrottesley's observations must refer to the first, and not the second, of these. The passage in Mr. Gore's letter may be repeated. It runs: "In January, 1877, it (the north star of the two) seemed to me about 7m. with 3in. refractor. On the same occasion I noticed another orange star 6m. a little distance P ι Leporis. Evidently the orange 6m. is really the star No. 12 of my list of Feb. 22, 1878. The mistake is repeated in the note on the star in Mr. Gore's catalogue of suspected variables. It also occurs in the notes of the Harvard Photometry. There seems to be a kind of fatality attending observations of this star, for even in Birmingham's Catalogue, as Professor Pickering shows, there is an error in R.A. of 22s. too much, and the declination is 2′ too far south. As Mr. Ward is unable to send you the observations of this star he and I have found, he has asked me to do so. The following are all that we know of:

1755		7·0	Bradley.
1799	Nov. 20	6·5	Lalande.
1825	Jan. 7	7·0	Bessel.
	Feb. 6	7·0	Bessel.
?	?	5·0	Wrottesley.
1856		5·0	Morton.
1874	Feb. 4	7·75	Webb (unpublished observation).
1875	Feb.	6·5	Sadler.
	Nov. 25	6·7	Ward.
	Dec. 5	7·2	Ward.
	Dec.	6·5	Winnecke.
1876	Jan. 1	7·0	Webb (unpublished observation).
1877	Jan.	6·0	Gore.
	Dec. 7	7·5	Espin.
	Dec. 12, 25, 26	7·2	Espin.
1878	Jan. 8	7·2	Espin.
	Dec. 17	6·0	Espin.
1879	Jan. 5	6·7	Espin.
	Dec.	6·5	Espin.
1880	Jan. 12	5·6	Cornish.
	Oct. 8	5·8	Espin.
	Dec. 22	5·86	Pickering.
1881	Jan. 1	5·56	Pickering.
	Feb. 5	6·06	Pickering.
	Nov. 17	6·0 ±	Espin.
	Nov. 19	6·3	Espin.
1882	Feb. 6	7·7 (?)	Dunér.
1883,	Jan. 5	5·5	Ward.
1885	Feb. 14	5·9	Gore.
	Dec. 22	7·0 ±	Ward.
1886	Jan. 1	6·7	Espin.
	Jan. 2	6·75	Ward.
	Jan. 3	6·6	Espin.

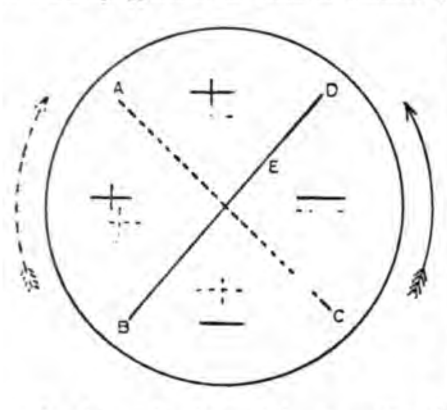
Burton's observation, as given in Birmingham's Catalogue, was probably in January 1874, as Mr. Webb in his observation book calls it "Burton's" Ruby on Feb. 4. I examined the region of ι Leporis with a 3in. refractor (the 17¼ being snowed up) on Jan. 6. Besides B I 16 I found a star still further *p*., and further N., and about 7½. It is Lalande 9768, the magnitude of which, according to Gould, is 7·4. The 3in. showed a star of about the same magnitude N. of ι Leporis, which must be the one referred to by Smyth and Gore.

Mr. Ward has sent me some particulars of the spectrum of this variable furnished by Dr. Copland.

It was described by D'Arrest in "A.N." as yellowish magnificent spectrum, III. type about equally precise separation of all the bands. Dunér, 31st Decem
6, 1882, 7·7 mag., bands
least from 1 to 9 inclusi
of the most superb in t

the figure is a diagram, there are no metallic sectors nor brushes, but in every other respect similar to the modern machine. Combs are put in the place of the brushes, the two upper combs may be connected, and the two under combs connected, or they may be connected as in the now usual way (when brushes are used they may be connected also in either way). In our diagram the circle represents the circumference of both plates, the dotted signs belong to the back plate, and the other to the front. A, B, C, and D are the positions of the combs, which we may, for the sake of simplicity, consider as of one point each.

We will suppose that this machine is to be primed or given its initial charge A. We place a charged body, say a positively electrified piece of glass near the front plate and opposite the conducting point at A, which point we will suppose touches the glass, then induction takes place through both plates of glass, and a charge of – electricity is deposited on the point touched, but the charge on the back plate, moving as it does towards D, when it reaches D acts in the same way on the point of the front glass touched by D, and the front plate moving towards A with its charge, repeats the operation at A. It will be noticed also that A being connected with C, the latter must tend to become positively charged, and for a similar reason B must tend to become negatively charged, and thus the electrification of the whole is completed. It will be noted that once started these interchanges are continuous. Now as to the question whence the rise of electrification from the small initial charge. It might be supposed the charge would gradually die out, but bearing in mind what has been said of induction, it will be noticed that at either of the combs, say D, there is a large inducing surface opposed (I here assume that I have a line of points, a comb, D E), the back plate. That portion, however, of the back plate on the left of the line D E being in its bound zone, does not act on the comb; but not only does the line of charged surface immediately opposed to the comb act inductively on the glass under the comb, but a considerable area in advance of this line, towards C, because the surfaces between C and D are both charged of similar and therefore free electricity. The electric density, therefore, on the line of glass under the comb is much greater than that on the inducing plate. But from the rotation of the plates this line—or these lines, as they are successively produced, are dragged within the bound zone, electricity meeting in opposition a surface similarly raised in charge, but, of course, opposite name. Being bound (reduced to nearly zero potential) the electricity is held till freed at A, where the plate performs the same office for the back plate, raising its electrification in the same way. This exalting process of course goes on till the limit of insulation is reached. I may here point out that the reason why the plates may be removed to a greater distance from each other than is actually necessary, without apparently much loss in efficiency, is because the mean distance of the inducing surface from the line on which the induced charge rests is not in the same proportion as the distance of the plates, but much less. Another reason is that an increased distance prevents somewhat the effect of the tendency to interchange electricities between the inner surfaces of the plates. What has been said of A and B may be said of C and D.



I need not refer to the combs leading electricity from the machine, as they in no way influence the cycle of changes I have mentioned, as this has always been completed by the plates before arriving at these combs. If while in action one of the rods with its combs B D be removed, the collecting combs would at once take up its office. Indeed, in the original arrangement there were only four combs, two of them doing double duty.

Now, with regard to the substitution of brushes for combs and the use of metallic sectors on the plates. These are simply to promote the self-charging of the machine. With reference to the brushes, I would remark that the effect is identical with that of the comb, but the substitution has two advantages (and some disadvantages).

Firstly, the brushes touch the plates, an arrangement not practically attainable with the stiff points of the comb, and are, therefore, in the best position for the effective effort of a small initial charge.

Secondly, with reference to the initial charge. I will not say that the initial charge is *always* given in this way; but I say that even if there were no other cause than the rubbing of the brushes, the wonder would be that the machine would not become excited, assuming that the multiplying of a small charge would take place as I have pointed out, because it is practically impossible to arrange the machine so symmetrically that all the brushes should press equally—that all should generate the same amount of electricity, and so balance; consequently a small initial charge must be generated. The closeness of the points favours the after operations of induction. As to the office of the tinfoil sectors. They theoretically (I have shown not necessarily) favour the self-exciting process. They extend the electrification over the plate, virtually increasing the size of the brushes, when they touch, and when one is acting as inducer to glass opposed it gives a greater charge, because the electricity in the conducting sector can accumulate under the point or part touched by the brush, and therefore condense there a greater charge. There are several other interesting interactions; but I have given merely the broad principle, my own time and the space of "Ours" forbidding more. It is a mistake to think that the tinfoil sectors are the principal agents or carriers of electricity in the machine; and it will be noticed by this theory the machine would not act with sectors alone (carried, we will suppose, by a central disc of non-conducting material) *unless* these sectors were made large enough to overlap—*i.e.*, that one sector on one plane would be able to overlap part of two on the other.

The sparks from the tinfoil sectors certainly seem strongest; but this is simply an effect of condensation due to the complete drainage of a large area from the conducting nature of the material.

I may, in closing, remark that the ordinary Holtz and the Voss can, I think, also be easily explained by this theory.

In the ordinary Holtz both surfaces of the revolving plate are used; the inner surface feeds the armatures or inducing surfaces by a special provision; while in the Voss the front surface is only used. These, however, I would return to again if thought desirable.

Swansea. **A. R. Molison.**

THE WIMSHURST INFLUENCE MACHINE.

[25223.]—As a science teacher. I must ever be grateful to Mr. Wimshurst for his machine. For travelling lecturers, the form with ebonite plates is most useful. There is no fear of breakage and consequent worry, whilst the weight and size are inconsiderable. One that I have is only used for one night a week, and always remains charged from week to week. If wetted by a shower of rain it need only be rubbed lightly over with a cloth, when it will work even though streaks of wet be still upon it. Ebonite plates should not be warmed for fear of warping; thus there need be no fire in the lecture room. **Bangor.**

THE OTTO BICYCLE.

[25224.]—As a hint to "South Australian," I beg to say that I have heard it stated by one who had tried the Otto, the drawback to it is its tendency to go to the right or left when one wheel is on rougher ground than the other. **W. R. K.**

[25225.]—There have been so many discussions on the Otto bicycle in various papers, including the English Mechanic, that it is surprising that "South Australian Bicyclist" has not come across one of them. Since his first inquiry, the Otto Company have perfected a new pattern of Otto, and it is not likely that any more of the present machines will be made. They are, however, very effective in the hands of experienced riders, but are not always to be recommended for those who are not clever at learning new things, or who are quite destitute of mechanical knowledge. They are undoubtedly good for rough roads, through having large wheels, and making only two tracks, and in any case of ejectment the footstraps are no cause of danger unless the rider is very careless. In my four years' riding I have never fallen on my face nor hurt myself in any way. The Otto is also as fast a machine as almost anyone can desire, though its true value lies rather in its suitability for touring, and such rough work, as it is very strong. Its weak point is its system of combined driving and steering; but if properly adjusted this need be but little trouble, except to learners, some of whom take a long time to get into its peculiarities. The balance takes no time to learn—an hour or two at most.

I have seen the sample machine of the new pattern, and should certainly advise "South Australian Bicyclist" to wait until it is put on the market. It has been designed to overcome the difficulty of learning to steer, especially downhill, which is the bête noir of many riders of the present pattern. It is certainly a great improvement in the matter of having a central chain, thus driving both wheels absolutely equally, whereas in the present pattern one wheel is alternately driven rather harder than the other, causing the machine to take a slightly wavy course, and wasting a certain amount of power. In this particular tricycles have moved ahead of the Otto up to the present, and the altered method of driving adopted on the new Otto will increase its speed, I should think, quite two miles an hour. A good rider on the present pattern can keep up twelve miles an hour on a smooth road.

I shall myself welcome the advent of a good central-chain driven Otto, no matter by whom introduced, as a great step towards that machine taking a leading place among cycles, and which the present pattern has failed to do, though I shall part with my old machine with regret, as it has already carried me safely nearly 10,000 miles.

Traveller.

STAY BUSKS.

[25226.]—I feel much obliged to the "Provincial Staymaker" for his information, as all matters of fact in connection with this subject are physiologically valuable, and hardly anything else is. Ladies will evidently go on making their "waists fine by degrees and beautifully less," as Prior wrote long ago, and as they very well know that most people think, whatever we may say; and therefore we had better learn as much as we can about the safest way of doing it, and not meddle with our wives and daughters without reason.

A great deal of such information used to appear from time to time in a now extinct periodical called the *Englishwoman's Domestic Magazine*, and much of it was collected in one or two small books which I have. Unfortunately, it has no successor in that respect, so far as I know, except occasional letters which have appeared here, but all of them from gentlemen.

In return, I will do my best to answer the "Staymaker's" question why the busks of tight stays are required to be as inflexible and as long as he says they are now by all the best-dressed ladies. It evidently is because, according to abundant testimony in the *E. D. M.* and elsewhere, they have long been found the best both for health and comfort, though they are sometimes thought severe at first, and resisted by girls who afterwards declare that they enjoy the utmost compression they can bear under long and wide busks absolutely rigid, and some pronounce "the sensation exquisite," while that from weak busks is very disagreeable. If the fact is so—and the testimonies of it are much too numerous to disbelieve—it is a mere waste of time to go behind it to discover or dispute about physical reasons either for or against it. Nature is never so deceitful as to make anything *permanently* pleasant which is really injurious. Moreover, a large, stiff, and straight busk makes the figure and carriage upright, as it should be, and also makes the waist look smaller, both in front and behind, than the same circumference with a weak busk. If they are now worn so long that ladies must sit upright, instead of lolling in hollow-backed chairs which double them up and make them round-backed, so much the better.

I am astonished, however, at what he says of their thickness and consequent weight, for it is quite unnecessary. Wooden busks, such as our ancestors of both sexes wore, when tight lacing was more general than now, would not be a quarter of the weight, though they must be rather thicker down the middle. The concave steel ones which I have seen, besides the description formerly given of them, are hardly more than a quarter of the thickness he mentions; and yet they are absolutely rigid, and would resist far more than the strongest attempt to break them by stooping if they were as wide as they ought to be for other reasons; and wide ones are pronounced more pleasant to wear than narrow. For ladies, probably 5in. wide near the lower end, which, of course, is rounded, tapering to about 2in. at the top, is the best width. The length must vary with their height. I have no doubt that for ordinary figures they are best quite straight down the middle; but if any curve inwards at the waist is needed for some figures, it is easily made when the steel heated.

The largest wooden busks that I have seen (f man) were full 6in. wide and nearly 20in. long, ⅜in. thick down the middle, slightly concave inside and more convex outside than steel ones, but they were thinned towards the edges all round. They are also narrowed to a kind of waist own to prevent their working up or down under the stays. Steel, covered with a pair of pieces of leather forming a margin all round, holds sufficiently by friction.

As I see nothing in shop windows but the common pair of thin steels to the most expensive stays, I conclude that the large and heavy busks the "staymaker" speaks of are worn independently under the thin ones; and that suggests the question why the old fashion of closed stays in front (which sundry writers to the *E. D. M.* strongly advocated) should not be resumed; and another question, also, why the still older fashion of lacing in front should not at any rate for that great majority of persons who have neither maids nor sisters to lace them up. It must be far easier and quicker to do in front; and, as he says that stays are now generally laced close and not left gaping, they would fit perfectly over the independent busks. The narrow steels at the sides, instead of many of the whalebones, are decidedly right, for they are much more elastic, though stronger, and also thinner, and their weight is insignificant. I do not know why they should not supersede whalebones altogether. If expense is any object, they could be used any number of times over.

As it seems difficult to make stays strong enough to bear such tight lacing as some—perhaps, many—ladies like, why should they not be made double with those steels sewn in between, which would show no projection outside? Or, why should leather not be used, which I have been several times recommended from experience? Nothing keeps clean and sweet so long, as everyone can tell from boots and shoes, and it was positively denied that it is unpleasantly hot, as someone had conjectured that it must. They were described as made of well-dressed brown leather in any suitable number of pieces, sewn in double seams, each with a ⅝in. steel within it, and a few more if necessary, the whole being well stretched when wet and soft on blocks of the desired shape, taking care especially to stretch the waist. It will then stretch no more under tighter lacing than the person inside it could bear. Of course, the lace-holes must be numerous, as they now are again in all the best stays, after becoming much too few in the flimsy corsets that came into use some 30 years ago, when we all thought tight-lacing was dying out; but it soon revived, as it always did before. and I suppose always will.

Will the "Provincial Staymaker" kindly give us a little more information about the actual sizes of the largest busks now used? And also the actual sizes of waist reached by the ladies who wear them. One can hardly take their own accounts without some discount, as they go down to sizes almost incredible in their published letters—at any rate, quite below what one ever sees in public now, whatever may have been the case in former times.

It is easy to believe that dressmakers and others who spend most of their time in a stooping posture find long and rigid busks oppressive, though very weak ones may be worse. But they can easily wear shorter ones, as I believe ladies do for riding; and independent busks can be changed in a few minutes. But it is by no means easy to understand—though I do not mean to question it—how ladies can bear and enjoy being laced so tight over perfectly rigid and long busks that no common stays will hold them, and yet dance easily for hours and walk as briskly and generally ride better than the thickest waists, and often look better in health too, as several medical men wrote to the *E. D. M.* (contrary to the general opinion of their craft), and sometimes live to great ages, instead of dying prematurely as they ought.

That is the real problem of the "corset controversy," which I declined, therefore, to go into. If the "Provincial Staymaker," or any other proficient, can solve it, by all means let him do so. It must be done by something better than mere prophecies of evils which we can see do not come, or by talking about Chinese ladies' crushed feet which cannot walk, or telling us that the waists of naked goddesses are ever so large, which only makes the above problem more difficult to solve, and not easier.

I am sorry to have written so long a letter, but I could not put the case more shortly.

X. Y.

LATHE MATTERS AND GRINDING TWIST DRILLS.

[25227.]—IN reply to "F.C.," who asks whether I have changed my views as to front and vertical slide, I may say I am constantly wishing for a *permanent* vertical slide. I think as much or more of it than ever, and, if no one takes it up, intend to make one for myself by-and-by, even if I must begin again from the beginning. No doubt such attachments as enable us to fix a *temporary* vertical slide on the slide-rest, are very good and useful. Still better, I think, is the plan fixing a vertical slide on the right-hand ndard; but, best of all, in my opinion, would be a vertical slide under the ordinary slide-rest, *always ready* and *never in the way*; also allowing milling cutters the benefit of the support of the back-centre whenever much overhung.

"F. C." and others complain of the overhang of the milling table in my design on page 52 of Vol. XXXIX. Well the overhang is constant at 3½in. about; but the milling table is about 1¾in. thick and 5in. wide. Moreover, the milling cutter is sure to be about the same distance from the mandrel collar, and is only supported by the mandrel—a round bar, say 1¼in. diam., which must, of necessity, fit rather loosely; surely if anything gives way, it will be the mandrel.

The vertical slide might be applied to lathes having the usual flat beds; but there would be required two slides, one down the apron and one in a corresponding position at the back, to have vertical lead screws moved simultaneously. This plan has been carried out by Mr. Sherwin, of Birmingham, in his lathes for boring. But for small lathes the front slide lends itself best to the vertical-slide scheme.

We have had several universal cutters for metal illustrated. Of these Wenham's and Hines's have the loaded pulley, which I think very important, particularly where the single point is used. In Hines's, which was rather roughly illustrated, the band runs straight up; however the instrument may be twisted at the quadrant. I suppose Mr. Wenham's is only intended to work at a small inclination? In F. Baker's instrument I see no reason why the guide-pulley need swivel round, nor why there should be guide-pulleys at all; Hines's cutter requires none. Walz's instrument is the only one which has a slide for cutting at an angle, as when cutting one side of a bevel wheel tooth. I hope some one accustomed to use these instruments will have a word to say about them, and tell us what kind of work they are capable of beyond cutting spur wheels and fluting taps and rhymers.

As "F. C." has asked a question about grinding twist-drills, I give the plan I use. I have a simple frame carrying an emery wheel, which is placed in the tool-holder, and is useful for trueing up the lathe centres. First I fix the twist-drill to be sharpened in a chuck, then screw a bit of ½in. wood to the boring collar support, revolve the drill, and push the wood against it till the point comes through. Now use the grinder on the point of the drill, driving grinder by the treadle, and turning mandrel by hand until you bring up the barest edges of the twist-drill. These edges being now true, you take the drill out and back off or relieve the cutting edge on the grindstone by hand. By using the grindstone dry you can lay the correct edge exactly along the face of the stone. I fear I could not describe the movement of the hands; but you notice first how much you have to revolve the drill in your hands, and as you turn it you diminish the angle the shank makes with the face of the stone so as to cause the stone to act more upon the heel of the cutting edge.

The wooden support steadies point against grinder, the grinder makes both edges alike and centres the point, and the grindstone relieves the cutting edge. I find the drills, treated in this way, will produce two curled shavings as when new. In half an hour you can grind a set from ⅛in. to ½in., beginning with the smallest, and pushing them through the same hole in the wooden support.

F. A. M.

[25228.]—"F. A. M." will think me ungracious for not acknowledging his goodness in noticing my original query on "Overheads" a few weeks ago. I have been unable to reply, but have watched with interest the resulting correspondence, and am glad to note that there are evidently more than myself on the look-out for a good overhead gear. Of the three forms "F. A. M." sent sketches of, I can scarcely understand the "Holtzapffel" plan; it seems to me as though the tightening of one band, say of the slide-rest, would result in the slackening of the other—i.e., to the large wheel. The rocking overhead, I mean the single-pivoted arm, lacks range of speed, as reported at the time, so can scarcely compete for the "all round" overhead which is sought.

What is wanted is a simple form of compound overhead with two shafts, and it is a question whether a movable pulley or continuous drum on the front shaft is the best. I have not yet seen the drum so balanced as to run without vibration at high speeds. The D.H.G. form was mentioned, and from its praises I thought it must be the thing, and regretted that a description could not be given. I was lucky, however, to turn up my old numbers of *Forge and Lathe*, and there it was accompanied by very good sketches. I came to the conclusion, nevertheless, that it was far too complicated, and do not think I should ever adopt it.

It is an exceedingly clever and complete arrangement, and will, without doubt, execute a large variety of work. Another form exists, adopted by Hines, which has not yet been mentioned; the overhead shaft is fixed, and the slack of the cord is taken up by an idle pulley pressed against one cord. By having a cone pulley on shaft, a greater range of speeds can be obtained than with the single swing arm overhead. Has anyone experience of this form?

With regard to the universal cutter "F. A. M." presents this week, I think the adjustment of the mitre wheels best arranged by making the hole carrying the horizontal shaft elongated, and thus giving the top wheel an up-and-down adjustment. When set, it should be clamped in position by locknut.

A. F. H.

HARD STEEL MANDREL BEARINGS.

[25229.]—PERMIT me to say, in answer to "Orderic Vital," that parallel bearings for small lathes are in this country preferably made of cast-steel bar; while for lathes from 5in. centre upwards castings are used. There seems to be an objection to forgings. It seems to me a pity that English makers do not make all their lathes with steel bearings (hardened, of course). About 80 per cent. of the German makers do, and it does not add 10s. to the cost of the lathe—at least, not in Germany.

A. F. Shakespear.

14, Lüttichaustrasse, Dresden.

SOFT WOOD TURNING.

[25230.]—WHAT is "M. A." attacking me about? If South Hants may stand for the county of Southampton, my own native county, North Hants is surely a lawful abbreviation of Northamptonshire, the native county of "M. A.," and "7 miles from Oundle" is a sufficient testimony to my geographical knowledge of King's Cliffe. If "M. A." is, as I fancied, "J. H. H.," I was his guest when visiting the place in question; and it was under his auspices that I witnessed the use of hook tools with which, as I know, he became an adept. Hence it is very unlikely that I should traverse any of his statements. I have referred to the few lines in which I spoke of hook tools, and find that my statement is quite correct, and not opposed in any way to that of "M. A." I only state that work too deep for the gouge is done with hook tools, which are, "par excellence," the tools for soft wood, and that they are made and used to perfection in King's Cliffe. I observe no statement about bowls being quite smooth inside, nor, in fact, anything about them. I know they show the tool marks, as most of such hook-turned work does; because it is done so quickly and cheaply that nice finish is not attempted. But, again, if Holtzapffel knows anything of turning, I am quite corroborated in saying that hook tools are used for turning bowls, for on p. 27, Vol. IV., he gives the whole process, and also drawings of the hook tools used.

I cannot understand "M. A.," who appears to me to have found a mare's nest. At any rate, he has attacked me for some statement or other which I never made at all.

O. J. L.

OPTICAL.

[25231.]—OUR good friend Mr. Holmes, ever to the fore, has been at considerable trouble to explain to me that when the vision is concentrated upon a distant object the limiting shape of the aperture used is not defined to the eye at the same time. Also, that gentleman has been good enough to give me an A B C lesson on appearances of a series of junctures under different conditions of distance and illumination.

There may be some of our readers to whom this may be enlightening; for myself I knew it before, and assure Mr. Holmes that he has advanced nothing that will make "luminous point" or "spurious disc" more appreciated as terms of precise meaning. Unless sufficient *magnifying* power be used, Jupiter does not show himself as a disc. Reasoning from the known, I should presume that all fixed stars would present a globular form, so that if the magnitude of the star be great enough, or it be near enough, we naturally expect a disc to be shown in the telescope. Mr. Holmes does not answer my question as to the use of the micrometer. I did not say it would be useless. Surely Mr. H. must be trying a "goak" when he says, "Surely the distance apart can be measured." I think even he will admit that magnitude should be measurable—magnitude of a point! Mr. H., the weight of a footless stocking without a leg. Granted that a reflector gives smaller *virtual images* of stars; "a *point* with rings," in lieu of the disc with rings, as seen in a refractor, is certainly rather a startling statement. Mr. Browning, in his "Plea for the Reflector," says the discs are less than the refractor shows them, and thus more easily measured by the micrometer. And certainly this is a puzzling statement. But Mr. Calver's "*point* and rings" is more so. "Orderic Vital" and myself seem at one on this point. The point, as a mathematical term, is reasonable; but to see that which has no actual existence, even in a telescope, is a very remarkable thing. Minute *spot*, or *dot*, conveys more meaning, and certainly more correctly describes the appearance of a small fixed star in any telescope of ordinary merit. One of the observers, with one of Mr. Calver's undoubtedly fine productions. describes the appearance of Castor as "two beautiful *silver balls*"; no point and rings about *that*. As far as concerns mortal sight we *must* magnify the stars equally with the space between them. If Mr. H. takes, for example, ε Lyræ (I can see this star just elongated with naked eye), and with his finder widen the gap between ε^1 and ε^2 in appearance to his eye, can he imagine that he has magnified space without magnifying the stars?

If Mr. Holmes will look at the sun through a bit of very dark glass, he will "cut off the irradiation" as far as he is personally concerned; or if he reduces the *angle* of vision by using a telescope, he will do much the same thing on any objects whatever. The moon for a few nights has been a good illustration. The crescent lit up by the sun, and the remaining portion feebly lit up by earth shine, and apparently *very much less*; in fact, "irradiation all cut off," as far as solar light was concerned, in the dark part of the limb.

As to Mr. H.'s last paragraph, I take that statement *cum grano salis*. I look over the individual obtuseness *re* railway track, feeling sure the majority of careful readers of "Ours" will see my drift. I also assure Mr. H. that *my* writing is not "loose" or "unconsidered."

Prismatique.

WHITE v. BROWN BREAD.

[25232.]—I THINK there is another and important aspect of this question, provided that we do not extract needful matter from bran in the best possible manner, or that bran is not the best material at hand to extract it from. It is this, that if the intestines are reduced by a gradual and careful concentration of our food, we are cultivationally benefited. I regret that there will always be some waste, so that we can never do without them, but I am not aware there is any merit in a large intestine, though domestication of animals produces such. Perhaps I differ in this respect, as far as practice points, in opinion with those who conceive an increase in devouring capacity and sensual pleasures to be the object of civilisation.

The amount of frothy artificialism and miscellaneous gluttony that exists shows how little we are really cultivated. Terrestrial conditions beyond our control and modification, of course, put a limit to cultivation short of the hot-house process; but though "schwarz-brod" is good food for soldiers, who have varying conditions and hard diet to sustain, and may be necessary, or something similar to it, to many or most ordinary individuals to-day, I do not consider it the food of intellectually cultivated man, nor yet wise to use it more than is necessary, or but as little as possible.

Cult. Evol.

VERTICAL CUTTING FRAME.

[25233.]—I SEND with this explanation a sketch of a vertical cutting frame, which I find is most useful for milling purposes, especially when used with the raising and lowering arrangement described last week in these columns.

My reasons for sending this I state lower down. I will only say here that I do not imagine that there is anything particularly new about it, or that it is equal to those made by our expensive toolmakers, but I do say that it is a good tool, and one that can be made by anyone who has a good lathe and the will to do it.

I may perhaps here state that any amateur who wishes to do so may have castings off my patterns from a firm whose address I will advertise this week in the proper place.

This address I would advise all amateurs to remember whenever they want good castings and civility, whether the order given is large or small. The points about this tool which I would specially mention are the following:—

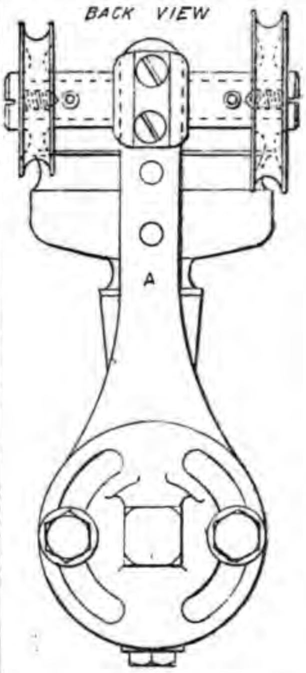
The frame and shank are made of malleable cast iron, one edge of the flange is graduated for 30° on each side of the zero mark.

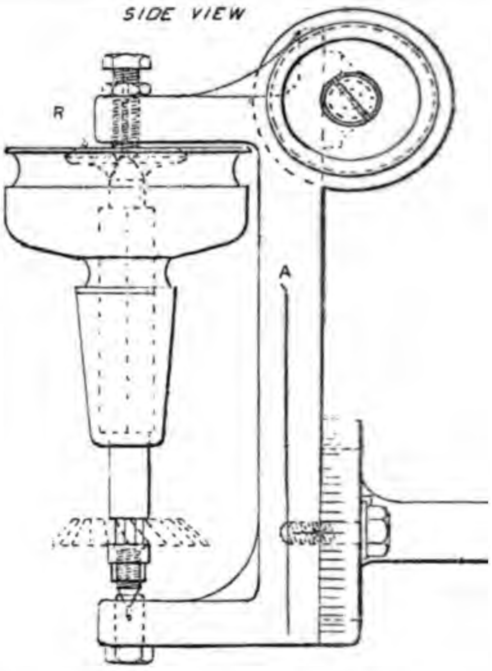
The frame A is attached to the shank by two steel set screws, working in radial slots round a centre-pin, which allows the spindle to be tilted in a vertical plane.

The spindle is made out of ½in. square steel, with a heavy flywheel of gun-metal cast on to it, as was recommended by a correspondent in the ENGLISH MECHANIC a few weeks ago.

On this flywheel two grooves are turned, the large for heavy and the smaller for light cuts and quick speed. The ends of the steel spindle are turned conical and hardened, and they run in the ends of hardened steel set screws at the top and bottom of the frame. In the top part of the flywheel there is a shallow recess turned, which, besides allowing the spindle end to be easily hardened, also forms a trap to catch the oil which would otherwise be thrown off the bearing.

The top set screw is fixed by a lock-nut, and a *hole bored right* through it allows the spindle to be lubricated while running. At the lower end of the spindle a slot is cut for fly-cutters, which are fixed by the cupped steel nut, shown in the sketch, clamping a small circular cutter.





When circular cutters are used a steel key is placed in the slot, which, projecting at one side, prevents the cutter from turning on the spindle. The gun-metal guide-pulleys have long bearings, and run on a spindle forged out of a piece of ½in. square steel.

When working with the large groove the pulleys are used in the position shown on the sketch; but they can be reversed on the spindle, and it can be fixed on to the frame by the screws being placed in the lower pair of holes when the small groove is to be used.

I have sent this description in the hope that many amateurs, who till now have been prevented by the excessive prices charged by toolmakers, or the difficulties of steel forging, from using this useful tool, may now, by using malleable iron, be enabled to make for themselves a tool as handy, if not as beautiful, as any offered for sale.

W. R. W.

SPECIFIC HEAT AND CONDUCTIVITY —METRIC OR ENGLISH MEASURES.

[25234.]—WITH reference to the experiment on the above subject alluded to in letter 25214, p. 385, it may be worth mentioning that if a lead cylinder be used instead of one of bismuth, the experiment succeeds perfectly.

May I ask if any of your readers who are teaching science would kindly give me the benefit of their advice in the following matter? In writing a school book, in which such branches of physics as dynamics are to be treated in a very elementary but exact manner, would it be best to use the metric system or the English system of weights and measures? I am much inclined to take the former course.

A. X.

NON-ACTINIC MEDIUM.

[25235.]—AS a hint to my brother amateur photographers, I advise them to try for their dark room lanterns the greenish-yellow medium known as golden fabric. I use two folds, and find it quite safe with extra rapid plates. I employ a paraffin lamp always when developing. Those who have not tried it will be astonished at the amount of light they can have with safety by using it.

W. R. K.

RAILWAY COUPLINGS.

[25236.]—I AM glad to be able to inform your correspondent "Railway Servant," page 381, 25192, that the preliminary arrangements for the forthcoming "coupling trials" are now completed. By invitation I yesterday had an interview, at Waterloo, with Mr. Charles Scotter, General Manager of the London and South-Western Railway, Mr. Haddow, the Company's goods manager, and Mr. Harford, the general secretary of the Amalgamated Society of Railway Servants being also present, to discuss the question and the facilities required. Mr. Scotter offered all that was necessary—namely, the use of sidings and waggons. The trials will take place at Nine Elms as soon as inventors have had the necessary time to fit their apparatus to the waggons; due notice will be at once given to patentee
Harford, and it is hoped they will lose n

Clement E. Stretton. C.
Vice-President Amal. Soc. Railway S
Head Offices, 306, City-road, E.C., Jan. 9.

THE BREAKING OF DRIV AXLES.

[25237.]—IT is satisfactory to notice
proposition to limit the mileage of crank
been very favourably received, and the
made by the Amalgamated Society of
Servants that such limit should be 200,
for iron and 180,000 miles for steel crank
to be very generally approved.

The following Table, compiled by th
from the Board of Trade Returns, shows
number of axles of all descriptions wh
broken when running during the past 7¾
30th September, 1885.

Year.	Engine Axles.		Tender Axles.	Carriage Axles.	Waggon Axles.	Mail Van Axles.
	Crank or Driving.	Leading or Trailing.				
1878	266	21	19	3	221	1
1879	248	24	23	3	190	
1880	251	27	25	1	192	1
1881	262	21	37	3	200	1
1882	242	22	32	2	140	1
1883	247	28	21	2	141	1
1884	200	23	24	6	113	1
9 months 1885	132	26	11	4	93	

When it is remembered that the break
axle (in conjunction with the use of i
brake-power) may cause a repetition of
stone disaster at any moment, the impo
the subject cannot be over-estimated, an
your readers will furnish any informat
may possess in regard to it. I shall be
send a copy of my recent lecture thereon t
respondent who forwards a *halfpenny
wrapper* to me.

Clement E. Strettor
40, Saxe-Coburg-street, Leicester, Jan.

BORIC ACID AS A BLOWP REAGENT.

[25238.]—ALTHOUGH much alarmed
ferocity of the attack (letter 25194) directe
me in the "E. M." No. 1,085, p. 381, I retain
presence of mind to point out that, though
used boric acid mechanically (B.B.) fo
of detecting phosphoric acid in min
of a piece of thin piano wire stuck i
and this process (published in
English translation of "Ber
copied in Griffin's li
use of boric acid h
my employment of
reagent, founded on

possesses the property of *separating* almost all oxides B.B., and of exhibiting them as pyro-borates of different form, colour, and specific gravity, which can be boiled *per se* out of the bead.

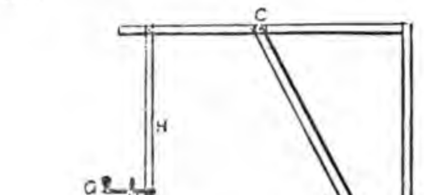
All this I should have thought even a tyro "of two years practical experience" would have ascertained before writing about it; indeed, it is all detailed in my books.

Plattner afterwards used boric acid in another way (only for alloys of lead with Cu, Ni, &c.); but still having no connection whatever with the purpose for which—as truly stated in my work—"I introduced it in 1869."

As the writer of letter 25194 has thus evidently studied the subject carefully before publishing his novel opinions and misstatements upon it, it will not be necessary to translate this latter use of boron trioxide for *him*, from the original German. (Probirkunst mit dem Löthrohre, page 58.), "8) *Verglaste Borsäure Anwendung*: geringer Mengen Kupfers in vielem Blei. Bei quantitativen Proben ist sie unentbehrlich zur Abscheidung des Bleies vom Kupfer, so wie zur Trennung des Bleies von strengflüssigen Legirungen edler Metalle, die auf der Kapelle nicht ganz davon befreit werden können." **W. A. Ross.**

MICROSCOPICAL.

[25239.]—THE accompanying sketch shows a small instrument which I have devised to make cells.



It consists of a wooden stand, A, upon which an upright rod, B, of metal or wood is fixed. The piece H can be dispensed with.

D is a small table to hold the slides, and J and K two spring clips to hold fast the slides.

G is a rod of metal carrying the brush F, and revolving round the piece I.

The piece G is pierced with holes for the reception of the brush $\frac{1}{8}$in. apart, from $\frac{1}{8}$in. to $\frac{1}{2}$in. inclusive, thus providing for large and small cells.

In action the slide is placed on the table and fastened, and G is spun round. It carries the brush round with it, and makes a perfect circle of varnish on the slide.

Ealing. **J. Bell.**

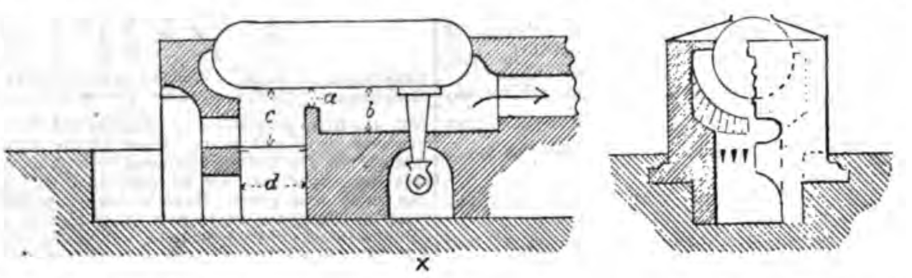
An Improved Stretcher.—Mr. Robert Stevens, a journeyman engineer, employed at the Edinburgh Royal Infirmary, has just taken out a patent for a new form of stretcher. The advantage claimed for it is that the patient may be placed in bed without being lifted from the stretcher. It is made of canvas, with wooden carrying poles on each side, and an iron cross rod at each end, which prevents the poles from coming too closely together, and secures a uniform amount of space in which the patient may lie. The rod is removable, so that the stretcher may be folded in the usual form when not in use. The chief peculiarity of the invention, however, is that the canvas is cut up the middle and looped, or held together with a slip of wood running through loopholes. When the patient has been lifted into bed on the stretcher this slip of wood is withdrawn, and the canvas consequently falls into two parts, which are easily removed from under the sufferer. The new stretcher has been adopted by the Professors of the Edinburgh Infirmary.

Patent Office Assistant Examiners.—The following is the list of successful candidates for e situations as assistant examiners in the Patent fice at the examination (scientific and technical) in November last. The maximum number of for the seven subjects was 2,500. F. J. obtained 1,727 marks; S. A. Willmott, W. [illegible]eld, 1,599; R. North, 1,590; T. H. erfield, 1,575; A. G. H. O. Minty, of the list— arks (!); se they subjects.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[55634.]—**Engine Boiler.**—I sent a sketch of a seating for a "wheel draught" arrangement of flues; but, as the Editor never acknowledged it, I presume it miscarried in the post. I now inclose sketch of seating for a flash-flue which I think will strain the boiler less, although it will not steam quite so well. The bridge is curved, so that it is 6in. from the shell at all points—i.e, dimension marked *a* is 6in.; *b*, the height of flue, is 25in. This is necessary to allow of inspection. Its width will be determined by the clearance at top of sides of flue (which will be, say, 3in.) or, say, about 3ft. 4in. The grate is 2ft. 3in. long (= *d*) by 2ft. 3in. wide; *c* = 24in. The hot gases escape through a passage marked by an arrow to the chimney. This passage may be just large enough for a man to pass through. X is a pipe for attaching blow-off cock. The cock is accessible from a well at one side of seating, through an arch in the brickwork. The weight of the boiler is carried by wrought-iron brackets riveted to the shell, which allow it to expand and contract freely.



The bricks next the hot gases should be firebrick. If you have a good draught, you may reduce the grate with advantage. This may be done by laying a sheet of iron over the front end of bars. It will be useful as a dead-plate for coking the fuel. A damper should be fitted to the arch leading to the ashpit. Diameter of iron chimney = 10in., and height = 25ft. to 30ft. I think the boiler will make enough steam for the engines; but it is not too large. I have not the time to sketch governor. Designs have often appeared in the "E.M." A governor of the Porter form—i.e., loaded and running fast, is generally the most satisfactory, though a little more trouble to make than the old Watt form. Probably the Britannia fret-saw (see description on p. 4) could be adapted to your requirements.—GLATTON.

[56934.]—**File-cutting Machines (U.Q.)**—There are some drawings and descriptions on pages 841-842 of Knight's "Mechanical Dictionary"; also in the *Engineer*, Vol. XLVI. page 351.—GLATTON.

[57034.]—**Painting Iron Bath (U.Q.)**—The other day I came across some stuff which seems just what you want. It is called "Chez Lui" enamel. It is used cold, can be had in any colour, and dries in 24 or 48 hours (I am not sure which). The makers say it has all the properties of enamels dried in a stove, and is suited for baths and hot-water jugs. I am afraid I do not know the address; but will ascertain it for you if you advertise. I saw it in a shop window some half-dozen doors off Mansion House station.—GLATTON.

[57071.]—**Beat Valves in Hydraulic Rams (U.Q.)**—I used to believe in making the pulse-valves heavy enough to just overbalance the column of water in the inlet-pipe; but "W. A. S." has shown that this is not necessarily the best. The following empirical rules have answered:—The inlet pipe to be of such a diameter that the weight of water it contains × fall in feet = height of lift × weight of water in delivery pipe. Inlet pipe to be nearly horizontal, head being given by depth of supply tank. Capacity of air vessel = capacity of delivery pipe. Pulse-valve to have a small lift—$\frac{3}{4}$in. is a very fair lift. This, of course, necessitates larger valves, in order to obtain sufficient area, and therefore some extra expense; but this is compensated for by the saving in wear and tear arising from a longer lift. In estimating the weight of water in a pipe, the following rough approximation is useful:—Pounds of water = square of diameter of pipe in inches × length of pipe in yards.—GLATTON.

[57082.]—**Hydraulic Leather Collar.**—The friction, according to Mr. Hicks and Mr. Luthy, is l to the pressure upon a ring equal in circum- ce to the plunger, and of a width varying from to ·015in., according to the state of lubrication of the collar. (Extract from Rankine's "Rules and Tables.")—GLATTON.

[57093.]—**Beam Engine Slide Valve (U.Q.)**—It is impossible to answer this query without more particulars. You should give the dimensions marked A, M, P, W, *b* in the sketch on page 301, as well as the length of ports. Assuming that you cut off at $\frac{5}{8}$th of stroke, the initial pressure being 35lb., and the back pressure 2lb. above atmosphere, the mean effective pressure will be about 29lb., and the indicated horse-power =

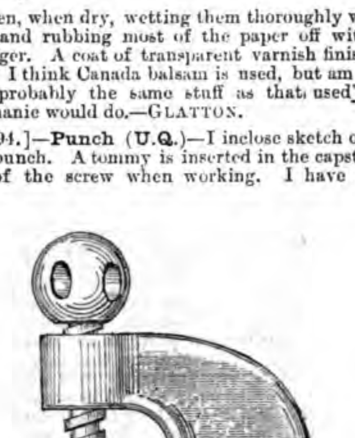
$$\frac{2 \times 22 \times (29 \times 615{\cdot}7) \times 6{\cdot}5}{33000} = 155.$$

—GLATTON.

[57253.]—**Water-wheel (U.Q.)**—TO "INVICTA."—The mere pressure in a pipe is not a safe guide in estimating the power of water. There may be such a length of pipe that the power is nearly all wasted before reaching the wheel, and this can only be ascertained by trial. See my letter on page 364, which will enable you to answer this question, as far as the power is concerned. Allow about 65 per cent. as the useful part of this power. If you will publish results of your trial, I will send design for wheel if "Invicta" does not reply.—GLATTON.

[57259.]—**Making Patterns on Glass (U.Q.)**—This is done by cementing the engravings, &c., to the glass, face downwards, with a transparent cement, and then, when dry, wetting them thoroughly with water and rubbing most of the paper off with a wet finger. A coat of transparent varnish finishes them. I think Canada balsam is used, but am not sure; probably the same stuff as that used for Vitremanie would do.—GLATTON.

[57194.]—**Punch (U.Q.)**—I inclose sketch of a small punch. A tommy is inserted in the capstan-head of the screw when working. I have not shown mode of fixing, as that will depend on your requirements; it might be held in a vice.—GLATTON.



[57336.]—**Eccentric for Loco. Engine.**—The passage you quote appears rather confused. The "throw" is the distance from the centre of eccentric-disc to centre of crankshaft. The eccentric-strap and rod is, of course, moved twice this distance, and where there is no reversing gear this motion constitutes the "travel." When a reversing link is used the travel of valve is not necessarily twice the throw of eccentric, and the positions of the various parts can only be obtained from carefully-made scale diagrams, which I cannot now undertake to explain in these pages.—GLATTON.

[57353.]—**Skewer-Making Machine (U.Q.)**—There are two drawings of machine in Knight's "Practical Dictionary," but their mode of action does not seem very clear.—GLATTON.

[57542.]—**Pull-up Weight.**—This will vary with the speed of the engine, the state of the surface, that of the atmosphere, the mode of applying weight, &c.; in fact, it will depend on so many things that nothing but trial would show, and even then it would not come twice alike. If you want to test the power, use Thompson's dynamometer, such as I described on page 565 of Vol. XL.

Use any shallow grooved wheel you can get, and adjust the weights until the engine is running at its usual speed, and with its usual supply of steam. The groove should not be much more than $\frac{1}{8}$in. deep in a pulley 3in. wide. If a one-man power be taken at $\frac{1}{8}$th of a horse-power, a two-man engine will do $\frac{33,000}{4} = 8,250$ ft.-lb. per minute. Let d be the diameter of pulley in feet, and r = the revolutions per minute. W = the weight of large weight in pounds, and w = the weight of small weight in pounds. Then $W - w = \frac{8,250}{3{\cdot}1416\,d\,r}$
—GLATTON.

[57362.]—**Engine (U.Q.)**—I cannot answer precisely; but the stress on wheel will probably vary with the initial pressure in cylinder. If the same work is to be done by the engine, neglecting back pressure, the stress will be $\frac{{\cdot}65}{{\cdot}315} = 2{\cdot}06$ times as great as at present. The decimal figures are the ratios of mean to initial pressure in the two cases.
—GLATTON.

[57505.]—**Engine Query (U.Q.)**—See my letters on pages 301 and 126. Say, port opens $\frac{3}{16}$in. to steam; to cut off at three-quarter stroke, lap must be $(\frac{3}{16} \times 1) = \frac{3}{16}$in.

Half travel $= \frac{3}{16} + \frac{3}{16} = \frac{3}{8}$.
$E = 1 - \frac{3}{8} - \frac{1}{4} = \frac{3}{8}$.
$A = \frac{1}{4} + \frac{3}{16} = \frac{7}{16}$.
$M = \frac{1}{2} + (2 \times \frac{1}{4}) = 1$.

Area of port $= \frac{1}{4} \times 1\frac{1}{8} = {\cdot}281$ sq. in. Velocity of piston should not be more than $\frac{6,000 \times {\cdot}281}{3{\cdot}34} = 505$ft. per minute, and ports are large enough for any speed up to $\frac{505 \times 12}{3\frac{1}{4} \times 2} = 932$ revolutions per minute. The throw of eccentric = the half-travel $= \frac{3}{8}$in.—GLATTON.

[57568.]—**Problem.**—What is in the tank—air or water, or what?—GLATTON.

[57740.]—**Free Reeds—Tuning.**—It is suggested on p. 385 that if N. E. Child would favour your readers with a chapter on voicing, it would be highly appreciated. Permit me to say that where an amateur wishes to make for himself a free reed organ, it will be scarcely worth his while to waste time, temper, and reeds in experiments on voicing; but if any one should desire the requisite instructions he can find them given in an admirable manner by Mr. M. J. Matthews, in Vol. XIX. No. 479, p. 277, and also by "Elève," in Vol. XXIII. No. 587, p. 384. When reading Mr. Fryer's praiseworthy efforts to enlighten his fellow readers, I often find myself wondering whether he is aware of what has appeared in earlier volumes. I do not know why he should think I "boasted" of having voiced more reeds, &c., because I thought I had made it plain that the tuning bellows I described on p. 322 was copied from those in use by professional voicers and tuners. I am not in the trade; if I were, I should probably respect the *lex non scripta* which prevents any member of the trade from running down the inventions and devices of a rival—at least in a public print. They do it vigorously enough in private. I quite agree with Mr. Fryer about correspondents giving "practical information"; but I am unable to reconcile his remarks with sundry letters and replies I have seen over the signature of G. Fryer It seems passing strange, too, that Mr. Fryer does "not know for certain" whether any other correspondent uses his signature; but I hope it is not to be taken as a sample of the extent of his knowledge—or, rather, want of knowledge—of other subjects.—N. E. CHILD.

[57906.]—**Bearings for Lathe Mandrel.**—On page 191 "Orderic Vital" solicits the opinions of correspondents as to the practicability of substituting hard split steel bearings for the ordinary gun-metal ones of the same form now in use. I have a pair now in use, in a milling machine that is constantly at work, and the only objection to them (if it be considered as such) is that, for some unaccountable reason, they require a greater amount of lubrication. They are cast steel, of precisely the same pattern as the gun-metal ones, and fitted in a like manner, until the hardening process is arrived at. When hardened, I bolted them together, and ran a small emery wheel through for a final cut, which of course brought them up very accurate. I should like to hear more on the subject, as I think it will be a great boon to lathe and machine owners if used, and I intend to use them myself wherever practicable.—ORIENT.

[58032.]—**Automatic Firing of Boiler Furnace.**—I am very pleased to see "Nun. Dor's" reply to above query. Could he give any information of the chain grate? To my imagination—I have never seen one—this is the most simple and therefore the one in which the least derangement could occur. I am willing to own an attendant is necessary for large boilers; but where a small boiler is used, it does not pay to have a special attendant to fire the boiler.—FIREMAN.

[57797.]—**Cane Sugar.**—There is not, so far as I know, any method of distinguishing pure sucrose made from cane sugar and that made from beetroot sugar. It is easy, however, to distinguish the raw or partially-refined sugars. Firstly, they smell different, and on allowing a little of the sugar to dissolve in the mouth, the after-taste is different. Secondly, the impurities present are different. Compare the following analyses:—

	Sucrose.	Glucose.	Ash.		Water.	Organic matters not sugar.
			Soluble.	Insoluble.		
West India cane sugar	94·40	2·20	·20	·10	2·80	·30
88 per cent. German beet sugar.........	94·20	Traces.	1·26	None.	2·76	1·78

Note in the beet the absence of insoluble ash and glucose, and the higher proportions of organic matter not sugar and ash.

ANALYSES OF SULPHATED ASH (AUTHORITY, J. W. MACDONALD).

	Potash.	Soda.	Lime.	Magnesia.	Ferric oxide and alumina.	Silica.	Sulphuric acid.
Cane Sugar ...	28·79	·87	8·83	2·73	6·90	8·29	43·65
Beet Sugar ...	34·19	11·12	3·60	·16	·28	1·78	48·85

Note the high proportion of alkalies, and the low magnesia, iron, and silica. Some of the organic matters not sugar are precipitated by tannin; but this precipitate must not be confounded with the one which iron gives. Make a few comparative tests, by adding tannin to raw sugar liquors and dilute solutions of iron, and you will see for yourself. The sugar liquors become contaminated with iron by being allowed to remain too long in contact with iron vessels, or by becoming slightly acid; either accident being the result of bad workmanship.—DEXTROSE.

[58033.]—**Steam Navigation on Canals.**—TO "S. R."—Supposing the apparatus which I have planned would so direct the water from the motive power as to keep the current in the centre of canal, and impinge it on the following boat or boats, the motive power being for three or four boats together, and capable of passing the locks at present in use. To what canal company could I write which is not under the control of railway company for information?—SURVIVALIST.

[58094.]—**Unable to Sleep.**—TO "LIMB O' THE LAW."—Having done the respectable by innocently asking the farrier to kindly oblige, and being owner of the property I tenant, I should be very pleased for further information how to proceed by law. How can I prove it to be a nuisance? Can I apply to Inspector of Nuisances for abatement, or to any of town authorities for redress? It actually reduces the value of property, as were I to try to let the house, I should be compelled to accept a less rent on account of disturbing noise during the night time only.—MORPHIA.

[58096.] — **Tempering.** — To temper spring plates, no definite rule can be applied, as a great deal depends on the hardness of the steel, which is best determined by the spring maker when he strikes it with his hammer. When springs are hardened in water they are returned to the furnace and reheated to a temperature which will suit the experienced spring maker, which is sometimes a dark red, or when rubbed with a stick will give off sparks. Springs are best hardened in oil, when the nature of the steel will allow it, and then they can only be tempered by experience. It it much easier to fit the plates together when they have been hardened in oil.—ACIER.

[58152.]—**Feedwater.**—When boilers have both feed-pump and injection apparatus, what amount should the feed-pump deliver to the boiler? I suppose that in his reply "Fireman" supposes all the water to be delivered by a feed-pump.—LEICESTER.

[58179.]—**Joy's Valve Gear.**—In reply to "T. J.," I should be glad to know where I can find the working drawings mentioned. As a matter of fact, I have worked out an answer; but what I want, if possible, is something more than rule of thumb.—NELS POORT.

[58182.]—**Nickel Plating.**—Did you put the current on strong at first? I believe that is essential with all nickel solutions for plating, while the anode should have a very large surface. As soon as a film is obtained, the strength of the current may be reduced.—P. M.

[58183.]—**American Organ.**—What does this querist mean by "double exhaust" bellows? The "bellows valve" may mean a "safety it is called—that is, a piece of wood leather and hung over a hole in the back screw in the middle board pushes open if the two boards should approach closel half a row means a lot of labour for a and you ought not to want extra wind ORGANON.

[58186.]—**Hot-Water Circulation.** at the number of bends in this arran don't think it would answer.—S. R.

[58189.]—**Photographic Changin** There is an illustration of a changi p. 240, No. 895, and no doubt similar other numbers. One can be made out o strong box by attaching to the inside and lid a cover of black twill, lined twill, in such a way that the lid ca opened. The end-pieces of this cover cut in them to which are attached sleeves, so that the arms can be insert risk of light getting in.—NUN. DOR.

[58190.]—**Lettering Book.**—If "An has a set, or rather sets, of brass letter to have little difficulty in learning lett letters must be made hot, and the gold in situ with glair, when the letters with some force so as to press the go the leather or cloth. Better mark lin get the letters as straight as possible. I to do on a separate piece of leather than of the book itself.—S. R.

[58195.]—**Magnet.**—I gave a brief of the Currie long-pull magnet on p. 2 Perhaps that will suit the querist.—Es

[58203.]—**Polishing Iceland Spar**— spar is most difficult and tedious work, can hope to succeed unless he is dete devote a great deal of time to it.—T. J.

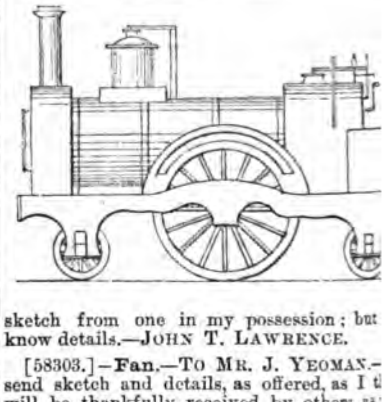
[58207.]—**Grinding and Pulveris chinery.**—Can "T. C., Bristol," give me information respecting the disintegrato tioned? Will it grind granite to a fin dry without excessive wear of the beaters "Pottery Tech," or some other correspon inform me if I were to replace the stones corn-grinding mill with iron ones, would quire to be grooved or plain?—A. J. S.

[58208.]—**Pan-Eidolon.**—I should say W. F. Stanley could answer this questi will the querist say whether Sir F. Head the instrument? It may appear under so name in Stanley's "Drawing Instruments." DOR.

[58222.]—**Gasoline.**—Why not pour so line into the bottle and heat it gently, time for the air to be driven out? Or exha air from the bottle, and draw in the vap another vessel.—T. J.

[58232.]—**Air Filtration.**—I should thi charcoal would stop as much oxygen as n in proportion, if the air is passed through.—

[58251.]—**S.E.R. Old Engine.**—I can



sketch from one in my possession; but know details.—JOHN T. LAWRENCE.

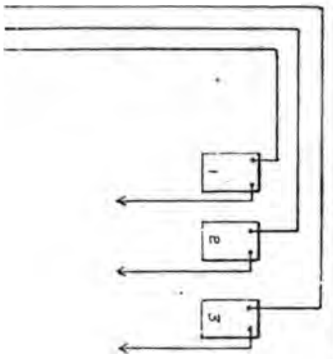
[58303.]—**Fan.**—TO MR. J. YEOMAN.— send sketch and details, as offered, as I t will be thankfully received by others as myself.—FAN-FAN.

[58320.]—**Content of Sphere.**—A sp one half the volume of a cylinder of same di and same height. Therefore, sphere $= \frac{1}{2}$ × area of a section $= \frac{1}{2} \times 12{\cdot}5 \times (6{\cdot}25$ = (reduced to cubic feet) $5\frac{1}{11}$ c. ft. very ap mately.—JOHN T. LAWRENCE, B.A.

[58344.]—**The Richardson Arc Lamp.**— much obliged to "C. W. R." for the inform contained in his replies; but unless I am grie misinformed, I think he will find there a Richardsons in the field.—NUN. DOR.

[58363.]—**Recovering Oil.**—Wo Bottone kindly describe the process or say were I could read, or purch necessary info [illegible] the a pensive one?-

Electric Bells.—I would suggest the an as a solution:—By inserting the er one, two, or three block (which d near push) the corresponding bell



The three bells can only be rung erly when their resistances are equal, Your correspondent will find this a expensive arrangement.—IOLO.

Firebrick Fireplaces.—If "Save t obtain silicate of soda, he can get e as good—namely, broken beer or which, if broken fine and mixed with e proportion of 1 part glass to 4 parts make a backing for his grate that will an firebricks, metal, or anything else I always have a supply of this broken to mix with the fireclay, so that be repaired at any time.—DOCTOR

Ammonium Bichromate. — The be at a loss to know which answer to ing how they vary. That by Mr. right as far as it went, but did not ulfil the requirements of "S. H. T." . J." is slightly inaccurate, inasmuch show to what a full extent the decom- urs. Messrs. Grey and Fleck send wers, in striking contrast to that over "S. and S.," which is most remark- I greatly doubt whether Mr. Thom- sible for such an absurd statement.—

Magneto Machine.—TO MR. BOT- h obliged for the sketch. Would you e simplest method of altering the con- s to give a continuous current in one milar to that used for electro-de- .. P. Soc.

Table of Atomic Weights.—See *ws* for 1884-5, Thorp's "Quantitative 'Watt's Dictionary," or "Bayley's n and Steel."—DEXTROSE.

Light.—The incident ray makes an with the surface of the water, and angle of 60° with a perpendicular to The reflected ray will also make and 60° with the surface and perpen- ctively (since the angles of incidence n are equal). Now, since by the angles and reflection are meant the angles erpendicular, the answer is 60°.—

Preservation of Fruit.—Try the ugar again, and make it strong. When in the water-bath, keep them there nd their contests have acquired the of the boiling water. You did not n the boiling water long enough, so the ms were only "scotch'd not kill'd." ur's work on "Fermentation," then w what you are about.—DEXTROSE.

Casting. — In making a jacketed simplest way is to make the jacket halves, and have the pattern in two g a flange at top, as shown, having les, either to fasten a blank flange on cover to cylinder. Always contrive to nd, as they are much cleaner castings; g the lines in the cylinders you will studs, as shown at D D, to keep the uter casing together. Bottom to be [illegible] as shown at B B, [illegible]

FIG. 1

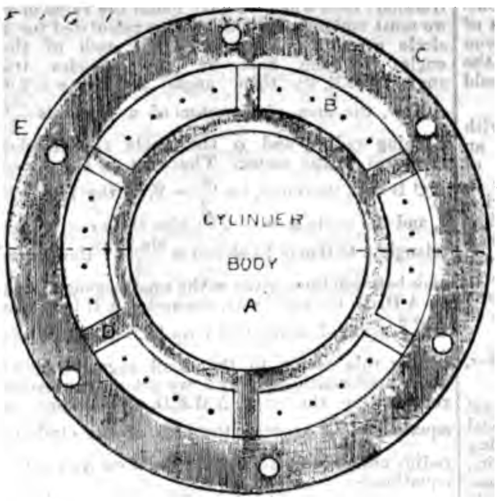


FIG. 2

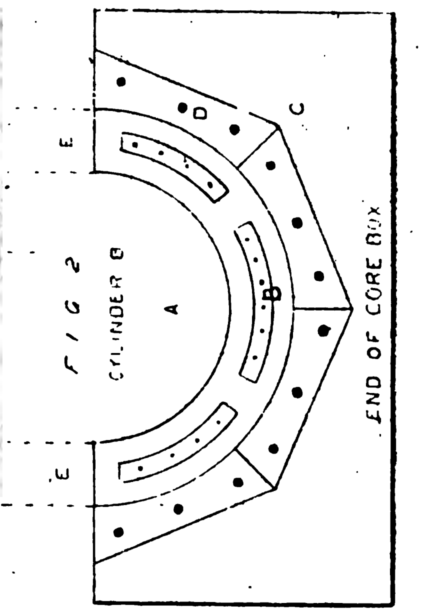
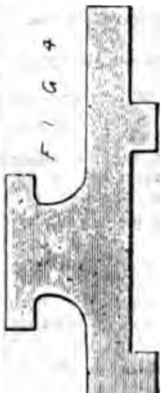


FIG. 4



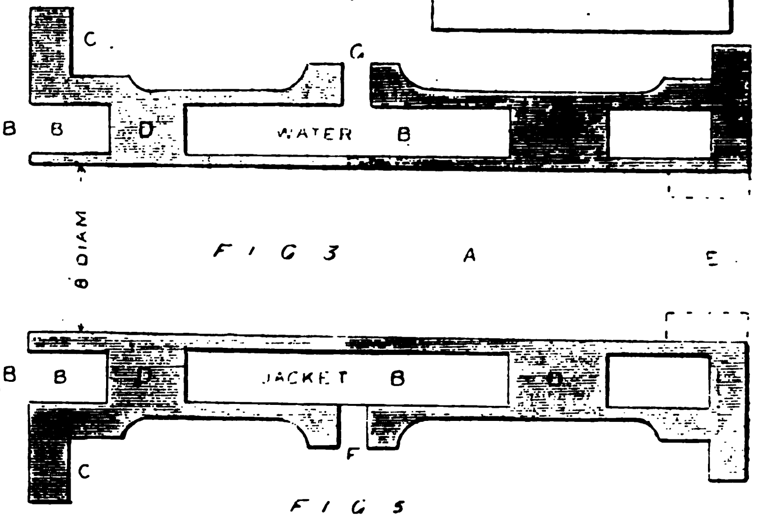


FIG. 3

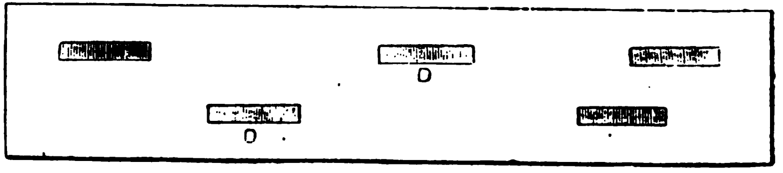


FIG. 5

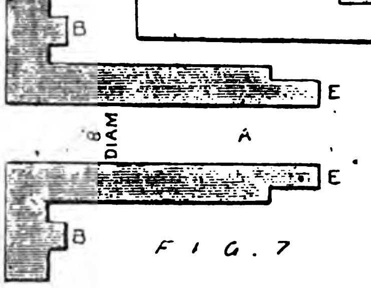
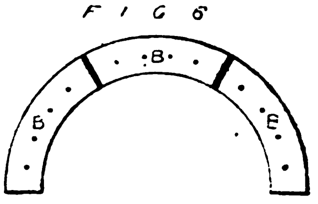


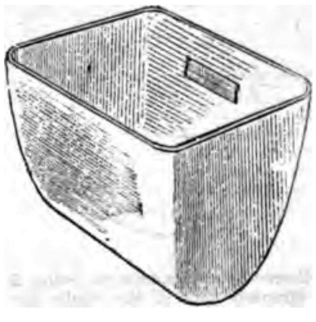
FIG. 7

FIG. 6



flange; E, bolt cores. Fig. 2. A, cylinder body; B, vents; C, showing end of core-box, showing end of luggs for outside of core-box; E E, showing thickness of casing, cores both ends to be the same, the inside to be strickled with a straight strip. Fig. 3, sectional view. A, body; B, jacket; C, flange; D D D D, studs; E, dotted lines, showing a neck when a loose liner is required, and bolted at the top as shown at B B; F, inlet; G, outlet. Fig. 4. Cylinder cover. Fig. 5. Showing the strengthening studs in jacket-core. Fig. 6. Core, iron cast, ⅜in. thick. Fig. 7, loose liner. A, body; B B, facings to fit in jacket; E E to fit in E of Fig. 3. Let the jacket-cores rest on chaplets, and cast on end.—SAND RAT.

[58405.]—**Elevators.**—The diameter of pulleys should not be less than 24in., or better, 30in., if they are required to do a good deal. For a 6in. bucket a 7in. face pulley will be wide enough if you raise the centre, say, ⅜in., this will keep the belt in centre and give you ½in. clearance each side, which will be sufficient. Buckets should never be made square: they are always liable to clog, and never discharge so well as round bottomed and round cornered ones. At a speed of 25 revolutions per minute, and buckets 15in. apart, 125 buckets will pass in a minute. Fill a bucket of the grain, &c., and weigh it 125 times; that amount will be discharged per minute; if that is not enough, put on more buckets. The above speed and space is about



right. The angle of cord marked X should be 1 if for flour, meal, or feed; less will do for corn. inclose rough sketch of bucket.—YOUNG MILLE

[58406.]—**Transmitter.**—To "C. L."—In l week's issue you give a description of a carl transmitter, seeing which I wish to construct one. You explain fully as far as fixing the pieces of carbon on a board, but I should be glad if you would be kind enough to describe how to fix the piece of deal as a sounding board. A sketch would greatly oblige, if necessary.—A NOVICE.

[58417.]—**Tarpaulins.**—Dress the sheets with boiled oil only, early in March, and hang under an open shed till dry: then give another coat of boiled oil, and sufficient black lead to darken it. The sheets must be spread out so that the wind can get both sides. If put out in the open they must be put under cover at nights and wet weather, but must be put in the day where the wind can get freely. If done as above to the letter, as to time and material, no better sheets can be produced. Coats and leggings should also be done in this way, and time.—E. K. B.

[58419.]—**Rust in Pipes.**—Stop the rain-water, and use hard.—E. K. B.

[58426.]—**Westcott Chuck Fitting.**—The best way to mount your chuck truly is to fit a cylindrical cast-iron chuck to the mandrel of a screw-cutting lathe, the diameter of chuck being about 2½in., projecting ½in. beyond the end of mandrel nose. Face up the end of this chuck, leaving it a trifle hollow in the centre, also turning the cylindrical part quite true. Now set your Westcott chuck jaws with the steps inside, and fasten the chuck on to your turned cast-iron piece. See that the face of the Westcott chuck beds truly against the turned end of your cast-iron chuck; revolve the lathe slowly, and correct any error with the screw key. Having secured the chuck quite true, bore and screw in the usual way. Any attempt to screw these chucks other than in a screw-cutting lathe will end in failure. Further details with pleasure if required; also replies to your other queries, if you like to address—B. J., 54, Brighton-road, Cheltenham.

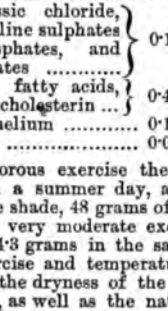
[58433.]—**Analysis of Perspiration.**—Normal sweat is a more or less clear and transparent fluid, specific gravity 1·004. The reaction is alkaline; but as to this, authorities differ, some stating it to be acid when freshly collected, and becoming alkaline after standing even half an hour.

Water	98·88	per cent.
Solids	1·12	„
Sodic chloride	0·22 to 0·33	per cent.
Potassic chloride, alkaline sulphates phosphates, and lactates	0·18	per cent.
Fats, fatty acids, and cholesterin	0·41	„
Epithelium	0·17	„
Urea	0·08	„

During vigorous exercise the hand and forearm give off on a summer day, at a temperature of 28° C. in the shade, 48 grams of sweat in one hour; while with very moderate exercise in a room at 18° C. only 4·3 grams in the same time. In addition to exercise and temperature, the quantity is affected by the dryness of the air, the amount of fluid drunk, as well as the nature and quality of the food; but the activity of the skin depends largely on the state of the kidneys. Mental conditions also exert a considerable influence on the secretion of the sweat.—DEXTROSE.

[58447.]—**Crank.**—I should advice you to purchase forgings of three-throw cranks from some firm having special presses for bending them, such as Clark's Crank Company; as they can make them at a much lower price, and more accurately than an ordinary smith. If, however, you wish to forge yourself, you will find it easier to get them exact by first bending your cranks all in a line, and afterwards heating the shaft between cranks, and bending round separately.—E. N. B.

[58436.]—**Ten Acres.**—This problem is more difficult than it appears to be at first sight; but it makes a good exercise, as the results are neat. The larger circle in the diagram contains ten acres; a horse is tethered by a rope, one end being fixed at B on the circumference of the circle, the horse having the "run of his teeth" as far as the tether will permit. Let B D represent the length of the rope, required to find its length when the space A B E D contains one acre. It will save trouble to consider the radius B C = 1, and the radius B A or B D = x, which will, therefore, be some proper fraction; then when we have found the value of x, we must multiply it by the radius calculated for a circle containing ten acres. Call each of the angles at the base of the isosceles triangle A C B, θ; then, angle A C B $= \pi - 2\theta$.



Now, the area of a sector of a circle is $\frac{r^2\phi}{2}$ r being radius, and ϕ the angle (in circular measure) of the sector. The area of the sector A C B will, therefore, be $\frac{\pi}{2} - \theta$, as the radius is 1, and the angle is $\pi - 2\theta$; also the area of the triangle A C B may be shown $= \frac{\sin.2\theta}{2}$; the difference between these gives us the small segment lying on A B. In the same way, the sector A B D will be $= \frac{x^2\theta}{2}$, which is equal to $2\theta \cos.^2\theta$, as $x = 2\cos.\theta$; adding this sector to the small segment found above, and multiplying by 2, we get an expression representing the area A B E D. This must be equated to $\frac{\pi}{10}$, as π is the area of the circle to radius unity, and after some reductions we get the equation—

$$\text{Sin.}\,2\theta - 2\theta\cos.\,2\theta = \frac{9\pi}{10} \quad \text{.................}(1)$$

The value of θ could be found by the trial and error process from this equation; but a more legitimate way is as follows: we have $\frac{x}{2} = \cos.\,\theta$ $\therefore \cos.^{-1}\left(\frac{x}{2}\right) = \theta$. Now, in works on the differential calculus this is developed into a series of which the first terms are $\frac{\pi}{2} - \frac{x}{2} - \frac{x^3}{48}$, the remaining terms being so small as not to affect the result: twice this will therefore $= 2\theta$, and must be substituted in equation (1). Also, it will be found that $\cos.\,2\theta = \frac{x^2}{2} - 1$, and $\sin.2\theta = x\sqrt{1 - \frac{x^2}{4}}$; if this root be worked out we get a series; but only the first two terms may be taken, the remaining terms being very minute, so that $\sin.\,2\theta = x - \frac{x^3}{8}$. Having substituted these and rearranged the terms, we obtain finally $x^2 = \frac{2x^3}{3\pi} + \frac{1}{5}$. Now, the first term on the right being much smaller than the others, we may (in order to get a first rough approximation to the value of x) suppress it altogether, and thus we get $x = \frac{1}{\sqrt{5}}$, roughly. Now replace the term, subitituting the above for x in it, and find a new value of x by taking the square root of the sum of the two terms on the right, and thus we get a more correct value of x. If this be repeated again, we get x correct to four places. It will be found $= ·4713$. Now, the radius of a circle containing 10 acres is 372·36ft. Multiply this by the value of x just found, and we get 175ft. 6in., the length of the tether, which is correct to an inch.—M.I.C.E., Bath.

[58449.]—**Cutters for Grooves.**—You may have the cutters any diameter you please, provided the circumferential speed does not exceed 15ft. to 25ft. per minute. Turn the blank the exact shape you wish to make your grooves. For a 4in. cutter ¼in. would be a nice pitch, making 50 teeth; back the teeth off only slightly; for cast iron, say, make the teeth ⅛th bare deep. The right speed for a 4in. cutter would be about 20 to 25 revolutions per minute.—E. N. B.

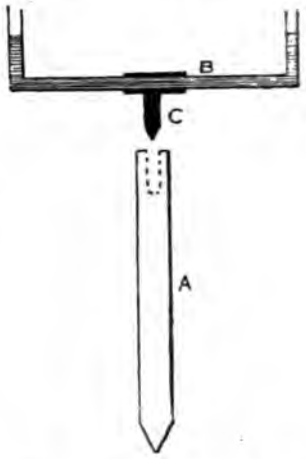
[58450.]—**Small Cylinder Pattern.**—In making the pattern of cylinder, make core print at the end of cylinder where flange is, the same size as the inside diam. of the flange. Tell your moulder to rub a 4in. core down to the desired size of hole 3. Tell him the thickness of the flange 4, and he will mould it for you all right.—T. OLD.

[58158.]—**Speed of Lathes.**—You will find the proper speeds for cutting metals in Professor Rankine's "Machinery and Millwork," as under:—

Material		Ft. per minute.
For white cast iron, about		5
For steel and grey cast iron, from		10 to 20
For wrought iron	„	15 to 25
For brass and bronze	„	40 to 100
For wood	„	300 to 2,000

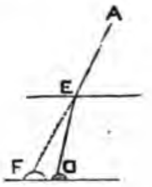
Higher speeds may be used for planing, and for ordinary turning where the tool and the cut surface are freely exposed to the air than for drilling and boring.—E. N. B.

[58159.]—**Dumpy Level.**—Querist should give more particulars. Does he require a telescope or plain sights? If the latter, perhaps the inclosed may suit him: A is a rod (to be driven into the ground) with a hole in top, into which is fitted about 2in. of ¾in. gaspipe; B is a glass tu
as shown, with stem C to fit brass pipe.
glass tube to about half-way up the ste
coloured water. If Johnny Nash says wl



wanted for, and whether his tripod is an
level tripod or not, I will be glad to giv
help.—J. STANYAN BIGG.

[58461.]—**Perspective.**—R. A. R. Ber
not have given the figure on p. 389 ver
attention, as it is utterly wrong as regar
If the eye be at A, and the stone at D, it is
impossible for there to be such a ray o
either D A or F E A. Rays passing out of
deflected from the perpendicular—that is
from D, to reach the eye at A, must cross
F E, which is drawn in the Fig. on p. 38



This deceives the eye, and the stone appear
on the line E A continued (i.e., at F). To a
who knows anything of optics the passage gi
p. 389 is unintelligible; to one who does not
stand optics, and does not intend to learn it
still rather indefinite, but the error is unimp
Nevertheless I must say that I think it wou
better to make both agree, especially as the
spective is not wrong in the one case, a
doubtful in the other.—A. B. S.

[58464.]—**Hot-Water Joints.**—One
ammoniac (by weight), 2 flowers of sulph
iron borings; or, 2 sal-ammoniac, 1 flowers of
phur, and 200 iron borings. Mix into a
with water. The latter is the better cement i
for immediate use. The first is slow, the l
quick setting.—J. STANYAN BIGG.

[58464.]—**Hot-water Joints.**—After p
your pipes in position, drive in tight all r
some spun yarn (or a piece of rope unravelle
do) well smeared with white lead, leaving
half the space for the cement, which is simpl
cast-iron borings and sal-ammoniac and
Make about the consistency of mortar, only a
quantity of sal-ammoniac will be required to
it rust up.—E. N. B.

[58466.]—**Flexible Compound.**—Gutta-
or printer's roller composition will fulfil cond
required if the water is not hot.—J. STA
BIGG.

[58470.]—**Breaking Strain of Tim**
Molesworth gives the formula $\frac{4KBD^2}{L}$, wh
beam is supported at the ends and loaded
centre; $\frac{8KBD^2}{L}$, when the ends are *suppor*
the weight distributed; and $\frac{12KBD^2}{L}$, wh
ends are *fixed* and the weight distributed.
B = the breadth of beam, D = depth
L = length of beam or span, and K = co
of rupture, which varies with the mate
For pine it is given as 12. **Note.—The sh**
the *breaking* weight in cwts., not th
J. STANYAN BIGG.

[58464.]—**Hot-W**
for "Ignorant" to
is not in a proper co
the sockets perhaps

mean the brown powder which sometimes collects, it is brown oxide of manganese. 2nd. The carbon rods used in the Leclanché can also be used for a Bunsen, but being, comparatively speaking, small, and presenting but little surface, are not so well adapted as the regular carbon blocks used in the Bunsen. 3rd. Yes, the addition of bichromate prevents fuming as long as it lasts; but why not employ a bichromate cell at once, and thus get rid of the nitric acid altogether? The addition of bichromate does not lower the efficiency of the cell; on the contrary, it heightens it. 4th. Five quart Bunsens will light well a 5-candle Swan lamp having a resistance of about 8 ohms.—S. BOTTONE.

[58524.]—**Cupola.**—I have made many casts out of cupola heavier than 12cwt. I find the best way is to melt the tin and spelter in the ladle with lump charcoal or wood; melt the copper only in cupola. Don't tap the copper till all is melted if you can help it; tap the copper to the melted tin, &c., and you will have it hot enough for anything. If you put the tin and spelter in the cupola, you will burn it and spoil the mixture.—PRACTICAL BRASS CASTER.

[58525.]—**Oxide of Iron.**—Of course a chemical change occurs as the gas passes: the sulphuretted hydrogen is decomposed into water and sulphide of iron; this latter, on exposure to air, decomposes again into oxide of iron and free sulphur.—SIGMA.

[58525.]—**Oxide of Iron.**—By the action of the SH_2 in crude coal gas the hydrated oxide of iron is reduced to ferrous hydrate with separation of sulphur and water. On subsequent exposure to air the ferrous oxide becomes peroxidised, and it can then be used again until it contains about 40 per cent. sulphur. It is then used to make H_2SO_4.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-upon-Tyne.

[58527.]—**Legal.** — The agreement will hold good, as it has been homologated by the widow acting upon it, living in the house and paying the rent. If she tries to repudiate it she will place her son in a nasty position, and still will not get quit of the responsibility.—B.SC., Plymouth.

[58527.]—**Legal.**—As the widow has always paid the rent, and thus ratified the agreement, I should sue her for the repairs, on the ground that she has authorised the signing of her name thereto. Does she prefer to have her son accused of forgery to discharging her proper liability?—B. H.

[58529.]—**Amyl Alcohol.**—A somewhat useful test for the detection of amyl alcohol is to place a piece of filter paper on a white porcelain tile or basin, and pour on it some of the spirit to be tested. On allowing it to evaporate spontaneously, or by the application of a very gentle heat, the smell of amyl alcohol may often be detected, especially by very slightly warming the residue. Another very useful method is to distil off as much as possible of the spirit, and to the residual liquid add water until the liquid has a specific gravity of about 0·985. About an equal volume of ether is then added, and the whole well shaken in a separator and allowed to separate. If the etherial layer does not separate directly, add more water. Separate the etherial layer which contains the amyl alcohol from the bottom liquid; allow the ether to evaporate spontaneously. The residue may then be tested for amyl alcohol by its smell and chemical character.—HENRY J. HARDY.

[58531.]—**Pure Chalk Caustic Lime.**—"Dandie Dinmont" can readily obtain from any respectable chemist pure calcium oxide (caustic or quicklime). Should he, however, prefer making it himself, his best plan will be to obtain some pure precipitated calcium carbonate and ignite it at a bright red heat in a platinum dish in a muffle furnace.—HENRY J. HARDY.

[58532.]—**Physics.**—Let v = velocity of bullet in centimètres per second; m = its weight in grammes; and s = its specific heat. Then $\frac{m v^2}{2 \times 981}$ = energy in gram. centimètres, and as Joule's equivalent for gram. centimètres is 42100, we get for heat in gram. degrees $= \frac{m v^2}{2 \times 981 \times 42400}$. This amount of heat will raise the bullet $\frac{m v^2}{2 \times 981 \times 42400 \times m \times s} = \frac{v^2}{2 \times 981 \times 42400 \times s}$ degrees C. Hence we have— $v^2 = 2 \times 981 \times 42400 \times s \times 100$; where s = ·0314, from which (by logs.) we obtain v = 16161 centimètres per second. It is interesting to notice that the velocity needed is independent of the weight of the bullet.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-upon-Tyne.

[58532.]—**Physics.**—The mechanical equivalent of heat is 425 kilogrammes per calorie: that is to say that the quantity of heat necessary to increase 1 kilogramme of water by 1° of temperature, would be sufficient if it was used as a mechanical force to lift 425 kilogrammes to the height of 1 mètre. As *you do not give* the weight of bullet and target, I assume the bullet to weigh 100 grammes, and the target to be of cast iron and weigh 1,000 kilogrammes. Let us suppose, first, that we have 1,000 kilogrammes of water. If the bullet weighed 42,500 grammes, a velocity of 1 metre per second would increase 1 kilogramme of water by 1° of temperature. If the bullet weighs 100 grammes, a velocity of 4,250 mètres per second would increase 1 kilog. of water 1° of temperature. Therefore, to raise the temperature of 1 kilogramme of water 1°, the bullet must have a speed of 4,250 mètres a minute. To raise the temperature of 1,000 kilogrammes of water 100°, the bullet must have a speed of 4,250 × 1,000 × 100 = 425,000,000 mètres per second. But the target is of cast iron, and cast iron has a specific heat of 0·17, therefore the bullet must have a speed of 425,000,000 × 0·17 = 72,250,000 mètres a second, or 722,500,000 centimètres a second = 7,225,000 kilomètres a second. The whole sum is a simple rule of three. I have not allowed for friction of the air, nor for the angle under which the bullet strikes the target. The above calculation is evidently for the case of 90°. Such a speed is quite impossible, for light only travels 308,000 kilomètres a second; unless you increase the weight of the bullet, the above result would be quite impracticable.—LIEGE.

[58532.]—**Physics.**—The mechanical equivalent of heat = 42100 gram. centim.—i.e., one gramme falling 42,400 centimètres would develop one unit of heat. Let us now find velocity with which a body would reach the ground after falling 42,400 centim. We know—

$$V^2 = 2gs. \text{ (now } g = 981, \text{ and } s = 42{,}400)$$
$$= 2 \,.\, 981 \,.\, 42400$$
$$= 83188800$$

∴ V = 9120 centim. per sec., and a body moving with this velocity (whether a falling body or not) would develop one heat unit; but the bullet will require 100 × ·033 (spec. heat of lead) units to raise it 100°, and since heat developed varies as velocity, ∴ ans. = 9120 × ·033 × 100 = 300960 centimètres per sec. Note.—The weight of the bullet may be neglected, since it equally affects both the heat generated and required.—BANGOR.

[58533.]—**Iron Tank.**—You should have roughly patched the holes first, or stopped them with rust cement, using the Portland cement and sand only as a strengthener. There is no union between this cement and the iron, and the water finds its way through the joint by capillary attraction and pressure. You might succeed by cutting a groove along the edge of the cement, and when quite dry running in hot pitch, which would adhere to the iron, if that were warmed with an iron or a gas flame as the pitch was run in.—SIGMA.

[58534.]—**Metal Moulds for Vulcanite.**—TO "DENS."—When I sent the reply to this query I considered it had regard to the vulcanising of small articles requiring to be brought out with a finished surface, such as copies of medals, coins, or carved articles in half-relief, and in such cases grain tin moulds had proved thoroughly satisfactory. But as "Dentist" wants information in regard to the use of tin in dental cases, I may say that, along with two other friends, at a deal of expense, time, and trouble in experimenting, we came to the conclusion that the benefit was not in proportion to or worth the trouble, besides the loss from broken teeth; the only exceptions are in artificial vela and full upper and lower cases with little or no undercut. For the inner palate of a case cast the plaster model in the sand (same as for zinc), dry thoroughly, and pour in the tin; but as the model must be shallow, so as to go in the flask, pour just enough as will go a shade deeper than the case; when cooled and dry, put case on tin model and cast in the flask as usual. In my own practice I very seldom use the tin, as with the whalebone rubber I have no difficulty with the plaster sticking beyond what a stiff brush can take away; but I always put a bit of soda in the boiling running-out water, so as to leave no trace of wax or grease.—DENS.

[58536.]—**Bisection of a Triangle by a Straight Line Drawn Through a Given Point Within or Without It.**—Find the centre of gravity, then a line drawn through centre of gravity and given point will bi-sect the triangle.—ELAG.

[58537.] — **Bisection of a Triangle.** — Bisection of a triangle ABC by a straight line TP*t* through a given point P. 1. Ascertain by observation which angle A of the triangle ABC must be cut off by T*t*. By Eucl. VI. 25, draw H*h*, so that AH = H*h* and triangle AH*h* = ½ ABC. Bisect H*h* by the perpendicular AV, and in AV produced take AS = AH. Now S is the focus, V the vertex, and AB, AC the asymptotes of an hyperbola, every tangent of which forms with AB, AC a triangle = HA*h* = ½ ABC. It is required to draw through P a tangent to this hyperbola with radius AV. Describe the auxiliary circle cutting the circle on SP in K (or *k*). Then PK, P*k* are tangents to the hyperbola. ∴ PK or P*k* produced to meet AB, AC cuts off a triangle TA*t* = HA*h* = Proof obvious.—VERBUM SAP.

[58538.]—**Mathematical.**—Vega give

$$e = 2{\cdot}7182818$$
$$\log e = 0{\cdot}4342945$$
$$\pi = 3{\cdot}14159265$$
$$\log \pi = 0{\cdot}4971499$$

The nearest approach to π in vulgar would be $\frac{355}{113}$, which gives 3·14. For e = of Napierian logarithms, the limit of $\left(1 + \frac{1}{m}\right)^m$ for $m = \infty$ is e, and one find

$$e = 1 + \frac{1}{1} + \frac{1}{1 \times 2} + \frac{1}{1 \times 2 \times 3} + \frac{\ }{1 \times 2}$$

The demonstration would be too long fo query.—LIEGE.

[58538.]—**Mathematical.**—Perhaps over 200 figures would suit "Ratio," her — 3·14159265358979323846264338327950 2 399375105820974944592307816406286208 5342117067982148086513282306647093844 317253594081284847378139203863383021 2593125912940183280651744, &c. The a proximate) number, representing the cumference to diameter of circle, may from the following easily rememberd ser series be carried far enough.

$$\text{Ratio} = 4\,(1 - \tfrac{1}{3} + \tfrac{1}{5} - \tfrac{1}{7} + \tfrac{1}{9} - \tfrac{1}{11}$$

Much more *rapid* series may be derived one by suitable mathematical meth ratio, 355 : 113, is more than sufficient ary purposes, and may be easily remem noticing that when inverted for divisi 113 / 355, we have the odd numbers five. This division actually performed the first mentioned number correct to 3·141592, &c.—W. G. HOWARD.

[58538.]—**Mathematical.** — The rati cumference to the diameter expressed by letter π is expressed in several forms. to two places, and $\frac{355}{113}$ correct to six plac latter form is quite accurate for all pract poses. The absolute value of the r follows:—

$$\frac{\pi}{4} = 4\,\Sigma\biggl(\frac{1}{(2n-1)} \times \frac{1}{5^{2n-1}} \times (-$$

$$- \Sigma\biggl(\frac{1}{(2n-1) \times 239^{2n-1}} \times (-1$$

Here Σ = sum to infinity of the serie by putting for n, 1, 2, 3, &c., successivel base of the Napierian logarithms, know symbol "e," can be computed from this se

$$e = 1 + 1 + \frac{1}{1.2} + \frac{1}{1.2.3} + \frac{1}{1.2.3.4}, \text{ \&c., to}$$

= 2·8182818............ I may add, there some fancy expressions or series for π—

$$\frac{\pi^2}{6} = \Sigma\left(\frac{1}{n^2}\right)$$

$$\frac{\pi^2}{8} = \Sigma\,\frac{1}{(2n-1)^2}$$

$$\frac{\pi}{2} = \frac{4}{3} \times \frac{16}{15} \times \frac{36}{35} \times \frac{64}{63} \times \ldots \frac{4n^2}{4n^2-1}, \&$$

JOHN T. LAWRENCE, B.A.

[58541.]—**Storage Battery.**—TO The completion of the charge is indicat bubbling off of the oxygen and hydrog which are no longer absorbed. No damage is done by this, except the waste The solution undergoes no change, except water by decomposition and by evapora little acid spurted away with the gases: the to be made good by the addition of wate quired. The surface of plate required per hour depends on the depth to which the peroxidised (see reply to 58509 above). the storage capacity depends also upon the of liquid present; that is to say, there sufficient acid present to effect the changes required, and to maintain the at all periods of the working, which take of the solution: beyond this the quantity has no influence on the capacity. I may all these points are fully explained in the devoted to secondary batteries in the sec of my "Electricity," from which I quote ing remarks as to the particular point thickness of the lead must be sufficient own weight and the strains put upon it the peroxide plate should therefore be as thick as the other. For ordinary pur probable that sheets of 1½lb. and 1lb. we advantageous, with the formation carried to convert ½lb. of the lead to peroxide plate. Space for acid must be allowed to effect the action, therefore the dist plates must be so adjusted. One po requires ½lb. of acid to convert it int as by the foreg [illegible] proportions th of lead to be [illegible] the opposing per [illegible] ch, diluted as 1 to 10, would be ace of half an inch between the

:on and Wool Solvent.—Cotton, f the forms of cellulose, may be ool by means of an ammoniacal ic oxide, in which it is soluble. in a solution of sodium or potasp. gr. 1·05. Cotton is not; hence means of separating wool from J. HARDY.

Injection.—To convert your r into a jet-condenser, you will umber of your tubes, whose comreas shall be equal to the area of ion. Then your circulating water d through your air-pump discharge

fre's Domestic Motor.—No d, as the steam is what is known water lubricates.—S. R.

ery Wheels.—Of course, there is t hot. Use water. Let it drop t where the tool touches.—LEI-

aery Wheels.—If "Mechanic" per of tools by sharping them on e must be very careless or very MAN.

ery Wheels.—Keep your finger f your tool, and directly you find warm plunge it into a bucket of sed to grind nearly all my tools on ry wheel.—E. R. DALE, F.S. Sc.,

ery Wheels.—The way to rectify lip the tool in cold water as you se there is danger: the tool really very time it is made hot. If for a lly does not matter at all; but it ver to run to emergencies unless .—READER OF MECHANIC.

tract.—I should get an estimate sary to complete the house accordnent, and then sue the builder for refused to finish the house within . As, however, the correspondent mployed a man of no substance, he whether he may not "throw good " by legal proceedings.—B. H.

to-Micrography.—In reply to ull account of apparatus for obopic photographs of microscopic s understood, appear in the next *ournal* of the Royal Microscopical PHILLIPS.

mshurst Influence Machine.—RST."—It is unnecessary to grind ly rub them with another piece of he cutting edge. A coat of shellac edge is good.—J. W.

itting Air-Gun Valves.—They n. I have tried wood, but the air through the pores. I have tried rass valve, without success, and t a new valve cannot be fitted in ps some Birmingham reader would DALE, M.S.A.

nalling.—Small arms are provided ggers," I believe, as they cannot elevated semaphore. I cannot say improvements have been made at Junction; but there are some adosts, and a new box which overine.—NUX. DOR.

logical Thickness.—The strata the surface of the earth vary in 0 to thousands of feet. But, of nation is not at its thickest at the the others. The thickest known ta is measured, and all these are —LEICESTER.

ological Thickness.—Suppose you a slice of particularly rich he sugar will represent the first um, the almonds the next one, itself would be the third. The h layer is what is called the thickm. This very practical example it clear to you.—R. A. R. BEN-

logical Thickness.—The stratias the Silurian, Old Red Sanderous Limestone, Millstone Grit, Magnesian Limestone, and the rest, ured approximately by the geologing the thickness of all the strata y find the sum of these to be so t he never finds all the strata in [illegible] her, althou [illegible] w the sa

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

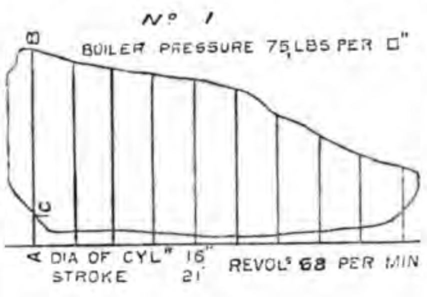
Since our last, "Glatton" has replied to 56934, 57034, 57093, 57194, 57253, 57259, 57353, 57362, 57505.

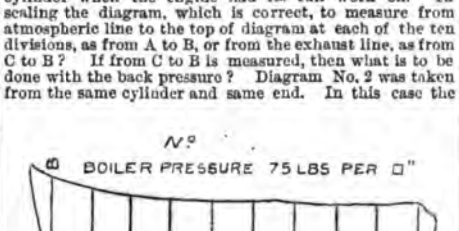
57946.	Tractive Force of Compound Locomotives, p. 210.
57950.	Chemical Reaction in Wall Paper, 210.
57965.	Carbon in Ferro-Manganese.—Eggertz's Method, 210.
57971.	Extracting Dye, 211.
57973.	Winding Engine, 211.
57974.	Cleaning Prism of Binocular Microscope, 211.
57988.	Screw-cutting, 211.
58181.	Sugar Inversion, p. 288.
58184.	Balancing Locomotives, 288.
58191.	Legal, 288.
58214.	Shooting Stars, 289.
58216.	Satin Wall-Papers, 289.
58217.	Fire Gilding, 289.
58227.	Lathe Qnery. To Mr. J. H. Evans, 289.
58237.	Load on Girders, 289.

QUERIES.

[58560.]—**Iron for Field Magnets.**—Are field magnets made in malleable iron castings susceptible of the same degree of magnetic saturation as those made from wrought iron, and, if not, to what extent do they differ? I am constructing a dynamo of an expensive description, and require the most recent and reliable information upon the above point.—LUX.

[58561.]—**Indicator Diagrams.**—Will some reader kindly enlighten me on the following? The inclosed diagrams are taken from a double cylinder horizontal high-pressure engine, with cylinders 16in. dia. by 21in. stroke; boiler pressure, 75lb. per sq. in. Diagram marked No. 1 was taken from the outside end of right-hand cylinder when the engine had its full work on. In scaling the diagram, which is correct, to measure from atmospheric line to the top of diagram at each of the ten divisions, as from A to B, or from the exhaust line, as from C to B? If from C to B is measured, then what is to be done with the back pressure? Diagram No. 2 was taken from the same cylinder and same end. In this case the engine was running light—that is to say, the engine was driving the shafting in shops only. The straps of the machines were running on their loose pulleys. When this diagram was taken, the expansion valve lever was held down, thus bastardising the engine and allowing more steam to enter the cylinders. In this case the diagram stands very high above the atmospheric line, and the back pressure is enormous. How shall I go to work to find out the H.P. the engine was exerting? and if the area of the figure only is to be taken for the mean steam pressure, then what is to be allowed for the back pressure which is against the engine?—SYDNEY.





[58562.]—**To Mr. Wetherfield.**—I have had a legacy left me by my aunt, and she says in her will: "I leave to my niece, Mary Brown, fifty pounds," and nothing more is stated. Can my husband claim the money legally, and, if not, will my own receipt only be sufficient for the executor?—ONE MUCH TRIED.

[58563.]—**To Mr. Wimshurst.**—I have followed out your instructions in making an electrical machine, excepting that I have used two 17in. ebonite discs, and have carried the foil of Leyden jars higher on the outside than inside. The result is total failure. Please tell me if you think the cause lies in the brushes. I mounted these [illegible] two years ago, and had a deal of trouble with the [illegible], and at last succeeded by using large ones and [illegible] a regular contact by springs behind. Believing your last plan of corporating Leyden jars in machine is a good one is why I have remade mine. I am making larger brushes, thinking that the plates must be excited by friction.—AN AMATEUR.

[58564.]—**Accumulators.**—How long should it take to fully charge six Planté secondary cells (new) with three bichromate cells? and I should be pleased to know how it is that, after partially charging them (coupled in quantity), on discharging them (coupled in tension), I get very little more power than I get from one single cell—not sufficient to light an 8-volt lamp?—F. W. MUNCEY.

[58565.]—**Microscope Stand.**—I have the following parts of a microscope, viz.:—Body tube (9½in. long) fitted with eyepiece and objective, sliding in an outer tube, in which it is movable by a rack and pinion: a collar and arm, into which this outer tube screws; also a circular brass stage and a mirror, with the usual semicircular support. I have rigged these parts up on a very rudimentary stand, consisting of a wooden upright mortised into a wooden base; but find it very inconvenient to work with. Can any reader oblige me with any hints on the construction of a simple and efficient inclining stand, within the power of an amateur to construct, with arrangement for fine adjustment if possible?—SCIENCE STUDENT.

[58566.]—**Fusee Pivots.**—Will some practical reader explain the best means of repairing the above? Also the best means for securing in the turns for repolishing same?—A. R. T.

[58567.]—**Lever Escapement.**—Will some practical watchmaker explain the action of the club tooth pallet wheel: its difference from the straight-tooth wheel? Also the best means of replacing Waltham pallet jewels?—A. R. T.

[58568.]—**Watch Turns.**—I have small-sized turns, and have drilled the two runners for use; but fail to turn down a very short pivot, as I cannot get the graver sufficiently close. I shall feel greatly obliged if any reader will tell me probable cause. Also, which is the best way of pointing piece of steel intended for pivot before placing in turns?—A. W.

[58569.]—**Spring Gun.**—If the spiral spring required for the purpose I mention below be described to me by any of your readers, so that I may be able from the description to order one to be made, I shall be greatly obliged. A spiral spring, 2½in. diam., and not more than 1½ft. long when open, to shoot from a barrel a lawn-tennis ball 2½in. in diam. and 2oz. in weight, to a distance of 40yds. before it touches the ground, which is level when the barrel is horizontal, and 3ft. above the ground.—J. DENMEADE.

[58570.]—**Size of Shaft for Cornish Boiler.**—Will some brother reader inform me what size the shaft for a Cornish boiler, 14ft. by 4ft. 6in., should be? Size of grate, 3ft. 4in. by 2ft.; height of shaft to be 46ft to 50ft. Internal size of shaft most needed. Is there any standing rule for boilers of different sizes?—A. BREWER.

[58571.]—**Difficulties in Collodion Process.**—Some few weeks since, I commenced to do do some copying, which I decided to do by collodion. All my results have been poor and thin, the deposit granular when seen with a magnifier, and the shadows clogged. At first, thinking the bath might be alkaline, I tested and made sure it was slightly acid. Then I made more than a dozen new developers with varying proportions of acid and iron, and several strengths of pyro-developer. After each change I made several trials; but the results being no better than at first, I tried half a dozen other samples of collodion—new, old, and mixed in various proportions. Lastly, I conducted all my operations at a higher temperature; but all to no purpose, and I cannot yet produce a negative fit to be seen. I see I have omitted to state that I made two new silver baths in addition to the changes mentioned above. As I can find nothing in the text-books to help me, I come to the MECHANIC, in the hope that someone will be able to point out the probable cause of failure. I am at present utterly non-plussed and very much annoyed, as ten years since I used to produce faultless collodion negatives, and have never before met the difficulty that now besets me. Is my silver nitrate likely to be at fault? It seems scarcely likely, as the same sample gives splendid gelatine negatives, and my first bath was made with a different sample from the last two. Still, I would try a fresh sample only that I have a large stock. I may say that my dark room is perfect. I shall be very grateful for any hints, either from those who have encountered a similar difficulty or from others.—F. V. B.

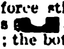
[58572.]—**Minute Fancy Photographs.**—How are the tiny photos. produced that are sold by fancy stationers mounted on penholders and many other useful and fancy articles? They appear to be placed at one end of a small rod of glass, which is ground at the other to the form of a lens. They are, I believe, made only in France, and one would imagine the process to be easy, as a variety of articles containing them are sold retail at sixpence each. A description of the way they are made would be very interesting, though I, for one, would be thankful for a reference to a description, if the latter cannot be given.—F. V. B.

[58573.]—**Chemist and Druggist.**—I should like to know if there is any means of commencing business as a chemist without becoming apprentice to a chemist and druggist. I have a good knowledge of general chemistry and some of pharmaceutical chemistry, and am fairly well practised in qualitative and quantitative analysis. Considering this and my age (29), I should consider an apprenticeship as simply a waste of time and money, and should, therefore, be very glad to know if there is any other way of qualifying?—F. V. B.

[58574.]—**Joy's Valve Gear.**—Is the experience of the G.E.R. and Midland Railways favourable to this gear, with regard to its wearing qualities and its giving a good distribution of steam? Is it true that the G.E.R. have reverted to the old link motion in their newest tank engines?—H. E. A.

[58575.]—**Replacing Wooden Cogs of Bevel Wheel.**—I have a bevel wheel filled with wooden cogs which I want to replace with new ones. Would any reader kindly give me a few hints as to the manner of pitching teeth and finding pitch circle? Is there any work published on the subject?—YOUNG MILLER.

[58576.]—**Aluminium.**—Being desirous of reducing a few ounces of aluminium metal, I should esteem it with the old one replaced. The tone is comparatively dead, especially on first string, and accompanied with a hissing sound on third string, and requires to be pulled out, instead of speaking easily.—PERFECTION.

[58579.]—Brick-making Machine.—Can any correspondent inform me if a brick-making machine, actuated by a screw, or rollers, would force stiff clay through a die having numerous holes of this  section in it? I now put the clay in a cylinder; the bottom is closed by a plate having the required holes. I have a plunger that fits the internal bore of the cylinder, which I weight to force the clay through the die. A very light pressure suffices to force the clay through the die at first, but after a minute or so the pressure has to be rapidly increased, and then the clay seems to solidify and refuse to pass at all, no matter what pressure is used. The question is: Can I get sufficient pressure in a machine to force the clay through the die? The drier the clay the better it will suit me, as it is less liable to be injured in the drying.—A. J. SELLS.

[58580.]—Launch Engine and Boiler.—I wish to make a launch engine for use next season, and should be obliged if any of your correspondents would kindly enlighten me on one or two points. I want to know how the bed-plates of these engines are usually made, and whether the longitudinal parts for fixing to boat are planed, and what rule, if any, is used for finding the proper length, and width, and thickness? How are the standards fixed to cylinder? Also I should like to have the construction of a horizontal tublar boiler described, as I wish to make one for the engine. A drawing, if possible, of both bed-plate and boiler would greatly assist, as, although an engineer, I do not understand this class of machinery, and where I live there are no launches which I could take for an example.—C. F.

[58581.]—Horse-power of Compound Engine.—Would anyone kindly tell me how to find the horse-power, both nominal and indicated, of a compound engine? I know that actual indicated power can only be found by the indicator; but I mean how to estimate what the indicated power would be. Must the intermediate pressure between the cylinders, or, in other words, the back pres. against the high-pres. piston, be deducted from the power exerted by the high-pres. cylinder, and, if so, how? Please work out an example in plain figures of an engine 6 and 12 cylinders, 7in. stroke, 80lb. boiler pres., 225 revolutions per minute.—COMPOUND ENGINE.

[58582.]—Clockwork Pedestrians.—There is a toy to be seen at some of the London shops in which there are two dolls connected by their hats with two horizontal wires, which revolve round a central tower like the hands of a clock. By some mechanism in their bodies, the effect of the clock-hands, dragging them along over a green-baize carpet, is to make their legs move alternately in a most natural manner. How is it done?—GLATTON.

[58583.]—Crackers.—How are these made? I shall be obliged to any reader who will give me instructions for making, say, three dozen quickly. I mean the fancy crackers, containing bonbons, &c.—GLATTON.

[58584.]—Magnetic Belt.—I wish to make a magnetic belt myself. Can any of "ours" inform me how to proceed? Will crinoline-steel pieces, say, 1in. long, properly magnetised, suit? In laying the pieces, must the opposite poles lie near each other or similar poles?—IOLO.

[58585.]—Cold Feet.—Can any of our readers give me a remedy for above? My occupation is of a sedentary nature; but even after exercise there is no appreciable change. Even in hot weather my feet are quite cold. On advised, for the benefit of a weak chest, to take the above voyage. I propose going by sailing ship, and shall be glad of information as to the best boats, the kind of outfit I ought to take for ship and colonial use, and also the best part of Australia to go to, and the sort of life one should lead for a few months whilst there. I am anxious to get away, as the present times are bad for my complaint, and shall therefore esteem an early reply, especially from anyone having been similarly affected and gone over the ground.—A. F. N.

[58592.]—Double Slide-Rule Problem.—In lat. 41° 53′ N., the sun's declination being 19° 50′, and altitude of centre 44° 7′, required the true Azimuth. Please show position of trigonometrical slide.—ORIENT.

[58593.]—Melting Snow.—Why does snow melt more quickly on iron than on stone or wood? Why does "frost" exhibit itself more strongly on wood than on stone?—NO SIG.

[58594.]—Chemical Bronze.—I shall be very much obliged if a reader will tell me how to rectify the error in the make of the above. The proportions are, 1 pint of nitric acid, three pieces of bluestone the size of a small marble, and as much copper as it will dissolve, which is about 2oz. After standing in a jar for about twelve hours, there is a solid piece of stuff, looking something like bluestone, with just a little solution on top. Of course, this is of no use (the solid part), the liquid being required for use; the article to be bronzed made warm, then dipped in soln., and held in a smokeless gas till black, afterwards brushed off; if wanted bright, hot varnished. This, I might mention, is only for certain metals. Shall be very glad for somebody to rectify this error.—READER OF "MECHANIC."

[58595.]—Moulding.—Could some brass-caster give me a little advice on the best sand to use, whether there should be any coaldust put in it, and whether it is usual to skin dry all moulds for small castings up to ½cwt.? I have been using Mansfield sand; but I have seen better castings than I can turn out with it; I can't get the skin and colour I should like.—PRACTICAL BRASS-CASTER.

[58596.]—Indigestion—Sarcina Ventriculi.—What are the symptoms, cause, and cure of the sarcina ventriculi fungus in the human stomach? What objective in the microscope is powerful enough to detect it, and what is it appearance?—A.

[58597.]—Fretwork Pattern.—Can anyone tell me how to take the pattern on paper of any piece of fretwork when you cannot procure the design?—H. E. IVATTS.

[58598.]—Midland Engines.—Are any of the 1730 class of express engines out yet, and, if so, what are their leading dimensions?—W. P. B.

[58599.]—G.W. Engines.—Wanted, full particulars of new No. 9, and if any more like her are being built? Also of a new broad-gauge single engine, said to be called Centaur?—W. B. P.

[58600.]—Hull and Barnsley Engines.—A brief account of these would greatly oblige—W. P. B.

[58601.]—Geometrical.—Would some mathematical reader of the ENGLISH MECHANIC kindly give a solution in pure geometry of the following? Show that an equilateral triangle is greater than a right-angled isosceles triangle, both being inscribed in the same circle.—PUZZLED.

[58602.]—Dynamo.—TO MR. BOTTONE.—Thanks for helping me, *re* my 500-c.p. dynamo. I should be glad if you would give me full details of a 500-c.p. Pacinotti ring, Gramme machine. Sketches would oblige.—P. WALKER.

[58603.]—Locomotive Experiments.—Can

of tools, and can eas
thickness should plates be? An
query will be thankfully receive

[58608.]—Legal. Can the
son (a bachelor) obtain letters
effects in intestacy, or what is th
case?—A. READER.

[58609.]—Copper and Co
manner is copper affected by th
sulphur, or zinc, to the extent
Why are the flanges of copper p
never attached by iron bolts?—

[58610.]—Light and Radi
me to any experiments on the l
through different kinds of glass
Swan lamp and the loss from
same? The narrowness of the br
to the eyes unless it is diffused.
any published experiments on th
tion from different surfaces—
R. R. WHITEHEAD.

[58611.]—Boiler.—Will any
what pressure I may be able to
made of copper with copper riv
and what would be best to hea
should inside dia. of safety-valv
what weight?—YOUNG BEGIN

[58612.]—Wimshurst Inf
have made one of these with
each, conductors being formed
foil, and mounted on long glass
electricity; but sparks betwe
¾in. long. Is there not somet
expected much longer sparks.
me a little information, statin
should be, &c.?—A. A.

[58613.]—Aneroid Barom
tell me how to reduce these to
SPEAR.

[58614.]—Magneto-Elect
medical magneto-electric machi
when it came into my possessio
some of your readers would kin
it. It has two horseshoe magn
the other, the points of horsesh
angles to legs. The upper mag
up, and the under 5in. legs. I
wound with cotton-covered wir
to these from a 4in. dia. brass w
grooved wheel fixed to pivot, o
top of box are two binding scre
on right side holding a p
electric connection with top o
screw, or stud, has no connectio
of sealing-wax is worn off the m
Should the coils touch the mag

[58615.]—Oscillating Cy
pattern for this cylinder made?
and outlets to be cast in cylin
Penn's slide-valve form require

[58616.]—Joy's Valve G
applied to oscillating cylinders
would greatly oblige—A. F. SH

[58617.]—Albumen Plate
—Are there any such in the ma
make them for his own use?—

[58618.]—Water Compa

NEW APPARATUS.

READY AND IN PREPARATION.

READY.

SAFETY BUNSENS (Fletcher's Patent). A new high-power Burner for confined spaces, small in size and of enormous power.

SMOOTHING IRONS, Self-heating (Fletcher's Patent), for fine Laundry work. Three sizes.

HIGH-SPEED BOILERS (Fletcher's Patent), for Boiling water **AT ANY REQUIRED SPEED** for Tea, Coffee, and Restaurant work.

LABORATORY BUNSENS for ordinary Chemical use.

IN PREPARATION.

A NEW ATTACHMENT FOR EXISTING GAS COOKING RANGES (Fletcher's Patent), for utilising the waste heat of the Oven in heating water for washing dishes, &c.

INSTANTANEOUS BATH HEATERS (Fletcher's Patent), for supplying **PURE** Water fit for Cooking or any purpose at any required speed.

NEW COOKING RANGES (Fletcher's Patent), for utilising the waste heat of the Oven in heating water. Five gallons of water heated 1° per minute, by the waste heat of the Oven without any cost whatever.

NEW FURNACES for Glass and China Painting.

INTERNALLY HEATED TAILORS' IRONS, which can be heated from an ordinary Gas Bracket.

THOMAS FLETCHER,
THYNNE STREET,
WARRINGTON.

London Offices and Showrooms—83, UPPER THAMES STREET.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 13, and unacknowledged elsewhere :—

G. BIRCH AND CO.—P. Vallance.—H. E. Hippisley.—J. A. Maclean.—T. Beecham.—V. Buhot.—J. W. Hotham.—S. Beeching.—L. Wray.—W. P. Thompson and Co.—T. Clarke.—Dr. Mantell.—J. B. Medland.—British Gas Engine Co.—W. P. Kelly.—R. C.—James Williams.—J. F. Smith.—Violinist.—Belgian.—F. E. F.—Puzzled.—Tish.—Amm.—Sine.—An Interested Subscriber.—Noil.—Copeaux.—Longing to Know.—A. H. M.—An Old Reader.—R. O'H.—A. M. W. Downing.—Lustra. Delta.—W. H. T.—F. B. Alison.—G. W. D.—Country Solicitor.—W. J. B.—Y. S.—R. W. Wigmore.—Steatite.

X. Y. Z. (See Hints No. 5. Works of the kind do not enter into such details. If you cannot refer to back volumes, procure Sprague's "Electricity," Spons, which will give you all the principles. The details you require about magnets will be found on p. 336, No. 872.) SPECTRUM. (See indices. Had you not better understand a little more about the instrument before attempting its construction? In No. 1037, p. 497, you will find directions for making one form; but whether that will suit you we cannot say, because you give no idea of the purpose to which it is to be applied.) TRIANGLE. (Consult a work on Mensuration, or Templeton's "Workshop Companion.")—LOCKSMITH. (We do not know that any are in actual use on railways; but several were shown at the Inventions Exhibition. See p. 293, No. 1,054.) ONE PERPLEXED. (Fix one of the "kitcheners" adapted for such places, or an American stove. The oil-stoves, when properly looked after, neither create a smell nor "taint the cookery"; but they are more expensive.)—AN ENGLISH MECHANIC. (Procure "Hot-water Heating," by Fawkes, B. T. Batsford, or Eldridge's book on the same subject, Murray-street, Hoxton, N.)—J. BLANCHARD. (You misunderstand. "Scientific men" do not make mistakes about the divining-rod. They have endeavoured to explain phenomena which have nothing to do with the tricks and charlatanry of the professed users of the hazel twig. If you can do what you say, you should come to London and exhibit your powers. The entertainment would be at least as well patronised as that of the thought-readers.)—MARK. (Not heat enough. See indices.)—F. L. BROWN. (Messrs. Trübner and Co., Ludgate-hill, E.C., will tell you the price. We gave sufficient address with the notice. We do not know the price.)—DISSECTOR. (Why not use the cotton wool or fireman's respirator introduced by Prof. Tyndall? We believe that is sold for the use of the firemen; but it might be too clumsy and cumbrous for your work. Will not the simple Stenhouse respirator do? Merely a little animal charcoal placed between two pieces of silk.)—BRASS. (Do you think it at all likely that we should refer you to a recipe for making blackboards, when you want to enamel dials. If you look again, you will find that No. 952 was the number selected, and that because it contains an article on enamels. It appears now that what you want is the common enamel paint. Mix the ground colours with the best copal varnish; or mix white lead and bleached resin, or white lead and white wax. Read previous answer again, and don't take the wrong line.) PATTERN-MAKER. (If you have not the back numbers containing the articles on Pattern-Making, published in Vols. XXXVII. to XL., you will find what you want in the book form by procuring "Pattern-Making," by a Foreman Pattern-Maker, from Crosby Lockwood and Co., Stationers' Hall-court, E.C.)—12 YEARS' SUBSCRIBER. (Add a little glycerine to the ordinary inks used for the purposes mentioned.)—QUEENSLANDER. (For methods of cleaning and bleaching sponges, see pp. 121, 141, 182, Vol. XL.)—ICE. (See indices for methods of making ice: pp. 461, 532, Vol. XXXVII.; p. 243, Vol. XXXVI.; pp. 322, 508, Vol. XXXV., and so on.)—A. B. C. (Two layers of No. 16 or 18 silk-covered will do for the primary.)—LELAND. (Your query is not definite; but if you mean internal decoration, see pp. 414, 431, 451, 476, Vol. XXXVIII. 2. If the bricks are crumbling, as you say, it will be better to obtain local professional advice.)—A NEW SUBSCRIBER. (You can remove the varnish by means of methylated spirit, price about sixpence a pint. See that you get it pure—that is, without shellac in it.)—E. K. B. (If you cannot see the back volumes consult any book on mensuration.)—E. W. E. (Scarcely definite. Do you mean plans of construction or details of methods of doing the actual work.)—WORKING MAN. (Rather too ambitious, is it not, for a novice? In Vol. XXVI. you will find full detailed instructions for making an American organ, and many useful papers since. No. 577 contains a diagram of a good reed organ—the Mustel or orchestral organ.)—SOAP. (See the indices for many recipes—Vols. XXXV. to XXXIX. of those most recent.)—PISCATOR. (About 10d. an hour. 2. The scale is given at the head or commencement of the respective divisions. 3. You do not mention what page; but c.c. stands for cubic centimètre, or cotton covered. The context will explain.)—J. W. REDMOND. (We have no further information about it than what was given in the number for June 22, 1866. The address of the agent was given; but it is twenty years ago. An engineer could, no doubt, make it work for you.)—ENQUIRER. (A good many "men" wear stays. You can get them of any outfitter. There is a good deal about them, and the effects of wearing them, in back volumes. See index to Vol. XXIII., for instance.)—MUTANS. (We have no record at present; but you can take the mean at 95° in the shade, 120° in the sun.)—R. R. WHITEHEAD. (Nothing is "best" for all three purposes. Dowson's is handy for the engine, and can also be used for lighting, and we suppose for cooking. Other queries inserted.)—SAM. (Do you mean Vitremanie?)—SINDBAD. (Given many times. Trouve's standard solution may be stated as 3oz. of bichromate, 1 pint of water, and 9oz. of sulphuric acid. Powder the salt, mix with the water (cold), and add the acid slowly through a strainer. Use a glass rod to stir.)—J. S. W. (Yes; combinations of old machines or old processes which produce "improvements" or new effects are protected by the Patent Law.)—CHIME. (Are you not confounding the question with another about the "centre of gravity" of the earth and moon? If you give the passage in Loomis we shall probably understand what you mean.)—UNCAS. (What sort of neuralgia is it? The term is applied to several forms. However, see p. 135, No. 929, and the indices.)—W. W. (Mr. Eldridge, of 54, Murray-street, Hoxton, publishes a book of the kind, and so does Mr. Batsford, of 52, High Holborn.)—WILL TOOGOOD. (Query covers too wide a field. Procure Watts's "Electro-Metallurgy," Lockwood and Co., Stationers' Hall-court, E.C., or look up back volumes.) W. R. K. (We do not know. Are any imported?)—ASPIRANT. (We do not know of a work on the art of ticket-writing.)—SALVO JURE. (Application must, for obvious reasons, be made at the Arsenal even for information.)—X. Y. Z. (Just so. Why not drive the dynamo direct by means of the cells, instead of losing power by interpolating a motor? You would require an engine of at least one horse-power.)—ALPHA. (We mentioned on p. 353 that it is published by E. and F. N. Spon. The address is 125, Strand, W.C.)—E. M. K. (Full details of process for browning gun-barrels in No. 1035. 2. Nothing better than coal-tar; but it should be boiled and applied hot. 3. Sprinkle with water until thoroughly moist throughout, and dip into linseed oil, or brush oil on. Hang up to dry, and then give another dip in oil.)—ONE ANXIOUS TO KNOW. (No certain remedy for eczema in a child six months old. Consult a medical man.)—LOVER OF LATHE. (There is no "law" to interfere with you, unless you make it a "nuisance"; but what that is we cannot undertake to say. The Water Company are scarcely likely to complain.)—J. T. (The information has been given many times. A "scheme" on p. 322. The "penholder," as you call it, is for muting one string while the other is tuned.)—BUSBY. (There are several screwcutters' guides. One was published by T. Greenwood, Reliance Ironworks, California, Halifax. Another by E. Holden, published by W. E. Allen, Ave Maria-lane, E.C.) HENDON. (Apply to the Secretary of the Amalgamated Society of Railway Servants, 306, City-road, E.C.)—A NEW AMATEUR. (From any of our advertisers who deal in such articles. We do not know who sells oxide of copper batteries.)—LANTERNIST. (The wide angle, decidedly. 2. If you will send the focus of your lens to any of the opticians advertising in our columns, they will be able to tell you what you require, and quote a price for the same.)—PUZZLED. (It is impossible, on paper, to aid you in your selection. We should recommend you to take it to a good maker and ask his opinion as to its worth.—A. P. S. (You had better write the Editor of the magazine in which the statements were made. We cannot find space for criticisms of theories propounded outside our own columns.)

Every Workman connected with the Building Trades requiring a Situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 332, Strand, London, W.C.

"THE BUILDING NEWS" is the Principal Journal representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

Every Workman should insist on seeing "THE BUILDING NEWS," every week at his Club or Coffee House. He will find more "Lists of Tenders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Intercommunication" if he wants to know anything about his trade; to write to the Editor if he has any suggestions to make, and to advertise in the paper when he wants work.

The charge for Advertisements for Situations is One Shilling for Twenty-four Words, and Sixpence for every Eight Words after.

CHARGES FOR ADVERTISING.

	s.	d.
Thirty Words	2	6
Every additional eight words	0	6

Front Page Advertisements Five Shillings for the first 40 words, afterwards 9d. per line. Paragraph advertisements One Shilling per line. No front page or paragraph advertisement inserted for less than Five Shillings. Reduced terms for series of more than 6 insertions may be ascertained on application to the Publisher.

ADVERTISEMENTS in EXCHANGE COLUMN—for

	s.	d.
Twenty-four words	0	3
For every succeeding Eight Words	0	3

ADVERTISEMENTS in the SIXPENNY SALE COLUMN.

	s.	d.
Sixteen words	0	6
For every succeeding Eight words	0	6

⁂ It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions; and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement, and charged for.

Advertisements *must* reach the office by 1 p.m. on Wednesday, to insure insertion in the following Friday's number.

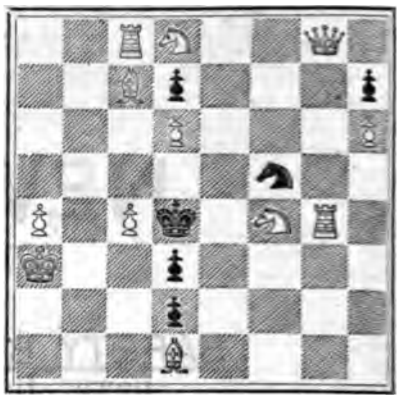
Holloway's Pills.—Easy Digestion.—These admirable Pills cannot be too highly appreciated for the wholesome power they exert over all disorders of the stomach, liver, bowels, and kidneys. They instantaneously relieve and steadily work out a thorough cure, and in its course dispel headache, biliousness, flatulence, and depression of spirits.

CHESS.

ALL Communications for this department [illegible] addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLXXIV.—BY H. F. L. MEY[illegible]

Black.



White. [12 [illegible]

White to play and mate in two moves.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 972, by P. L., Hafren, [illegible] James Squillar (St. John's Institute), W. T. Bayne, A. [illegible] Orr, Tommy Atkins, W. J. Carpenter, Link, [illegible] Peet, T. J. Barnes, James Ough (variations mus[illegible]), H. Wright, Harold, Constance E. Younger, Ke[illegible] G., G. W. Middleton, L. Morris, F. A. Vincent, and A. [illegible]

W. C.—Many thanks for the Problems, whi[illegible] acceptable.

P. I.—All variations must be sent in order t[illegible] marks.

O. J. L.—Thanks for game.

GEORGE AND A. APPELBEE.—There is [illegible]

1. K-K 4

F. S.—It has already been pointed out that [illegible] Bishop should be a Black Pawn. The soluti[illegible] sound.

S. D. RAY AND JAMES PALMER.—You have [illegible] that Black can play 1. P-Q B 4 and so escape [illegible]

TWELVE competitors have entered for the fir[illegible] and sixteen for the second.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the [illegible] quested to observe that the last number of the term [illegible] their subscription is paid will be forwarded to them i[illegible] Wrapper, as an intimation that a fresh remittance is [illegible] it is desired to continue the Subscription.

TERMS OF SUBSCRIPTION.

PAYABLE IN ADVANCE.

5s. 6d. for Six Months and 11s. for Twelve Months, Po[illegible] any part of the United Kingdom. For the United State[illegible] 3 dol. 25c. gold; to France or Belgium, 13s., or 16f. 50c. [illegible] (via Brindisi), 15s. 2d.; to New Zealand, the Cape, [illegible] Indies, Canada, Nova Scotia, Natal, or any of the [illegible] Colonies, 13s.

The remittance should be made by Post-office Orde[illegible] numbers cannot be sent out of the United Kingdom b[illegible] ordinary newspaper post, but must be remitted for at th[illegible] 4d. each to cover extra postage.

Messrs. JAMES W. QUEEN and CO., of 924, Chestnut-stree[illegible] delphia, are authorised to receive subscriptions for the [illegible] States for the ENGLISH MECHANIC, at the rate of [illegible] 25c. gold, or Thirteen Shillings per annum, post free. Th[illegible] will be forwarded direct by mail from the publishing [illegible] London. All subscriptions will commence with the num[illegible] issued after the receipt of the subscription. If back num[illegible] required to complete volumes, they must be paid for at th[illegible] 4d. each copy, to cover extra postage.

Vols. IV., VII., XXVI., XXVIII., XXX., XXXII., [illegible] XXXIV., XXXV., XXXVI., XXXVII., XXXVIII., [illegible] and XL., bound in cloth, 7s. each. Post free, 7s. 9d.

All the other bound volumes are out of print. Subscribe[illegible] do well to order volumes as soon as possible after the co[illegible] each half-yearly volume in February and August, as only a [illegible] number are bound up, and these soon run out of print. [illegible] back numbers can be had singly, price 2d. each, through [illegible] seller or newsagent, or 2½d. each, post free from the [illegible] index numbers, which are 3d. each, or post free, 3½d.

Indexes for Vols. I., VI., VII., VIII., and IX., 2d. each. [illegible] 2½d. each. Indexes to Vol. XI., and to subsequent vols., [illegible] post free, 3½d. Cases for binding, 1s. 6d. each.

LATHES

AND EVERY DESCRIPTION OF TOOL FOR AMAT[illegible] TURNERS.

LATHES, complete, £7 15s., £10 [illegible] £19 5s. Chucks, and all kinds of apparatus [illegible] Engineers' Files and Tools of every description. [illegible] TWIST DRILLS and SELF-CENTRING CHUCKS [illegible] all-sized drills. AMERICAN SCROLL CHUCKS of ALL [illegible]

JOSEPH BUCK,

56, HOLBORN VIADUCT, E.C., and 164, WATER[illegible] LONDON.

GASMAK[illegible]

EXHIBITION

Cheapest Lamps in the [illegible] William-street. Wanted[illegible]

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 22, 1886.

MICROSCOPICAL ADVANCES—ANCIENT AND MODERN.—IV.

By DR. ROYSTON-PIGOTT, M.A., M.D., Cantab.; F.R.S., M.R.C.P., F.C.P.S., F.R.A.S., formerly Fellow of St. Pet. Coll., Cambridge.

Black Dots, Test Rings, and Lines.

THE black dots of the French Podura, alluded to in the last article, were in 1862 the prolific cause of entering upon a seven years' search, for the reasons why the most excellent glasses of that date utterly failed to show them. Then incessant study led up to a research which rewarded the writer with the detection of an unsuspected residuary aberration. It was thus alluded to (*Phil. Trans.* Vol. II. 1870):—

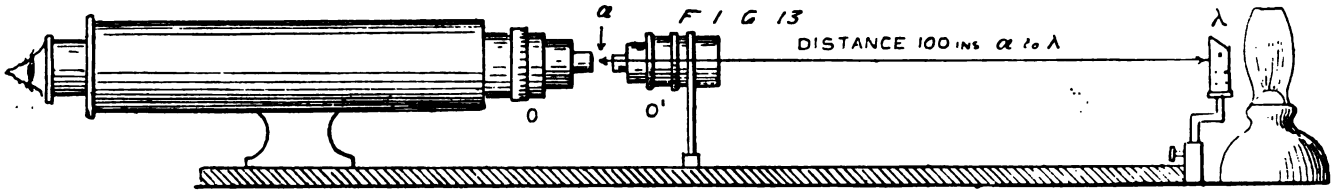


FIG 13

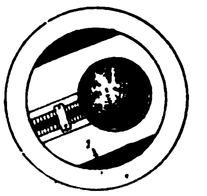


FIG 13 a

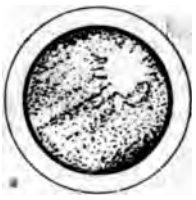


FIG. 13 b

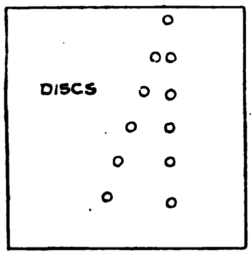


FIG 14 λ

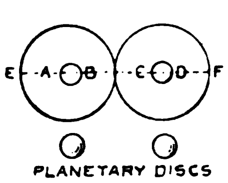


FIG 15

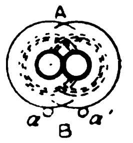


FIG 16

"I purpose at present to describe as briefly as possible some experiments which suggested an inquiry into the method of raising microscopic power consistent with a corresponding improvement in the precision of definition, so generally destroyed by excessive amplification.

"Such an inquiry—in the present elaborated delicacy of adjustment accomplished in microscopes of the highest quality, especially when armed with 'immersion sixteenths,' which have alone succeeded in resolving Nobert's most delicate bands, embracing lines 112,000 to the English inch—would seem either superfluous or futile.

"The research was originally suggested by the accidental resolution of the Podura scale. This exquisite object, so justly prized by the optician for the trial of microscopes, affords peculiar markings resembling notes of admiration, of sufficient delicacy to put even the defining-power of objectives of one-fiftieth of an inch to a severe ordeal. I had observed these markings to disappear and be resolved into black beads. The objective employed had nearly one-seventh of an inch focal length and an aperture of 50 deg. The object was illuminated by solar rays reflected obliquely by a plane mirror. Having related this effect to eminent opticians, I was informed that no objectives (at that time 1862) could resolve this test. I prevailed on them, however, to construct a 'very fine' one eighth expressly for this resolution; as this totally failed, a one-sixteenth was care- [illegible]ly constructed with no better success, and [illegible]-fourth of very large aperture : [illegible] exhibit the Podura bead- [illegible] of this failure evidently remained to be investigated. The evidently delusive character of the standard test, so much relied upon for the construction of microscopic object-glasses, suggested the necessity of a search for other less uncertain methods of testing. The principle of proceeding from the known to the unknown appeared to offer the only sound basis of inquiry.

"Simple objects were now examined. The finest glass threads presented linear images of any conceivable degree of proximity, whilst their fused extremities, when selected as forming refracting spherules one-thousandth of an inch in diameter, presented miniature landscapes and points of light of remarkable precision, the spherical aberration of which could be easily calculated to be of insignificant amount for limited apertures. Even a plano-convex lens of one-thirtieth of an inch focal length and three-hundredths aperture displayed, though uncorrected, miniature pictures of marvellous beauty, bearing considerable amplification; whilst a combination of achromatic lenses corrected with all the resources of modern art, seemed capable of forming an exquisitely small image of any given object placed at a distance from it, the appearance of which, when examined by the microscope to be tested, could at once be verified by the object producing the miniature test. When suitable precautions are taken—such as (1) axial coincidence of the objectives; (2) proper corrections for an 'uncovered' or aërial, or for an aqueous image when immersion lenses are employed, and for the distance of the object from the image-forming objective—these miniature test-images bear an extraordinary amount of amplification by the microscope, displaying at once the erroneous corrections. I have found it convenient in general to use the image or *miniature*-forming objective of a deeper focus than the observing, generally one-half.

"The following experiments, as elucidating the operation of this testing will, it is hoped, explain its critical powers. The mechanical arrangements are shown by diagrams, Fig. 1.

"*Experiment* 1.—Miniature of a small thermometer, the ivory scale being graduated 24 deg. to the inch. A power of 300 diameters, gained by a low eyepiece 'A,' and the objective of one-eighth focal length (made expressly for Podura beading-test), was applied to view the miniature formed by a one-sixteenth objective of excellent quality; and the following appearances were carefully noted at the time of observations.

"*Result.*—The sparkle of light on the bulb of the instrument, the graduation, and the metallic thread within the glass tube are invisible, obscured by a nebulous yellow fog which no objective adjustments are able to dissipate (Fig. 13, *a*).

"In consequence of this unexpected discovery regarding the quality of a 'very fine one-eighth,' it was returned to the opticians, to their surprise, for better compensation. It was then, after more accurate compensation by them, again submitted to precisely the same testing conditions.

"*New Results.*—Appearance of a slight nebulous yellow cloud, through which could be distinctly seen the ivory scale finely graduated, the bulb sparkle, and even minute separated mercurial particles scattered within the glass stem (Fig. 13, *b*).

"The definition had been therefore decidedly reformed. Previously, however, to the altteration, experiments had been tried for the purpose of ascertaining whether a defective glass would still form a fine miniature. It might be reasonably expected that such slight errors as had escaped the notice of eminent opticians would not materially injure a miniature image in which the aberration would probably be reduced in the miniature itself. The image of the thermometer now formed with the imperfect eighth was viewed with a fine sixteenth (at about 800 diameters), when it was gratifying to observe a very beautiful display of the picture well defined in all respects.

"These and other experiments appeared to warrant an important conclusion—that an image-test miniature formed by an objective of fair quality enjoyed sufficient accuracy of definition in miniature (even when the object was placed at varying distances from the stage or focal point of vision) to form a trustworthy test of microscopical definition, provided the aperture of the miniature-forming objective was equal to that of the objective to be tested.

"To estimate the size of a miniature (a) of a given object (θ) placed at a considerable distance (d) from the miniature (Fig. 13, *a*), it is necessary to consider that the conventional length F of an objective may be defined to be 10in. divided by the micrometric ratio of amplification (m) when the image is thrown on a screen 10in. from the object, so that—

$$F = \frac{10}{m}, \text{ when } d = 10,$$

or

$$m = \frac{10}{F},$$

$$\propto \frac{1}{F}, \text{ when } d \text{ is constant } \ldots\ldots\ldots \text{(1)}$$

When very deep objectives are used the position of the plane of focal vision varies slightly for a considerable increase of the length of the microscope, so that if the draw-tube be graduated, the increase of power is nearly proportionate to the increased length or reading, because the focal plane being nearly fixed, the image will appear upon a screen enlarged proportionately as its distance increases. On reversing the rays, the miniature diminishes in proportion as a given object is removed further from it: from which it follows that approximately, and sufficiently near for the purpose in hand—

$$m \propto d \text{ when F is constant} \;\ldots\ldots\ldots\; (2)$$

"Compounding these expressions (1) and (2),

$$m \propto \frac{d}{F} = p \cdot \frac{d}{F}.$$

The constant $p = 1$; for if m be made equal 160, the conventional focus F = one-sixteenth, when $d = 10$, and hence (d being large and F small) approximately,

$$m = \frac{d}{F} \;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\; (3)$$

"If (f) be the focal length of a small lens whose thickness is neglected, a very similar approximate result can readily be obtained from the optical formula—

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}.$$

For by construction

$$u + v = d,$$

and by similar triangles

$$mv = u.$$

(u being the distance of the object from the centre of the lens, and v the distance of the image from the same point. Here we have got rid of the refractive index, and we are only concerned with the distance between object and image: this remarkably simplifies the optical calculations). Eliminating the unmeasured distances u and v of the object and image from the 'centre' of the lens, it will be found that—

$$f = \frac{d}{m + 2 + \frac{1}{m}},$$

and m being very large in these experiments,

$$f = \frac{d}{m + 2} \text{ nearly*} \;\ldots\ldots\ldots\ldots\; (4)$$

or

$$m = \frac{d}{f} - 2 \;\ldots\ldots\ldots\ldots\ldots\ldots\; (5)$$

But in the case of the miniature images employed, m is so large that (− 2) may be neglected, so that $m = \frac{d}{f}$ is sufficiently near for their measurement.

"The thermometer was now placed 100in. distance from the microscopical focus; the one-sixteenth being employed to form the image, $f = \frac{1}{16}$, $d = 100$; hence—

$$m = 100 \div \tfrac{1}{16} = 1{,}600 \text{ very nearly.}$$

The divisions on the thermometer would be therefore reduced in the image to a miniature 1,600 times less than the original, or about 40,000 to the inch, whilst the breadth of a single line would be only the 400,000th.

"The means being thus obtained of readily estimating the size of images of known objects at known distances, the examination of immersion objectives next occupied my attention. Double stars were artificially produced in thin brass (3-100in. thick) by placing minute apertures (12-1,000ths in diameter) in front of a brilliant flame, at the distance of 100in. from the focal point of observation. The apertures were so arranged as to gradually exhibit closer double discs (as shown roughly in Fig. 14), which were carefully drawn on brass under the microscope and then accurately pierced. The miniature effect of the star-doublets is represented in the following table, the immersion $\frac{1}{16}$th objective being converted into $\frac{1}{20}$th†, so that f here $= \frac{1}{20}$, $m = 2000$ at 100in. distances (nearly):

Doublet.	Size of discs.	Calculated size of images nearly.	Distance between their centres.
No. 2	$\frac{12}{1000}$	$\frac{1}{166000}$	$\frac{1}{10000}$
No. 3	$\frac{12}{1000}$	$\frac{1}{168000}$	$\frac{1}{20000}$

"It will be readily seen from the diagram (Fig. 8) that, in No. 2 the discs being 12-1,000ths and the separating interval between centres being 1-20th, the actual dividing interval is 38-1,000ths, or above three times the real diameter of each disc.

"*Experiment* 2.—A drop of distilled water being suspended between the objectives, both of which were fitted with single front 'immersion lenses,' I was astonished to find that the separating interval (measuring 38-1,000ths) between the centres of the discs had totally disappeared in the miniature image. The discs now resembled a finely divided double star just separated by a black line, yet this minute interval should have appeared above three times the diameter of a disc, as at B and B C (Fig. 15). Apparently, therefore, in the eyepiece, spurious discs had been formed four times and 1-6th larger than true aplanatic representation by the microscope.*

"It follows from this experiment that if the discs be supposed to gradually diminish to points, the limiting value of the residuary spurious discs would give nearly 1-52,000th of an inch for the diameter of the least circle of confusion, representing the actual amount of residuary lateral aberration.

"This appears from a diagram, where in the limit E F = 4 A E, when A B, C D both vanish in the case of the discs being reduced to points (Fig. 15).

"The phenomena presented by these artificial doublet-image tests, gave fine evidence of the skill employed in the construction of the glasses, and of the accuracy with which the axes of the optical parts had been made to coincide in this delicate experiment.

"All the discs appear sharply cut and planetary, surrounded *with a black ring* supplemented by accurately formed diffraction rings, which enlarged and glowed with prismatic colours, both within and without the sharpest focal point or image, forming concentric intersections, displaying coloured pencils passing either to or from their finest point of focal combination where colour should be destroyed (Fig. 16).

"*Experiment* 3.—The discs (λ) shown by the apertures $\frac{12}{1000}$in. in diameter, and separated between centres $\frac{1}{20}$, were now brought nearer to the objective O′. It was then observed that the image-discs (of above four times their proper size) began to separate; and since the spurious disc retains its false *annular* expansion independent of the true magnitude, it became evident that the exact distance at which the test doublet was first divided, gave for other objectives a comparative measure of their aberration; the very slight aberration in the image (of the 16th) being scarcely appreciable, especially when favoured by the advantage of the water-film to enhance the precision of definition on the immersion system.

"By such experiments, with the finest glasses obtainable, the existence of an aberration of material and measurable amount being thus established, the next question to be settled assumed the following character, viz.:

"What was the nature of the aberration produced by displacement of the final focal image viewed by the eye-lens;† and whether better effects could be produced by a different distribution of the magnifying powers?

"It was now found that increasing the distance between the eye-lenses and the objective gained power indeed, but caused *the aberration to increase faster than the power gained.*

"Intermediate Huyghenian eyepieces, re-verted, were found to increase power but sacrifice definition; the apparent aberrations seemed incorrigible, so that this plan was finally abandoned in 1864. Although by this means the *Pleurosigma rhomboides* was fairly shown to Messrs. Powell and Lealand, with their one-sixteenth objective (dated 18[illegible]), they stated this method had been tried long before and relinquished as useless to improve definition.

"Sliding-tubes (made by them at my request) were now finished with a 'universal screw,' in order to admit a great variety of single and compound cemented lenses (more or less chromatically and spherically corrected) being inserted within the draw tube midway between the eyepiece and the objective. So also, whole or parts of objectives were similarly applied, thus forming a microscope within a microscope admitting endless combinations of compensations" [thus forming a new kind of Dyalite or Amplifier].

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* This method also gives the focal length of a minute lens, to determine which accurately is attended with no little difficulty.

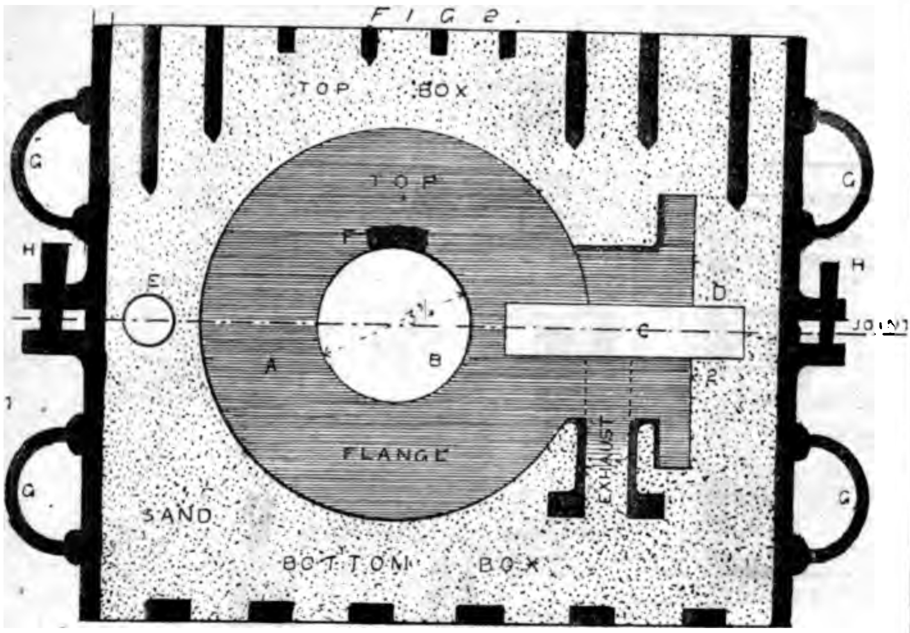
† By the adaptation of a "water-lens" 1-30in. focus.

* It will be observed in this experiment that the standard distance of 10in. at which the object should be placed from the objective was increased to 100. It was found that only a very slight adjustment of the screw collar of the image-objective was necessary to compensate for this great increase of defining distance. It is hardly necessary to remark further that in a minute miniature image the aberration is insignificant compared with that taking place in a greatly magnified image of an object placed in the focus. This distinction is inseparable from this experiment, as already explained. The minute apertures, made accurately with Swiss watchmaking tools, were carefully blackened, to prevent internal reflection, with a solution of perchloride of platinum.

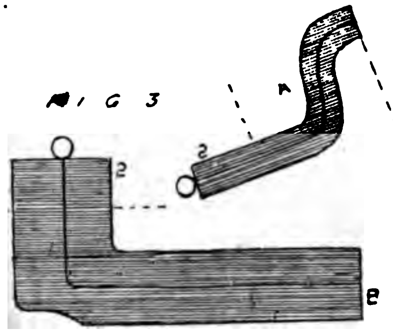
† This means by shortening or lengthening the body of the microscope.

THE SHIPMAN STEAM-ENGINE.

AN ingeniously arranged steam-engine and boiler, known as the "Shipman," from the name of the patentee, Mr. A. H. Shipman, of Rochester, N.Y., has just been introduced to this country by Messrs. Churchill, of Cr[illegible]-street, Finsbury, E.C. The engine is of the self-contained type, and occupies little space, the steam being generated in a sectional tubular boiler by means of kerosene; hence it is of special interest now, when renewed attempts are being made to utilise the liquid hydrocarbons as fuel. The engravings annexed will serve to convey an idea of the engine and its construction, though the one Messrs. Churchill have on view is smaller and is differently arranged to that shown in the perspective drawing, while the sectional diagram, though it serves to explain the general principle of the construction, scarcely represents the newer pattern—in outline, at least. The boiler consists of a number of tubes screwed into a back, which forms a water space, and the "furnace" is formed by a sort of blowpipe which produces an intense heat and raises steam very quickly. The oil is injected into the furnace tube by the spray or atomiser method, live steam being used while the engine is running; but to start, it is necessary to turn the shaft the reverse way until the gauge shows an air-pressure of about 40lb. in the boiler. The tank containing the oil is protected from the heat of the furnace by a jacket through which water flows to the feed-pump, and the fuel is at first injected into the furnace tube by an air spray. When we saw the one-horse-power engine which Messrs. Churchill have on view, it was a bitterly cold morning and the down draught of the flue was considerable; but in spite of that drawback and others incidental to a rough-and-ready arrangement, steam was raised in a very short time to 120lb., and the engine started to drive an emery grinding wheel. A reference to the sectional diagram will give a correct idea of the general arrangements, and as all parts are distinctly marked, a fully detailed description is unnecessary. The oil used in the United States, where this engine has met with a favourable reception, is of 115° fire test, and the patentee states that if a higher grade is used, the heating power is decreased. The quantity used is about half a gallon per hour for the one-horse engine; but it is not unlikely that a cheaper fuel than kerosene will be found in this country. The boiler it will be seen is practically safe, though the inventor goes further and claims that it cannot be exploded; but the whole device is so complete in [illegible] that it is difficult to see where any improvement can be introduced. It is provided [illegible] steam-gauge, indicat[illegible] normally the saf[illegible] up to 200 so great are th[illegible] to [illegible] the boiler that [illegible] steam at 100lb. w[illegible]



equal by laying a little soft loam either near the flange or at the end of the core-print. It will also require the barrel fastening to keep it from lifting or to keep it from slipping lower down in the moulds and reducing the thickness of metal. It is best to have two holes through heavy core barrels, one to go inside the box and one to go outside, and to put a bar through and wedge them so that they will neither rise nor fall if the core is set true in the mould; then when the top part is put on, the barrel may be packed from the box bars to keep it true every way; but when both ends of core have a bearing the trouble of packing is very much reduced, although they all require well holding down when there is a bottom cast in, and it will require a small belt on bottom end of core for clearance of boring tool, as shown at G. I have shown a sketch of a pair of boxes for a cylinder with a bearing at H, as well as the top end, so that to balance the core you will require a box



about 12in. longer. The sketch is one without chest being cast on; but it has an exhaust branch cast on with flange on. It is a good plan to cover the face of the branch with a loam cake, and bring the air out at D. The prints ought not to be less than 2in. long, and have a small loop to fasten them with thin wire to keep them in their place. Make up with loam, and bring the air off by laying a piece of lace or cord in, and draw out before casting. This design is moulded in two parts, as it is very simple and easy to mould (Fig. 1). A is body of casting, B is body-core, C is exhaust-core, D, prints for ports 2in. long, and the size required is usually about 1⅜in. by ¼in. for a 4in. cylinder, and exhaust 1⅜in. by ½in., E is running gate, F is rising gate, G is clearance belt on end of core, H showing core-print for large, close-ended cylinders minus the spindle-hole; I is box handles, J J are chaplets to hold the port cores in their places against the body core. The bottom flange is shown larger than top flange (Fig. 2), A, body; B, body-core; C, ports; D, prints; E, running-gate; F, rising-gate; G, G, G, G, box-handles; H, snugs and pins; top box to have deep bars, bottom to have flat bars. Fig. 3: A is ports, B, exhaust with small loops in; bring the vent of 2 at loops 1, *make in good stiff* sand, and vent them well.

THE MATERIAL CONDITIONS OF MEMORY.[*]

By Prof. E. D. Cope.

THE greatest possible importance attaches to the question of the physical conditions of consciousness, but the investigation of it is surrounded with great difficulties. One of the most available points of approach is by a study of the characteristics of memory. Memory may be defined as intermittent or recurrent consciousness; and it follows that whatever produces or destroys memory is also a cause of the appearance of disappearance of consciousness, I refer especially to reminiscence, or the recurrent consciousness of a previous impression, as that part of memory which gives it its importance in this connection.

Memory is reasonably understood to be the result of an impression made on a physical basis of consciousness by some stimulus. The structure of this matter is affected, so that on the recurrence of consciousness within it the consciousness takes the form or character of the modified structure it finds there. Important information as to the effects of different stimuli may therefore be gained by a consideration of their relative capacities for reproduction in the reminiscent phase of memory. On this point the following propositions may be considered:—There are two sources of impressions which reappear as memories; those from the subject or subjective activities of the mind, and those from objects or things external to the mind. Before considering these, it is necessary to guard against confounding the recollection of the occurrence of an event with the recollection or reminiscence of the sensations which constituted that event. Thus one can remember that he reached some conclusions in a given discussion, but may be unable to remember the conclusion itself. He may remember that he was angry, but be quite unable to reproduce the passion. He may remember that he had a toothache, but may be unable to reproduce the suffering itself. Subjective stimuli are of the two classes into which all mental acts fall, the intelligent and the emotional. Objective stimuli belong to the pains and pleasures of all parts of the body, and to the special and general senses. To what extent are all these phases of consciousness susceptible of reproduction in the reminiscent part of memory? There is a kind of memory not strictly reminiscent, which may be well termed recognition. The difference between reminiscence and recognition in this. In reminiscence the peculiar form of consciousness is actually reproduced, according to the law of associated ideas; in recognition the recurrence of the original stimulus is necessary to arouse memory; otherwise the sensation would not return to consciousness. The former is evidently the stronger and truer form of memory, and as it answers our purpose best, and is most easily examined, I confine my attention to it for the present.

This much being understood, it appears to me that the following propositions may be maintained:—

1. That objective impressions are less profound than subjective, the capacity for reminiscence being the index.

2. That of the objective, those introduced by the
special senses are more profound than t
duced by the general senses.

3. That of the former, those introdu
posed vibrations (sound, sight) are mor
than those produced by supposed contac
(taste, smell).

4. That of subjective impressions, tho
by acts of intelligence are more readily
reproduced than are those produc
emotions.

These propositions might be illustrat
length, but for the present I content n
the following:—

2. The pleasures and pains of genera
cannot be reproduced by an act of me
one can reproduce any particular pain f
It is probable that pleasures and pains
characteristic (locality being left out
can be more or less *recognised* on t
rence, showing that they make a real b
tively slight impression on the physi
consciousness.

3. No one can reproduce a taste or a
the same degree of distinctness that is
the case of a sound or a sight. Most p
not reproduce them at all. As to
reproduction is very imperfect; and al
reproduction of visible objects is, in n
more distinct, it is short of the reality

4. Mnemonic reproduction of an em
difficult, but falls short of the emotion i
in the most pronounced cases. Althoug
leave behind them deep impressions,
plainly evanescent, in some persons m
in others. Nevertheless a reproduced
more distinctly like the original than
duced sight.

Of processes of the intelligence, th
imagination are reproduced with great
and clearness in most persons, but not m
processes of reason. It is only in the i
that it is safe to say that the repro
reminiscence is identical with its ori
is true that the impression may be
here also, but it is less so than in the
emotion. It is only in bad mental h
association fails to revive completely a
intelligence. It is a consequence of this
intelligence is more cumulative in its
than emotion, and much more so than p
pain. Could we reproduce in our con
sights, sounds, and sensations as truly
thoughts, we would be different beings f
we are. And were they cumulative in
sciousness in the same sense that thought
would be still more different.

Thus there seems to be a relation bet
nature of stimuli and their effects on c
ness, which may perhaps be formulated as
The persistence of an impression on the
basis of consciousness is in inverse propo
its intensity in consciousness. Thus th
violent and least permanent of impress
molar, as in physical sensations. The inten
are those of such special senses as are supp
be the result of exterior vibrations. Th
delicate and the permanent are those prod
the supposed extremely rapid vibrations of
brain-tissue. These create an accustomed c
of apparently greater perfection of const
than do the more violent forms of conscio
which are therefore longer preserved, and
readily followed by new arrivals of conscio
The reason for this is to be found in the pr
fact, which is also supported by other con
tions, that the more violent forms of conscio
destroy more tissue, while the most delicate
destroy less, rendering rearrangement more

These considerations are of course appl
only to new stimuli, which are not mere repe
of old ones, and are especially not applica
the secondary stimulus furnished by remini
itself, in which are to be included dreams.
the materials of thought are often only re
cences is no objection to the theory here pres
for the processes and conclusions of thoug
perfectly new experiences when first perf
and attained. And the precision with whi
telligent thoughts are reproduced is a guara
their persistence, since each reminiscence
some degree as a new stimulus. This is t
the simplest processes of intelligence in the
types of mind. We can derive some hints
these considerations as to the evolution of
porary and permanent states of consciousnes

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[*] From the *American Naturalist*.

TRUEING UP MILLING MAC CENTRES.

THE following remarks on true
placing milling mac
alignment are by Mr
Machinist. The
is usually constru
centre is liable to b

showed that this was not the case—indeed it could not be so.

Let us call the counter electromotive force e, and the loss of potential caused by the resistance of the armature e_1, and the difference of potential at the terminals E. Then

$$e + e_1 = E.$$

Calling the current C. and the resistance of the armature R, we know that

$$e_1 = CR;$$

The resistance of the armature of the motor in question was ·027ohm, which we will call ·03 in order to make some allowance for the effect of heating.

In the first and last readings of the second set of tests we have, therefore, the following conditions:—

Speed.	e_1.	e.
680	·87	99·13
660	3·75	96·25

Now

$$\frac{680 \times 96{\cdot}25}{660} = 99{\cdot}13.$$

From which it appears that the counter electromotive force was exactly proportional to the speed, as is to be expected where the field is constant and the magnetic distortion *nil*.

The other cases do not work out with the same accuracy. The results are, however, quite within the limits of error inseparable from the rather rough conditions of these workshop tests.

One other fact may be pointed out in connection with these tables of results and curves. In the case of dynamos working with a constant field, the output with the same current is almost exactly proportional to speed, as the E.M.F. is also simply proportional to speed. So, with the motor, the speed is proportional to the E.M.F. of supply; and the work, with the same current in the two cases, it simply proportional to speed, therefore to E.M.F.

With regard to the theory alluded to above, that in a motor the fields should be much weaker and lighter than the armature, it may be pointed out that in this, as in the other points mentioned, there is a real analogy between motors and generators, inasmuch as, according to the views briefly expressed in this note, such a motor, although a bad one from most points of view, would have a certain advantage in that for its weight it would do a good deal of work. Similarly, dynamos may be, and have been, built which, although far from efficient and reliable, will give a large output for their weight. Their construction is, however, scarcely to be recommended on this ground, except, perhaps, under very exceptional circumstances; and they, as well as the motors constructed on the same lines, appear to be instances of a mistaken apprehension of elementary principles.

Having briefly traced the analogies between generators and motors thus far, the subject may be dismissed for the present with the remark that a further consideration of the matter serves only to reveal the fact that in almost every phase of their actions the two machines afford further opportunities of a direct comparison.

Turning now to the question of efficiency alluded to above, it is evident that there is some important cause of loss or waste of energy in electric motors which is absent in generators. This has always been a kind of *lacuna* in the explanations of the action of motors; and in order to localise the loss and to ascertain its cause the several possible sources of waste were carefully considered. These are:—(*a*) Friction at the bearings, air-friction, and friction of the brushes against the commutator. (*b*) Loss of energy in heating the armature and field-conductors, and a certain loss due to self-induction. (*c*) Loss by the production of eddy-currents in the iron.

Now it is evident, especially with a generator or motor having the qualities sketched above, that at the same speed, and working with the same currents in its conductors, the losses under (*a*) and (*b*) must be identical, whether it be working as a generator or as a motor. And as with such conditions its efficiency as a motor is lower than as a generator, the cause of the loss must be sought under (*c*)—*i.e.*, the eddy-currents in a dynamo must be less than in a motor, all other conditions being the same. And such is the case, the explanation arrived at by the writer and by Mr. Watson being a very simple one.

In a dynamo the rotation of the armature causes eddy-currents to be generated in the iron core, in the same direction as in the conductor proper with which the core is surrounded. Of course, as the armature is always more or less subdivided or laminated in a direction at right angles to the lines of force, any circulation of currents round the core is avoided; but local currents, which are aptly called eddies, are set up, and, taken as a whole, these eddy-currents on the outside of the core are in the same direction as the current flowing in the copper conductors.

In an electric motor, however, the eddy-currents and the currents in the copper conductor are in opposite directions; as, although the E.M.F. set up in the conductor is in the same direction in a motor as in a dynamo, the current in the former is forced through the armature in a direction contrary to the E.M.F., or opposite to its course in a generator. According to the laws of induction, therefore, it will be seen that while in a dynamo the two sets of currents, those in the iron and those in the conductor, tend to oppose and to reduce one another, in a motor they act in such a manner as to mutually assist each other. Thus, with the strength of field, the current in the conductor, and the speed the same in the two cases, it will be seen that in a motor the eddy-currents in the iron core of the armatures will be greater than in a generator, and therefore the heat-loss in the former will be more than in the latter. There is little doubt that this is the cause of the lower efficiency of motors than of generators; and it points to the advisibility of giving even greater attention in the former to those principles which are well understood for the reduction or elimination of eddy-currents.

SCIENTIFIC SOCIETIES.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE fourth meeting of the session was held on Tuesday, 12th January, 1886, in the Association Hall, Mount Pleasant; Mr. R. C. Johnson, F.R.A.S., one of the vice-presidents, in the chair, in the absence of the president. There was a good attendance of members and friends. Three gentlemen were elected members. A paper sent by Mr. R. Cross, of Oxford, was read on "The Andromeda Meteors." He states that on the 27th November, he and two others, about 7 o'clock in the evening, counted as many as 500 in fifteen minutes, that they fell so fast from all points, that it was impossible to count them, eight or ten falling at the same time. The radiant point, as near as he could calculate, was γ Andromedæ. The Rev. S. J. Johnson, F.R.A.S., contributed a paper on "The Suspected New Star near χ Orionis." He says the appearance of Mr. Gore's star through a 3½in. as to colour, and very nearly as to magnitude, resembles the "nova" that lately shone out in the Andromeda Nebula, being just a trifle brighter than that one. But the point to which I would draw attention is that in Bode's maps (1782), I find a small star marked which seems to occupy the position of this one. It is not in the larger or smaller maps of the S.D.U.K., or in any other Atlas I possess. Mr. J. E. Gore, F.R.A.S., M.R.I.A., contributed a paper, entitled "Observations of Suspected Variable Stars," giving a tabular statement under the following heading. The following observations of some of the stars in my "Catalogue of Suspected Variable Stars," were made by me, during 1885. The observations were made with a binocular field-glass, accurately focussed on the star, and the estimated magnitudes are the results of careful comparisons with neighbouring stars. The table gives the "No. in catalogue," R.A. 1880, Declination 1880, Date of Observation, Estimated Magnitude, and Remarks upon the state of the sky during the Observations." This valuable paper will be printed in the Society's *Journal*.

A paper read by M. Armand Gunziger was read, called "Table of Sunspots Visible to the Naked Eye, from June 11 to December, 1885." All the observations were first made with naked eye, and afterwards with a telescope of 1in. aperture, power 12; the sun was observed on 85 days, and on 34 days spots were visible. The most remarkable were those of June 21, July 9, September 4 and 13. These were large enough to be distinguished by the most inexperienced observer. A paper was sent by Mr. Cattermole, containing some useful hints on the construction of observatories, &c. Interesting discussions took place on the papers.

Floor Wax.—Pure yellow wax, 1 kilo. (2·2lb.); Castile soap, 0·2 kilo.; tartar, 0·15 kilo.; water, 15 litres (13¼ quarts). First dissolve the soap in 2 litres of water, heating gently, then put in wax cut into small pieces, and boil. When the wax comes up, pour in 2 litres of water, in which the tartar was previously dissolved; heat twenty minutes more, until saponified, if the wax is pure, and add 11 litres of water. It is useless to add more wax than required; it would make the floor dirty without adding any extra brilliancy. The excess of tartar in the solution sets any powdered colours that may be used more firmly.

THE *Angler* mentions a mixture which is recommended for keeping off mosquitoes and gnats, which abound in moist districts. It consists of three parts olive oil, two parts oil of pennyroyal, one part glycerine, and one part of ammonia. It is to be well shaken before applying to the face and hands, and it must not be allowed to get into the eyes.

SCIENTIFIC NEWS.

ALTHOUGH Brooks's comet (*f* 1885) i decreasing in brightness, the followi notes from Dun Echt Circular, No. 109. may b useful. The elements are computed by D Oppenheim. from observations made at Ca bridge (U.S.), on Dec. 28, at Vienna on Jan and at Berlin on the 7th:—T = 1885. No 24·7806, Berlin M.T.; π − ☊ 34° 36′ 57 ; ☊ 1′ 48″; i 42° 25′ 11″; log. q ·03012. Dr. Oppe heim's ephemeris gives the following po tions:—

	R.A.			N. Dec.
Jan. 22	21h.	35m.	11s.	15° 21·0′
26	21	49	50	16 51·9

Dr. J. Palisa, of Vienna, has re-determin the orbit of the comet, and finds the dat perihelion passage to be Nov. 28·2436 Be M.T. His ephemeris gives the followi positions:—

	R.A.			N. Dec.
Jan. 22	21h.	35m.	48s.	15° 28·2′
26	21	50	48	16 57·4

A remarkable meteor is reported from seve quarters as having been seen about 5.5 5.10 p.m. on Jan. 16th. It was marked b brilliant and continuous train, and its cou was apparently from the zenith to a point d east about 15° above the horizon.

It is understood that the gold medal of t Royal Astronomical Society has this year be awarded conjointly to Prof. Pritchard Oxford, and Prof. Pickering, of Harvard their valuable observations and researches stellar photometry.

The December number of the *Monthly No* of the Royal Astronomical Society contai note of observations of the magnitude of N Andromedæ, made at the Radcliffe Observa contributed by E. J. Stone, M.A., from which find that the magnitude of the new star in S tember ranged from 8 to 11, and on Decem 10th it had decreased to 14.

We regret to announce the death of Mr. J Morris, for many years professor of geolog University College, London, though per better known as president of the Geolog Association, an office he filled for sev years, and personally conducted the mem over most of the more remarkable dist in these islands. John Morris was born 1810, and early in life devoted his at tion to scientific pursuits. In 1836 commenced his catalogue of British Foss work which became a standard, and in 187 Roderick Murchison was deputed by a num of prominent patrons of geological scien present Prof. Morris with an address on vel and the sum of £600 as a testimony of t appreciation of his labours. Prof. Morris also the recipient of the first Lyell medal of Geological Society, and will be remember a wide circle of geological students for manner in which he succeeded in impar knowledge of his favourite science (he something of an astronomer and a pha ceutical chemist by profession), and by a wider circle for the amiability of his char

At the meeting of the Anthropological tute last week Dr. R. Munro read a pap "The Archæological Importance of A British Lake Dwellings, and their relati analogous remains in Europe." The dwellings of Scotland were essentially th duct of Celtic genius, and were construct defensive purposes. Dr. Munro believes those in the south-west parts of the cou attained their greatest development in Roman times, after Roman protection withdrawn from the provincial inhabit and they were left to contend single-han against the Angles on the east, and the P and Scots on the north. He suggested theory that the British Celts were an off of the founders of the Swiss lake dwe who emigrated into Britain when these trine abodes were in full vogue, and so r a knowledge of the custom long after fallen into desu while in Europe. Among arguments in support of this hypoth Munro pointed out that the geograph tribution of the lake dwellings closely corre with t occupied by t structure three ston ewis showed that in these circles, as in others reviously described by him, there is a marked reponderance of outlying stones and promi-ent hills towards the north-east, and that the ircle builders followed the Babylonians rather han the Egyptians in their rules of orienta-ion. In the relation between stone circles and djacent hills and outlying stones, suggestions night be found, not only of sun worship, but lso of mountain worship and of phallic wor-hip.

Commencing on Thursday, Jan. 28, Mr. W. handler Roberts-Austen, F.R.S., chemist of he Mint, will deliver, at the Royal Institu-ion, a course of four lectures on "Metals, as ffected by small Quantities of Impurity," ontinuing on the three following Thursdays.

On Saturdays, Jan, 30, Feb. 6, 13, and 20, rof. A. Geikie, F.R.S., director-general of the eological Survey of the United Kingdom, will eliver at the Royal Institution a course of our lectures on the "History of Volcanic ction in the British Isles."

The remains of an extinct type of dog, differ-ng widely from any of the ordinary wild or omestic dogs, have been recently described by Ir. J. A. Allen in the *Memoirs* of the Museum f Zoology at Harvard College. The bones ere found in Ely Cave, Lee County, Virginia, ne of the oldest of a group of caverns in lime-one of Cambro-Silurian age, described by rof. Shaler, of the Geological Survey of Ken-ucky. In general form the new dog was a ort-limbed, heavy-bodied animal, resembling its proportions a badger rather than a dog. he skull has not been found. Mr. Allen refers e remains to a new genus, under the name of *achycyon robustus.*

The Academy of Natural Science in Phila-elphia has, by the death of the widow of the te Mr. H. N. Johnson, come into possession of e entire estate as residuary legatee. It is lued at over 50,000 dollars, and the available nual income is nearly 1,500 dollars.

The new Technical School at Sheffield, which as been established in connection with Firth ollege, will be formally opened on February 1 y Sir Frederick Bramwell.

The Mercers' Company have given notice that e Gresham lectures will be delivered at the ollege, Basinghall-street, on the following ates:—Law (Dr. Abdy), Jan. 26, 27, 28, and ; Rhetoric (Mr. J. E. Nixon), Feb. 2, 3, 4, d 5; Geometry (the Dean of Exeter), Feb. 9, , 11, and 12; Astronomy (Rev. E. Ledger), eb. 16, 17, 18, and 19; Divinity (the Dean of hichester), Feb. 23, 24, 25, and 26; and Music Dr. Henry Wylde). March 2, 3, 4, and 5.

Lord Crawford, who is one of the committee inquiry appointed by the President of the oard of Trade to investigate the working of e patent laws, paid a visit to the patent office Saturday, and spent some time in examining e work of the various departments. The llowing gentlemen have been invited by the resident of the Board of Trade to give evi-ence before the committee:—Sir Bernhard amuelson, M.P., Sir William Thomson, F.R.S., r Frederick Bramwell, F.R.S., and Mr. John rray, M.A., president of the Institute of atent Agents.

Dr. R. E. Dudgeon has reprinted from the *omœopathic World* a paper on "Medical oycotting," which may be commended to all vers of fair play.

Those who wish to take part in the competi-ive trials of couplings promoted by the malgamated Society of Railway Servants, ould send drawings, specifications, or models Mr. Harford, 306, City-road, E.C., before the t inst. Preference will be given to such as in the kind of drawbar-hook at present se. The trials will take place at the Nine s goods-yard on a date not yet fixed; but rs of the couplings selected for trial will ample notice, and will be required to affix to the waggons provided by Mr. Scotter he purpose. The number of these is d: hence a selection of the devices must de.

Alderman W. H. Bailey delivered his add— as President of the Manchester last Saturday, taking for for Canal Boat e impor of cheap carriage to the development of English commerce, and gave a variety of useful information in connection with the application of steam to transportation by canal. In concluding, he stated that under most conditions a ton of goods can be sent a distance of 2,000 miles by water at a cost equal to that of 100 miles on land.

The *Howe*, a new armour-plated barbette ship of the *Admiral* class, has concluded a satisfactory series of trials in Stokes Bay. With 89lb. of steam in the boilers the starboard engines showed means of 59·1lb. and 14lb., the port engines 59lb. and 13lb., the total indicated H.P being 11,711·8, or about 2,200H.P. more than the contract, and nearly 16H.P. per foot of grate surface—the highest result at present obtained in any ship of the Navy. The coal consumption was 2·17lb. per h.p. per hour, and the mean speed nearly 17 knots. The engines are twin-screw vertical compound by Humphrys, Tennant, and Co., with a high-pressure cylinder of 52in., exhausting into two low-pressure cylinders of 74in., the stroke being 3ft. 9in. The boilers are of Martins-Siemens steel, and the crank-shafts are hollow steel, and made in three interchangeable lengths.

It is stated that Reckenzaun's electrical tramcar in Berlin is an assured success.

USEFUL AND SCIENTIFIC NOTES.

The Petroleum Resources of Absheron.—Mr. Vasilieff has lately contributed a paper to the Institution of Civil Engineers "On the Oil Wells of the Absheron Peninsula," the centre of the whole oil region of the Caucasus. The peninsula does not exceed 4½ square miles in area. The yield is now 950,000 tons per annum. The bore-pipes. vary from 18in. to 14in., and are made of sheet-iron from $\frac{7}{16}$in. to ¼in. thick, but the diameter decreases as the depth increases; for instance, an 18in. bore ends at 14in. at a depth of 451ft., and another at 13in. at 525ft. This would pass 222 tons a day. A bore 600ft. deep of 16in., 14in. and 12in. pipes cost £510, with £1,000 for labour of sinking. The bore-pipes are not unfrequently crushed in from excessive external pressure. Boring goes on day and night. A gang consisting of a foreman, two assistants, and ten men, costs £30 a month. The total cost of sinking a 16in. bore 600ft., amounts to £1,300, the average rate of sinking being 140ft. a month. Mohammedan workmen are preferred, because of their sobriety and absence of holidays. A naphtha fountain on leaving the pipe is broken up into many jets, the larger part, on account of the liberation of the occluded gases, is shattered into the finest spray. The pressure in the pipe has been found to vary between 50lb. and 300lb. per square inch. In the year 1883, two fountains played simultaneously to a height of between 250ft. and 350ft. Continuous fountains always become sooner or later intermittent and ultimately settle down to ordinary wells from which the oil has to be raised. A continuous fountain may yield over 3,300 tons, and require the labour of 100 men to collect and store. The daily yield would be worth £100, the cost of labour being from £15 to £20. Some wells must be allowed to rest for several days, and the mean produce of 100 wells now in active work is given at 32 tons per well per day, and assuming that the season extends from March to November, Mr. Vasilieff calculated that the total amount produce of oil is about 1,000,000 tons; the average cost of production being estimated at £2 12s. 6d. per ton.

A NOVEL application of cold-air machinery has just been made in the construction of a tunnel at Stockholm. The tunnel passes through a hill consisting in great measure of a light wet gravel, on which a number of very large houses are built. It was practically impossible to underpin the foundations of these houses on account of the expense, and the contractor, Captain Lindmark, therefore decided to attempt to freeze the gravel by means of cold air, the lining being put in when the material was solid. This has now been successfully accomplished by cold-air machines, made in London. The results have been in every way most satisfactory, and already several large houses have been safely passed under.

APPLICATION is to be made to the Canadian Parliament for a Bill authorising the construction of an iron tubular subway nine miles long and 18ft. in diameter between Cape Traverse, on Prince Edward Island, and Cape Tormentine, on the main land of New Brunswick. Railway cars are to be run through by means of a stationary engine at each end. The greatest depth of water is six fathoms.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁎ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE COUNCIL OF THE ROYAL ASTRONOMICAL SOCIETY.

[25240.]—WILL you permit me, through your columns, to thank the twenty-three Fellows of the R.A.S. who have done me the honour of placing my name on the balloting list proposed by them as a member of the Council for the ensuing year? At the same time, I wish to point out that my name was omitted from the list proposed by the Council at my own request, on the grounds that I have now been on the Council for four years consecutively, and I consider that that is a sufficiently long time for me to have been on at one time. I, therefore, venture to ask those Fellows who make use of the "opposition" list to insert a fresh name in place of mine.

Jan. 12th. **A. M. W. Downing.**

THE R. A. S. MEETING—LIVERPOOL ASTRONOMICAL SOCIETY—ERRATUM.

[25241.]—THE farce which was enacted at Burlington House the other evening, in respect to the "admission" of certain Fellows of the R. A. S. by proxy (one of them had been a Fellow for nearly thirty years!), ought to show the absurdity of of maintaining a practically obsolete and useless by-law, which is out of all keeping with the spirit of modern times. That any Fellow who had not gone through this antiquated form should be objected to, as not entitled to the privileges of the fellowship of the Society, is simply astounding. If the Fellows generally are desirous of seeing a little less formality and a little more life in the Society, they would do well to record their votes for the independent list as nominated.

It does, indeed, seem a pity that the Liverpool Astronomical Society, after a brief career of unparalleled success, should be threatened with disruption; and that owing to the narrow-minded policy of a few members residing in the city of its origin. So cosmopolitan has this young society become that the resident members now form but a small proportion of the total number. Nor is its popularity far to seek, inasmuch as it supplied a want which had been long neglected by the more pretentious R. A. S.—that of catering for the requirements of a large and growing army of amateur observer. Probably no one individual had done more in fostering this taste for astronomical pursuits—even in the days when a good telescope was an expensive luxury—than the late Prebendary Webb; and that the germs sown by his valuable work have borne fruit, is abundantly testified by the multitude of amateurs who now "consider the heavens." This, then, is the class to whom the Liverpool Society appealed with peculiar attractiveness, and to them it largely owes its present position. To throw overboard this important element, under the guise of a cheese-paring economy, is nothing short of suicidal. If the recent numbers of the *Journal* are at all indicative of the spirit of the new management, it seems pretty clear that the Society has passed its meridian, and is on the wane. It is much to be regretted that the former progressive and liberal policy is no longer adhered to. Such a policy is perfectly sound from a business point of view, and why it should fail when applied to the working of a scientific society is more than one can comprehend. *Verbum sat sapienti.*

In letter 25221 there is a misprint which might as well be rectified. Under the heading of ψ Draconis, XXVIIh. should be, of course. XVIIh.

Stella.

THE ROYAL ASTRONOMICAL SOCIETY.

[25242.]—THE remarks of "A Fellow of the Royal Astronomical Society" in your last week's number, will no doubt be read with much interest by the Fellows of the Society who have recently put forth a list for election upon the Council which of the present office holders seeks to remove four, two who have each attended 6 (the full number) meetings, one who has attended 5, and one 3 = 20 attendances; while it proposes to re-elect one who has attended 0 meeting, two who have attended 2 each, and one who has attended 3 = 7 attendances.

The figures are from "F.R.A.S.'s" statistical table of services rendered.

Jan. 16. **De Haut en Bas.**

OCCULTATION OF ALDEBARAN, JAN. 16th.

[25243.]—THICK clouds, accompanied by a squall of short duration, unfortunately prevented the immersion being seen at this place. The sky had been clear for about half an hour previously, and continued so until a few minutes before the time of occultation. Using a power of 160, Aldebaran was well defined, showing a clean small disc. A break in the clouds occurred shortly before the time of emersion; the star was then seen to suddenly emerge from behind the bright limb of the moon in undiminished brilliancy. The redness of the star was not so striking as at the daylight occultation of July 9th. Telescope used, a 6½in. Calver.

Southampton, Jan. 19. **A. H. S.**

[25244.]—ALTHOUGH the weather in this district was very stormy on Saturday evening, the 16th ult., yet the sky cleared sufficiently to allow the occultation to be observed. The disappearance took place at 7h. 54m. 56s. G.M.T., and the reappearance at 8h. 41m. 50s., Aldebaran having been occulted for a period of 46m. 54s. Nothing strange or unusual was noticed, either at disappearance or reappearance.

The position of Felton is: Lat. N. 55° 17′ 37″; long. W. 1° 41′ 50″. **T. J. Murday.**

Felton, Northumberland, Jan. 18.

NOVA ORIONIS (GORE)—TEMPEL'S NEBULA—42 M. ORIONIS.

[25245.]—I CAN most thoroughly confirm Mr. Espin's interesting letter (No. 25219, p. 403) relative to the colour of Gore's Nova in Orion. It has been carefully observed on five nights with the 3in. achromatic and 10¼in. Calver, and in both instruments the colour was noted as "deep orange, almost red." It bears magnifying unusually well, but is rapidly declining, as I rated it a full magnitude smaller on Jan. 9th, then when the first observation was made on Dec. 29. The little *comes. s.f.*, was estimated at 10 mag., and it was readily visible in the 3in. The 10¼ mirror showed another smaller star at almost exactly the same distance *s.p.*, est. at 11 Σ, and a third a little closer, *n.p.*, P. A. 330° ±. This latter is so excessively faint as not to be steadily visible with any power, and I have only glimpsed it on one night: it is evidently very nearly the "min. vis." of my aperture. With regard to the Merope nebula in the Pleiades, I quite agree with Mr. Goodacre (letter 25217), that abnormally clear air is requisite to see it at all, and such a condition of the atmosphere being exceedingly rare in this country may account for the few observations of it on record. I have only seen it twice this season on Dec. 29 (when the air was so transparent that the fifth and sixth stars in the Trapezium were quite bright, and the *comes* to Sirius visible) and on Jan. 6th. A power of about 50 seems to show it best; but it is very ill-defined even with that, and I feel sure that the group might be observed six nights out of seven without seeing any trace of it. It is quite possible that may also be variable. The whole space around the principal stars appeared nebulous on the night in question, and the wonderful photograph just taken by Henry Bros., showing a spiral nebula around the star Maia seems to point in the same direction. It will be well to watch the group carefully on every unusually clear night. The nebula 42 M Orionis has also been observed regularly, and I have succeeded in picking up the stars numbered 13, 10, 14, and 20 on Mr. Sadler's chart of the central portion of the nebula March 6, 1885 (letter 23890). The last is a very difficult object, as it falls nearly on the bright "bridge" which crosses the Fishes' Mouth, and, consequently, is almost lost for want of contrast, and the same remark applies to several other of the small stars involved in the nebula.

Kenneth J. Tarrant.

Letchford House, Pinner.

SELENOGRAPHICAL.

[25246.]—IN my letter, 25155, "E.M.," p. 359, for Σ 138 read Σ 183. May I ask selenographers to watch the following suspected prolongation of clefts? 1, The branch ζ joining cleft Ariadæus with the west branch of Hyginus cleft prolonged to crater *a* Triesnecker; 2, the cleft Triesnecker δ extending far in Mare Vaporum; 3, a cleft crossing the floor of Ptolemaüs from ring *b* to the eastern extremity of this formation; 4, a cleft running from the east side of Wollaston B towards Gruithuisen.

Jan. 16. **C. M. Gaudibert.**

THE METEOR SHOWER ON EVENING OF 27th NOVEMBER, 1885, AS SEEN IN THE TRANSVAAL, S. AFRICA.

[25247.]—HEAVY rain had fallen during the afternoon, and loose masses of cloud were still floating about towards sundown. Soon after dusk the sky was almost entirely obscured, but by 7 o'clock the clouds had again separated so as to leave considerable openings in the heavens.

At about 8.30 p.m. (*local* mean time) my brother said to me "Come and see what a number of shooting stars there are falling." It at once flashed into my mind that we were passing through a meteor stream. On going out of doors, a most splendid sight was witnessed. The sky was fairly free from heavy clouds, although a haziness considerably dulled it, yet great numbers of these meteors were seen rapidly darting through the sky with a soft gliding motion, in a southerly direction.

At first there seemed to be so many of them bursting into view that it was a very difficult matter, if not altogether impossible, for one observer to count them.

Hurrying to the observatory, I opened the northern window of transit room, lighted up the clock's face, opened Proctor's atlas, and, with notebook in hand, stationed myself outside, alongside of window, in such a position that the principal line of vision was directed to the regions of the heavens between *α* Arietis and *β* Triangulum, because a first hasty observation of a few minutes roughly indicated the radiant to be somewhere there.

In this position meteors could be seen nearly up to zenith, and I may say to 90° each side of hour circle of *α* Arietis, or, roughly, the *half* of visible heavens was included in the "field."

Counting was commenced at 8h. 44m. (l.m.t.) Every visible meteorite was taken visible in the regions above given, though in several instances meteors further south were counted in. The results of counting are given in the following table:—

		Total Meteors.		Meteors per Minute.	Remarks.
8h. 44m. to 8h. 47m. =	3 min.	107	=	35·6	Sky hazy-nimbus
during next	4½ "	121	=	27	
"	3 "	107	=	35·6	Slightly clearer
"	3½ "	101	=	29	" "
"	2⅔ "	100	=	37·5	" "
"	2⅓ "	137	=	58·7	" "
"	5½ "	148	=	27	Covering slightly
"	4½ "	146	=	32·5	Covering heavier
"	6½ "	115	=	17·7	Covering hazy
"	4 "	120	=	30	
"	4½ "	113	=	25	Nimbus heavier
"	6½ "	110	=	17	Heavy loose clouds

The sky over principal part of field had now become covered with heavy floating masses of cloud. Counting interrupted for a few minutes. Although I had already been able to trace, and fairly fix the radiant in Triangulum, I now hastily dotted down the principal objects from Proctor's Atlas. On this diagram was marked the place of appearance, path, and direction of any meteor seen near the radiant. Resumed counting at 9h. 40m., the heavier masses of cloud having left a fair opening again.

		Total Meteors.		Meteors per Minute.	Remarks.
To 9h. 44m. =					
	4 min.	69	=	17	Clouds clearing
	5½ "	75	=	13·6	" "
	7 "	80	=	11·4	" "
	5½ "	63	=	11·4	" "
	5 "	44	=	8·8	" "
	9 "	51	=	5·67	" "
	6½ "	60	=	9·2	Fairly clear
	6 "	56	=	9·3	" "
	3 "	24	=	8	" "
	5⅔ "	45	=	8	Clouds gathering
	5 "	23	=	4·6	Sky murky

(Note.—As there was a pretty strong breeze blowing, the clouds were gathered, or drifted past in a very short time.)

From my diagram, as well as from eye observation direct, it seemed pretty certain that the radiant was situated near the star *ε* Triangulum, in the direction of a line joining *ε* and 7 in the larger triangle.

To say *when* the maximum display took place
would be a matter of some difficulty, if the
of meteors per minute are taken from
here given, because it is very possible
maximum occurred near to 8.25 or 8.30,
the regular counting was commenced. Th
a glance at the table will show a peculiari
from the very first, struck me, that th
arrived in volleys. Every now and then
charge took place.

Whenever a large meteor appeared wit
30° of radiant, it was almost sure to be fo
a shower.

The meteors, one and all, had a s
gliding motion, much resembling a flight
Their trains increased in apparent len
portion to their zenith distance. In s
stances trains of the larger ones remai
for from 5 to 15 seconds, and with dist
purplish trains.

Most of the meteors themselves remai
from, perhaps, half a second to two, and
cases perhaps three, seconds.

Colour of meteors seemed, one and all,
white, yellowish-white, yellow; in a
bordering into orange. The state of a
probably affected their apparent colours.

During first half-hour or 45 minut
the largest number of meteors appe
zenith, as if they grazed the atmos
gentially. During next 20 minutes or so t
number seemed to shoot across the no
sky; but this may be due to the clear
sky in that direction. To a similar ca
bute the larger number seen near zenith

In size the meteors seemed much to
follow the proportion of the stellar magni
6th to 1st, a few being as large as Jup
not one seemed to equal Venus.

On looking southwards every now and t
meteors seemed to strike so low down as
appearing to run towards a vanishing
30° below S. pole.

Counting and observation were disconti
10h. 30m., or, it should be said, *countin*
I continued to watch up to 11h. 15m. o
number of meteors having greatly decre
still the *volley feature* remained.

Next evening, 28th Nov., 8.50 p.m
dozen straggling meteors, certainly of sa
were seen.

29th Nov. Some five or six meteors
this evening, resembling in motion and
the Triangulids. 30th. 10.30 p.m. Wa
neighbourhood of Triangulum, a single
or 4th mag. meteor appeared a little p
Triangulum, and describing a small p
wards, disappeared. **John**

Rolfontein, Transvaal, Dec. 2, 1885.

BRIGHT AURORA.

[25248.]—AN unusually brilliant d
aurora was observed here on January
Soon after sunset a peculiar light was ob
the northern horizon, and at about 6 p.m.
arch of white light was visible below
The lower edge of this arch was well de
passed just below the star *η* Ursæ Ma
illumination at times being so strong tha
stars in the end of the Great Bear's
nearly obliterated.

At 6.30 p.m. a bright beam of light a
little below Vega, and another similar
through the stars *α*, *β*, *γ*, and *δ* Ursæ
These soon united, and formed a beautifu
light, the apex of which passed over the sta
γ Ursæ Minoris. The appearance of th
luminous bands was very grand. The li
continually flickering and changing. At
the western side would be very bright
eastern quite faint. Suddenly this woul
versed, and this interchange of light wa
times repeated, the colour varying from w
warm rosy tint.

At 6.45 p.m. another bright beam furth
west, and passing over the constellation
Dolphin, was noticed, and immediately aft
responding ray appeared in the east. The
(exactly as the lower arch had done), and
a third arch of light, the apex of which was
towards the zenith, so that a little before 7 p
were three distinct auroral arches visible.
case the lower margin was well defined, t
margin fading off irregularly into strea
rays continually fluctuating and quiverin

Some idea of the intensity of the lig
inferred from the fact that the two sta
end of the Great Bear's tail, the bright
β and *γ* Lyræ, and the stars of the Do
at times nearly obliterated.

G. Grover,
Assistant to G. E. Peek, M.A.
Rousdon Observatory, Lyme Regis,

WINTER QU

[25249.] — IT
vapour; that vap
water, and snow is

nt in cold? How is snow whiteness ex- d? When submitted to heat, snow transforms olourless liquid water. Why? What becomes whiteness? Is there in heat a destructive of whiteness? What is it? Now it freezes; r is dry and invisible, its temperature is C. In respiring, a man inhales it in that but when he expires it, its temperature has to + 31° C. Difference in plus + 34° C. emperature of the lungs and blood was at C., and remains the same. How and by what he exhaled heat generated and the lung's rature maintained? The exhaled air is not introduced, but is very damp, overloaded water vapour, which renders it visible. is the origin of that water? By what and s it formed? It cannot be extracted from ngs, which don't dry up. In cold countries, Russia, the air being inhaled at, say, − 30° C., ewise exhaled at + 31° C., which makes an se of + 61° C., the lungs remain at + 37° C. can the increase and its difference be ex- d? That heat did not exist in the body, and es off without changing the internal tempe- . How is it? The quantity of vapour d corresponds to the intensity of the cold.

A man having remained 24 hours without or drinking anything, or a sick man having several days without taking any food, the effects having continuously been produced, lood and lungs, nevertheless, preserve the temperature. How is it possible? The of a man having been ascertained accu- if after 12 hours he is weighed again, his is the same; still he has inhaled dry air xhaled wet air containing a quantity of Where from? If cold water be poured on 's body, its surface temperature rises. Why w? Severe cold does not cool the lungs nor od. How can this be? The temperature of blood is the same all the world over—North, Equator; it never varies according to it air. Why? In summer time, similar are not produced. Why? In countries the ambient temperature of the air is, say, C. or more, it being so inhaled, the lungs ood heat does not increase. How can the 13° C. heat be accounted for? How does it that the body being placed in a medium at C. or − 30° = difference + 80°, the blood s at + 37° C., in the first case losing 13° C., other gaining 67° C.? In such hot regions ired air does not produce water vapour, and t become visible as it does in cold countries?

How is it that more heat produces less Which are the physico-physiological agents roduce these physico-physiological pheno- and according to what law?

Would Know.

SOARING BIRDS.

50.]—WITH regard to Mr. I. Lancaster's the whole matter can be put into a nut- Suppose an inanimate soaring plane in per- calm air. It falls, and at the same time, by of its position and the air currents it sets ves laterally. By friction against the air it es, it expends energy in this movement, con- tly it has lost a portion of its energy of n. On repeating the movement it will lose r portion of the same, and the process will e until it has expended all its energy of , and comes to rest and the ground at the me.

r. Lancaster admits this, it disposes at once theory. If not, will he find a flaw in the ng or a mistake in the premises?

soaring inanimate plane, and its difference bsence of movement of the air he postulates . He also admits the existence of the riction" of the sides of his plane against the from this he argues that because the latter the "fall of the body can be secured in- ly," whereas I most fearlessly assert that r small the surface friction is, so long as it t all the fall of the body cannot be secured itely; but, on the contrary, only for a per- efinite and calculable period.

ould indeed be strange if anyone who was ng to "get round" the law of the conserva- energy could come to any other conclu-

B. B.

NG POINT OF ALUMINIUM.—TO MR. W. JOHN GREY.

1.]—YOU say that "Al fusing point is etween that of zinc and silver." But why nd how has this been ascertained? Was rically, or does it result from the applica- a known physical law?

e fusing point of metals differs, and depends peculiar physical state, there must exist a relation [illegible] e constituent elements [illegible] be known, [illegible] determine

it changes in case of alloys. How is this explained? For instance, bismuth fuses at 256° C.; lead at 334° C.; and tin at 250° C. Darcet's alloy is formed of 4 bis., 1 lead, 1 tin; so—

4 bis. × 256° = 1024°
1 lead × 334° = 334°
1 tin × 250° = 250°

Separately fused they require 1588° C.

If mixed and cooled at 0° C., when reheated the alloy fuses at 94° C. How is this explained? According to what scientific law?

Would Know.

THE BLOWPIPE, &c.

[25252.]—IN No. 1085, letter 25194, p. 382, second column, there is an error which completely alters the meaning I intended to convey. For the words "perfect combination and definition." read "perfect combustion and definition." I see from letter 25238, pp. 406-7, No. 1086, "E. M.," that Col. Ross has not yet recovered sufficient equanimity to appreciate the fact that he has only been the means of *extending* the use of boric acid as a blowpipe reagent, not of "introducing it," as would appear from the note in his book; boric acid having been used B. B. as a reagent at an early period in the history of the chemical blowpipe.

C. R. Beaumont.

COLLIERY WARNINGS.

[25253.]—IN the ENGLISH MECHANIC of July 10 last appeared a letter (24448), signed T. J. Murday, in which the writer stated that on 39 days which he named "a change of atmospheric pressure, combined with disturbances of the magnetic currents and seismic perturbations, may be expected to occur during the ensuing six months." . . . . "therefore I name those dates as being highly dangerous, and the greatest care should be observed by miners.

My admiration for the courage of a writer who dare predict six months in advance the state of the atmosphere on a particular day, being greatly excited, I made a note of the "dangerous" days, and will, with your permission, endeavour to show how far the prediction was verified.

Now, it is well-known that in our variable climates, a writer who selected any 39 dates out of six months, and predicted a certain state of the atmosphere on those days, would, by the law of chances, be right on some of them; but in Mr. Murday's case I think he may reasonably complain that the law of chances has dealt very unfairly with him. Comparing the 39 dates given by Mr. Murday with the charts issued by the Meteorological Office, I find that on 17 the barometer was above 29·9in. in all parts of the kingdom. On five others it was above 29·7in. On 8 days only was it below 29·5in. in any part of the kingdom, and on two only was it below 29·5 all over the British Isles, and on both of these occasions the barometer was rising, while on six of the other eight that it was below 22·5, in some parts of the kingdom it was also rising. In some cases Mr. Murday gives dates very close together, and here he has been fortunate enough to catch a depression as on Dec. 2, 3, 4, and 5, when a rather deep depression with readings ranging from 28·6 to 29·6, crossed the country between the 3rd and 5th; while in October, when a depression crossed on the 4th and another on the 6th, Mr. Murday omits these two dates, and gives only the 3rd and 5th as 'dangerous" days.

I should, perhaps, not have been so much struck with Mr. Murday's letter had it not been that here in Sheffield there are published in one of the local papers some of the most remarkable warnings to colliers by a more than usually ignorant penny-a-liner dubbed "Our Meteorological Correspondent." One of these was issued the other day when the barometer stood at 30·1in., and temperature was below the freezing point. As, however, colliers are at one time told to keep away from the "goafs" (*sic*) because the high pressure will force the gas out, and at another time to keep out of the "goafs" (*sic*) as much as they can on account of low atmospheric pressure, a state of high pressure and low temperature may be considered dangerous. This same meteorological correspondent, by the way, saw during a thunderstorm last summer a lightning flash that lasted several seconds.

I quite agree with Mr. Murday that "observation has put it beyond all doubt that an intimate connection exists between these [atmospheric] disturbances and accumulations of gas in mines," though I certainly do not think that "although we can never expect to be able to prevent the outrush of gas in mines, there is no reason why we should not be able to indicate the periods [six months in advance] when these occurrences have a tendency to take place."

Without entering into the general question of warnings to colliers, I think it is very undesirable that, through ignorance or presumption, anything ould be done to bring them into contempt with people they are intended to benefit.

eld, Jan. 12. **Tish.**

ON THE MUSICAL INSTRUMENTS FOR HOME, AND TO A "FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.'

[25254.]—THE perusal of "Organon's" communication has increased within me the wish that I were very much better acquainted with the interior mechanism of free-reed instruments than I am now, or I fear, am ever likely to be. I can but judge, imperfectly perhaps it may be, by results. And with regard to his first question, "How do I keep the instrument in unison with the piano?" I answer by the aid of the piano tuner. If the piano be a well-made one, this should create no difficulty. The first piano I ever had—a small, inexpensive French instrument, would keep well in tune with the Mason and Hamlin American organ I then had for six months. I sold this, and some two months ago purchased an upright grand, by Hopkinson, a noble instrument, and a worthy companion to a Mustel organ. This piano was tuned to the pitch of the Mustel before leaving the manufacturer's ware-rooms, and after travelling a distance by rail of some 150 miles, and being placed in my drawing-room (a room subject to very variable temperature), is, at the moment of writing this, in perfect unison with the organ. I think my correspondent creates a very visionary difficulty here. It is surely his experience that a well-built piano will remain in tune infinitely better than the reed stops of a pipe organ. The liability of the latter to get out of tune, and the difficulty (let alone the expense) of having them tuned in a country town, is a great drawback to a domestic pipe organ. I only wish that in every musical home there might be found a reed instrument used with and practised upon as freely as the piano. I believe this would do more to create a taste for orchestral and classical music of the highest class than any other incentive which could be named; moreover, pianos would then necessarily be kept in much better tune than many of them now are.

With regard to "Organon's" second query as to why expression cannot be obtained on the American organ? I am surprised at such a question being asked from one evidently so well-informed as my querist. The expression stop is the charm of the harmonium: by its aid alone can you "sing" even upon that instrument. I am sure I have no necessity to tell my friend that on bringing the expression stop into use the reeds are blown straight from the bellows, the wind passing directly into the wind-chest or air-chamber, and not into the reservoir, and so not being distributed under a mechanical and equable pressure as otherwise it would be. By using the expression-stop in Mustel's organs you feel the foot almost to be in actual contact with the reed. So exquisite is the workmanship, that the bare touch of the ball of the foot upon the blow pedal is of itself sufficient to cause the reeds to speak without any exerted pressure. The "foot touch" is simply perfect. But the very principle of the American organ prevents this being obtained in that instrument. There, *ex necessitate*, the wind must be drawn by the bellows from the reservoir, and so the immediate touch between the foot and the reed is lost. To take an instance:—"Ernst's Elegy," for violin and piano, played upon the Mustel accompanied by the piano, is exquisite. I do not think that even the violin itself can give more tone shading to that piece (full of feeling in every bar and in every note of every bar) than the Mustel; but I should be very disinclined to try it upon the American organ, and this solely for want of the expression stop.

As to my friend's next query, I do not know that in the *principle* of Mustel's percussion action there is much to distinguish it from the percussion of other makers. All I can say is that until I came upon the Mustel organ I never met with any percussion action that I would have troubled much about, and I have tried many. In Mustel's percussion almost as much may be done by finger-touch as in a grand piano. Again and again I have astonished good pianists by the results obtained from the percussion (and I am but a sorry indifferent player). I believe, however, the superiority of Mustel's percussion arises simply and solely from the great care taken by Mustel himself *personally* in its production, and the beautiful workmanship bestowed thereon.

Now as to the Metaphone, I believe this occurs in Mustel's instrument alone. It acts upon the fifre, hautbois, musette, and baryton stops in the treble. In the bass upon the harpe eolienne, basson, and clairon. Its actual operation is when drawn to close a series of Venetian shutters. The result is very much to soften the tones of the affected stops, and to make them mellower and sweeter. For sacred music it is most useful, and renders the tone of the organ very similar to the American organ, and to a church organ heard at a distance. Now here I fancy I see a sarcastic smile upon the face of my friend. What, that learned name "metaphone," after all then, stands for nothing more than a forte wrong way up? So be it; I am content; but, I say emphatically, let my friend try it carefully. *Carefully*, for although the effects of the metaphone are most obvious, yet to discover *all* that can be done by it many hours may well be spent, with the result of increased admiration at what can be done by means apparently so simple. I use the metaphone, treble or bass, almost continually in sacred music. Last night I was much struck with the exquisite way in which it told on the "Pastoral" symphony from "The Messiah." The idea of distance conferred by the metaphone is very striking indeed, and is one which most musicians notice on hearing the instrument for the first time. Its effect is as marked upon each separate stop as upon the whole instrument when all the stops are drawn.

Now, as to the double touch; I am surprised to hear that this is so very old. I believe Mustel was the first to use it, and the few others who have adopted it have only followed him (as nearly as they could), but with a tithe of his success; and, notwithstanding my friend's remarks upon the old age of this arrangement, I will say that the results obtainable thereby are very useful and very beautiful.

Then, again, as to the knee pedals over which my friend makes merry. I do not think he quite understands all that can be done by them. Each pedal has three distinct uses.

Buttoned close up to the instrument we have the ordinary harmonium in use. Allowed simply to hang loose, nothing more than a soft tone, affected but slightly by the hardest blowing, is obtained—a most useful effect when it is desired to bring out a melody in contrast with the accompaniment. Finally, by pressing the pedal outwards to its full extent a second series of Venetian shutters are opened. These shutters act upon all the stops, and when it is remembered that there are two of these knee pedals—one each for treble and bass, it is obvious that six different effects are produced by them alone.

I ought to have mentioned the expressive fortes; they are pneumatic swells, which open and close in perfect unison with the pressure exerted by the foot upon the pedals, and so, through the expression stop, directly upon the reeds. I do not think it is too much to say that this expressive forte doubles the power of expression of the instrument. They are also operated on by the knee pedals when drawn, and so more readily usable by the tyro.

I am glad to reply to my friend; but, if he is really anxious to know more about the Mustel, I should strongly advise him to see one. If he lives near London, he can, of course, see one readily enough at Messieurs Metzler's. If he lives in any of the Midland counties, I should be only too pleased to show him mine.

Since the foregoing was written, I have carefully read the letter by "Amateur Organ Builder" in your issue of the 8th inst. He will, I think, find I have already dealt with some of his queries. He, however, asks further details, which I will now supply, although, Sir, I fear I am trespassing considerably on your space.

There are in the Mustel fourteen rows of reeds, eight in the treble; six in the bass. In the treble they are 8ft., 16ft., 4ft.; a second 8ft. for basson, 16ft. musette, 32ft. baryton. The celeste has two sets of reeds, one tuned slightly lower, the other slightly higher, than the pitch of the organ. In the bass the six rows are made up as follows: one, 8ft.; one, 16ft; one, 4ft.; second, 8ft. basson, and two rows of 2ft., forming together the harp eolienne stop, tuned similarly to the celeste.

That the celeste stop and the harp eolienne should be formed of two rows of vibrators is, I believe, a peculiarity of Mustel's instruments, but, at the same time, one of its superlative excellences. Such a contrast to the mean devices of some so-called celestes (merely, if so much, a change in the wind direction), and whose whole value begins and ends with the manufacturer, enabling him to add one more to his imposing array of stop knobs.

With the Mustel you are not invited carefully to shut these stops off when the full organ is used, for instead of diminishing the power of the instrument they add to and blend most beautifully with the other stops. There is no more beautiful combination in the whole instrument than the celeste with the clarinette.

As to the percussion, and in reply to other queries of my amateur friend, I would strongly urge him to invest a shilling or so in one of the practical manuals on harmonium tuning and regulating published by Metzlers; they contain full details and diagrams. I do not think my friend can have the faintest idea as to what Mustel's double touch really is. It has nothing whatever in common with what he mentions, and his similitude really shocks me. In reply to one observation of his, I know of one instrument which has had the double touch in use twelve years, and is as good now as the day it left the ware-rooms.

I fear my friend will find his own proposed instrument not very satisfactory. He would have *done better at least* to have had two key-boards, one for the harmonium part, the other for the American organ part of his instrument.

I do not think I claimed "portability" as one of the attributes of the Mustel organ, for, as a matter of fact, they are, for their sizes, enormously heavy. My instrument is a beautiful piece of ebonised cabinet-work, stands 3ft. 4in. high, and goes into a recess 4ft. 4in. broad. To do this, however, I had to take off one of the handles, and a piece of skirting board.

No doubt, Sir, those of your musical readers who take the trouble to read my letter will consider me enthusiastic on Mustel's instruments. I plead guilty to this charge at once and unreservedly. They stand alone unapproached, and, I verily believe, unapproachable. I am not exaggerating when I say that my own instrument has become to me an intimate companion, a veritable soothing draught after many a day of worry, contention, and strife, yet in equal measure a sympathetic friend in hours of gladness and joy; and I am glad to think I am not alone in this feeling. I believe other possessors of Mustel's instruments find in them the same charm and never-ceasing freshness.

I ask "F.R.A.S." to tell me whether he has read Dr. Ball's book "The Story of the Heavens" lately published, and whether I may rely upon it to give me the latest facts and discoveries in and a thorough insight into astronomical science? Would it be a really useful companion to a 3¼in. Wray telescope?

Country Solicitor.

THE MUSICAL INSTRUMENTS FOR HOME.

[25255.]—IL a paru, le mois dernier, dans votre journal si honorablement connu et si répandu, un article sur les harmoniums de notre maison signé "Country Solicitor." Cet article, écrit avec une grande compétence, apprécie bien justement le résultat des efforts faits par notre père et par nous, ses collaborateurs, pour doter le salon d'un instrument qui—par l'étendue de ses ressources, le charme de sa sonorité, et ses qualités, hors ligne, d'expression—puisse devenir, seul ou associé au piano, un précieuse interprète de la musique mondaine.

Extrêmement flatté des éloges et de la sympathie si vivement exprimés dans cet article, notre père serait bien heureux (vous le comprendrez aisément, Monsieur le Directeur) de pouvoir se mettre en relations avec son client le "Country Solicitor" afin de lui exprimer tous ses remerciements et tout la gratitude que des procédés si bienveillants méritent au plus haut degré.

Je viens donc, en conséquence, demander "Country Solicitor" nous envoyer ses nom et adresse.

En attendant votre réponse dont nous vous remercirons d'avance, veuillez agréer, Monsieur le Directeur, l'expression de notre haute considération.

V. Mustel et ses Fils.

Rue de Malte 42, Paris, Jan. 16, 1886.

[25256.]—SOME of the points in "Country Solicitor's" letter which I have read must be subject to a mild exception. The organ for home is, no doubt, the Mustel or the Liszt; there are, however, denials to both of the white elephant kind, and, unless the "élite of amateurs" have also élite pockets, they may, like myself, have to rest content with lesser things. The Mustel is charming—it *must tell*, forgive the pun, and it must be "victor"—it is a triumph of genius, and wants neither novice to play or repair it. I could not go so far as my friend and call it "beloved,"—that would be making an idol of it, and that term is only fitting for the best on earth and beyond it; but, apart from this, his enthusiasm is well grounded.

I cannot join issue with him in calling the American organ expressionless, because the Mustel has the soul of expression, but his baby has spoiled him—the M. and H., with automatic swell, and Vox Humana is worthy a very decent place in our affections, and I confess a lasting regard for it. If the pipe organ is without expression, I much enjoyed our friend's playing on my instrument. I wish many of our organs were without expression. As far as swell goes the singing would be expressive, and the organ thoroughly subordinate as it was meant to be; but the sound of the sackbut, cornet, psaltery, and all kinds of music is not always helpful to the human voice. The Mason and Hamlin, minus the tremolo, which I hate, is the small-purse man's home instrument, unless some kind soul leaves him his white elephant, which may happen. With "Country Solicitor," I think, too, that if players cannot manage the harmonium expression, they will not draw much charm from the instrument. At our friend's suggestion I got the Vol. of Littolf's "Harmonium Concertante"; it is full of gems and a marvel of cheapness; but wants careful playing and counting. I may at the same time mention that there is a cabinet organ series begun by Pitman, and highly spoken of in a leader of the *Telegraph*.

Henry Ussher, B.A., M.B., Surgeon.

REFLECTORS v. REFRACTO

[25257.]—I AM much interested in t
sion concerning reflectors and refractors
been raised by Mr. Burnham, and as I h
the reflector my special study from my
until now, far past middle age, I may p
allowed to say a few words on the subjec

I consider Mr. Burnham quite right
marks concerning the inferiority of refle
for this reason: The Newtonian form,
on glass, is the kind now generally used
vantages are, cheapness and abundance
Its disadvantages are, that no fine defin
high powers can ever be obtained while
body of the observer is so near the mo
telescope as is necessitated by this form
have proved by numberless experiments
over many years. Then, again, with reg
glass speculum: This is generally test
silvering, because, for the perfection of
quired to equal a refractor, it would req
tested and reworked, perhaps from 50 to
and to silver and polish every time woul
very expensive. Now this testing requ
done with powers of from 100 to 150 to t
aperture. The unsilvered glass will not
cient light for this high testing. This I
actual experiment. So that the silver o
never give good definition under a very h
Then, again, the silver film when d
always of unequal thickness, sufficiently
the definition even were the glass perf
follows the polishing of the silver film.
the figure of the glass to be perfect, and
be of equal thickness throughout, even
process of polishing would be utterly d
of very fine definition. What would be
of finishing off a high-class metallic sp
this manner? The fact is, these silv
Newtonians are cheap and good for amus
quite unsuited for original research re
very highest defining power.

With regard to refractors, although ex
fine as at present constructed, I think the
said to have reached their limit. With
tures the enormous thickness of the glas
is alone a serious defect, and I think it i
that the error from defects in the glass
creases as the square of the aperture, and I
sorry that the Lick trustees have decided
fractor for their observatory.

There remains to be considered th
neglected metallic reflector. This, I think
the telescope of the future where fine de
required with very high powers, because
ness admits of a much more perfect surfa
obtained than is possible with a soft
silver. Its only defect, that I know of, is
deficiency of light. This I have no doubt
corrected by the discovery of some more
fractive alloy than that of copper and tin.
forms of this instrument worthy of atten
the Gregorian and the Cassegrainian. I
very curiously, that in the construction
instruments hitherto, a strange error has
mitted, whereby nearly half the light has
off, thus making them appear more de
light than they would otherwise be. I
covered and corrected about 20 years ag
not hitherto brought it before the pu
intended to make it the subject of a pa
may still do so. I have a small reflector
in this way, which, on favourable nights
a power of 100 to the inch without
woolliness of definition.

Pen-y

THE WIMSHURST MACHINE
MOLISON'S THEORY.

[25258.]—I AM favoured much by the
marks of Mr. Molison, and regret that
seen his way to criticise the matter ins
manner, the former being of general
only of individual interest, while it is
what useful result follows such remarks
notice is worthy consideration, although
have been more acceptable if he had
the errors which he was able to see with
any clear notion of my meaning.

In giving a scientific explanation
there is no objection to putting forward
opinions, together with admitted
to help in explaining the applic
authorities, or to quote an experimen
tion thereof: but I think there is
when the opinions are given inste
rities, and the experiment quoted
opposite of what it is stated it w
near the close of his letter Mr. Mo
while in action one of the rods
B D, be removed, the collecting
once take up its office." I have t
ment, and find the collecting comb
up its office. Either of us has th
err. Wil kind owner of a
a neutr which
Thu may
and how

›y, which of course may be my

with interest his able comments
.eory lately given by Mr. Walters,
'ed with admiration his ready
rt of the disproved theory which
for his own. He says: "A (a
›onnection with C (another brush)
end to become positively charged."
ction be cut across, which can be
ury to the working of the machine;
'ushes give free passage to the
ıe and go, there is no use in con-
forced this passage of electricity
e rod; the result was not an im-

own theory bears so strong a
ıat of "Old Smings," that I should
it suggested thereby; but Mr.
s "Old Smings's" theory, and says
.gainst three sectors inducing one,
.vill work without any metallic
." Yes, it will, but not under the
Glass without the sectors requires
:harge to excite it than glass with
ample is not relevant, for they
hat is claimed for them under dif-
of excitement, for any reason Mr.
› the contrary.
ıough of this lately. On the 5th
iting to some friends the working
I gradually reduced the sectors,
:es to the brushes. The result was
wer up to the disappearance of the
glass when idle appeared to re-
.ed. I kept the machine in this con-
:sent time for daily observation,
sion I come to is that such a
require such a powerful excite-
ıld be worthless in comparison to
ch the public is indebted to Mr.

›xt relies on two facts for his own
t is: "He evolved a theory of the
We are left to infer the merits
from the statement that it is 18
›lified. His next fact is: "That
ıshurst and the Holtz machines
principle." This he proved by
nachine to work *vertically*, and as
cceded, the principle of the two
›e identical with each other, and
another machine of much older
think of more general use than
led "a grindstone." The analogy
e argument is not published. Will
lly supply the want?

ıge of his lecture, and without the
ct to the Holtz theory, 15 years
, I must ask Mr. Molison, with due
r me to some authority beside his
which will contradict the fol-
›m "Electricity'," by Dr. Ferguson,
tated to have been proved by
amount of electricity induced by
dy on surrounding conductors is
:e to that of the inducing body."
ıst conclude, if Mr. Molison suc-
the charge under the combs of his
it must have been at the expense
ıg surface, and such raised charge
der the comb, and not be carried
late.
difficult to prove by analogy the
ıchine, which I shall still call the
Molison's exception to the title
. Differing conditions may escape
is very good as far as it goes,
bility but not to proof. The con-
at must be capable of bearing
ı searcher may devise; and even
say what is conclusive, for others
untried test. I have tried all I
ı theory. My plan is to make a
ould or should not theoretically
ıg of the machine, and to see if
lt confirms the theoretical one. I
ıy resources, and have asked my
or further ones, which I should
friends equally concerned with
uiry.
Mr. Molison or the theory of "Old
stand a test. These writers hold
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them, induce and raise the charge
ıout other assistance. If so, they
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ıpply us with, whether we take it
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lisperse through the brush. Yet
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. beg to observe that the use of
rguments are scarce has been re-
Mr. Molison's day. There is no
the [illegible] ourt I
Mr. [illegible] beg [illegible]

"original," and I should gladly return the compliment could I do so with a shadow of truth.

F. Taaffe.

TESTING MICROSCOPE OBJECTIVES.

[25259.]—In reply to "E. D. W.'s" letter (25162), it is quite impossible for me to give a satisfactory answer. The microscopic image is a thing to be felt by a trained eye. The eye can only be trained by long and constant practice. Reading the most able articles on the subject will not train the eye, or enable it to appreciate critical images. The art of testing object-glasses can only be acquired by long practice, and by seeing a great number of lenses, especially those by different makers.

Jan. 15. **Edward M. Nelson.**

MICRO. O.G.'s.

[25260.]—The use of 10in. for focal length of microscope is only a general (not correct) mode of expression. Mr. F. Crisp explains the case in Vol. III. of the *R.M.S. Journal*, page 817, which is too long for insertion. He says that the cause of error is the substitution of 10in. for a variable quantity—viz., the distance between the posterior focal length of the o.g. and the anterior focal length of the eyepiece, which vary with every o.g. and every e.p. I think, also, from the appearance of Table I., that F. H. Evans does not allow for the variation caused by the cover correction of o.g.

R. O. H.

COMPRESSIBILITY OF WATER.

[25261.]—"Sigma" (in letter 25117) emits an opinion respecting "boiler explosions" which deserves attention. When a man of such a high scientific standing treats of so important a question, his words, having a great weight, must not be allowed to pass without serious examination. In the peculiar instance of boiler explosion, not only large properties, but precious human lives are concerned, and should there be errors in his opinion, a blind confidence in it may be fatal to many, as it would prevent further proper researches for preventing means.

"Sigma" says: "It is quite true that when a vessel bursts under hydraulic pressure the pieces do not fly off as they would under air or steam." Is it really quite true? I believe not. Whenever a boiler bursting is caused by mere pressure, either of water, air, or steam, the effect is exactly the same—that which is due to an excess of pressure on an insufficiency of resistance, nothing more. The proportions of such effect are in perfect accordance with the power that caused it, and such a power never causes the pieces to fly off in every direction at tremendous distances, destroying walls, buildings, &c., as does an explosion. As soon as an outlet is produced by the bursting, the hitherto concentrated power escapes through it, and the after or consecutive action is relatively insignificant, except as expansion of steam and hot water. Hydraulic, air, or steam pressure never have caused, and never will cause, an explosion. They can only produce bursting.

"Sigma" is right when he says that, "In the case of a boiler explosion, it is not the steam in the boiler which does the mischief." This is quite true, it is something else; but he is wrong when he adds, "but the water—that is to say, it is the sudden release of a large quantity of stored energy, not a mere pressure, which has to be taken to account." What is that stored energy, if not mere pressure? If this energy be released by the explosion, it does not cause it. How, then, could it have made the pieces fly off? After the bursting, a consecutive effect alone can be produced, differing from a prime action. If it were as asserted, a boiler explosion would be a secondary effect which would follow the bursting, whereas an explosion is a prime instantaneous phenomenon without duration. A gas explosion is instantaneous, and has no duration. Gunpowder does not split the gun after the projectile is off.

A proof that "Sigma's" opinion is erroneous can easily be obtained. Let us suppose a large boiler containing steam at, say, 15 atmospheres pressure, which is produced by water at 200° C. temperature. By its side let us place two small boilers of a resistance of, say, 5 atmospheres. On one of them an hydraulic pressure of 15 atmospheres is applied; it instantly bursts, but the bursting will not have the effect of an explosion. On the second one the 15 atmospheres pressure of the large boiler is applied; it bursts exactly in the same manner as the first one, the only difference being that after the bursting steam and water came off, whereas nothing issued from the first one. No splitting effect will follow the bursting, notwithstanding the large quantity of stored energy contained in the large boiler, which will escape. Besides, it is well known that boilers in perfect condition, tested at 10 or more atmospheres, do not burst, but explode at 2, 3, 4 atmospheres only, which evidently proves that such explosions are not caused by pressure, and differ widely.

If means for preventing boiler explosions have not yet been discovered by English scientists, it depends entirely from the ignorance of their cause; and if they don't know that cause, it is because they do not admit that heat is a *composed* or *combined* fluid, which therefore can be *decombined* or *decomposed* into its constituent elements, just like water, a fact that is most easily proved. When they admit this, they will soon understand that boiler explosions are due to a double decomposition—(1) that of water into H and O, (2) that of heat into $E + E\bar{r}$; the sudden recombination of which produces simultaneously gas explosion and thunder, to which nothing can resist.

Another time, if permitted, I will say more on the subject.

Morchain, Somme, France. **Ch. Rabache.**

ADJUSTMENT FOR ECCENTRIC STOP ON REFLECTING TELESCOPE.

[25262.]—In a perfect and perfectly adjusted reflector the image of a star (in axis of large mirror) formed by rays falling on the whole aperture is perfect, and in axis of eyepiece. Also the axis of eyepiece coincides with axis of cone of rays reflected from large mirror. If, now, an eccentric aperture be used, it is evident that a perfect image is still produced, though less brilliant and showing a larger "spurious disc"; hence "flat" and mirror are still in adjustment. But axis of eyepiece does not now coincide with axis of cone of rays proceeding from eccentric aperture, which it should do to give a perfect result, and such coincidence therefore should be effected.

The eyepiece tube on my home-made stand admits of the above adjustment.

It may interest some to know that one evening during the latter part of October I plainly saw both rifts in the great nebula in Andromeda with my 6½in. With (clear aperture 6$\frac{3}{16}$in.), power about 64. **H. Pettit.**

Belmont, Ontario, Canada.

ORNAMENTAL WORK IN THE LATHE.

[25263.]—I was pleased to read the letter of "Working Engine Man," page 384; his case is exactly my own, and I hope some kind friend will assist us. I have a few corozo (vegetable ivory) and coquilla nuts; perhaps some talented subscriber will instruct me how to chuck, and what to turn them into. My lathe is a 3in. centre back gear, without overhead, and I only possess the usual hand tools. **Durston.**

SOFT WOOD TURNING.

[25264.]—I am glad to think, from the lively remarks of "O. J. L." (25230), that there is now little chance of the claims of Northamptonshire being overlooked. Not having, to my recollection, ever seen my county designated as North Hants, and in my prosaic mind limiting this nomenclature to the region of Hampshire proper, I was not prepared for that analogical flight which carried "O. J. L." so far north. If "O. J. L." has not been altogether correct, I am sure he may well be excused for this exercise of an inventive genius, from which your readers derive so much interest and profit, and should he ever pass my way on a personal visit to King's Cliffe, I shall have much pleasure in supplying the place of his former host J. H. H.

As my hints on soft wood turning were intended to apply to the execution of smooth and finished work, I do not see any irreconcilable difference in our letters on the subject, if there appears to be, as to the advisability of using the hook tools in question. "Copeaux" will use his own judgment as to applying for advice to some such practical or professional turner as I named before deciding on their acquisition. **M. A.**

[25265.]—I have to thank "M. A." (25168) and "O. J. L." (25169), for their answers to my former letter. I should have done so last week; but as I live pretty far north, where the bookselling machinery is worked on the slow motion, I don't get my "E. M." till well into the following week. I think "M. A." is somewhat hard on native woods. I have not had much experience of them, but some apple I find rather pretty when polished. It much depends on the soil in which it grew. Some of it is characterless enough. I am sorry I cannot help "M. A." as to stains. They raise the fibre of the wood, and I have discovered no satisfactory way of laying it again. Something may be done with a piece of wood used as a burnisher, while the article is in the lathe, but the result is not very satisfactory. I have done a good deal with Stevens's ebony stain on small vases, &c., to be afterwards painted upon. In this case I take off the chuck with the work upon it, stain, and replace on the lathe. It is then rubbed with the hand as it revolves, where this can be done, while a painted stick does for the mouldings. By this means a paintable surface is got, and if well executed, flowers, &c., are put on, a very pretty ornament is the result. These vases look, I think, quite as well as the terracotta, which is now so common, and have this advantage, they are not so easily broken, and their form rests with the artist. Articles in constant use as bread platters, egg-cup stands, and stands for hot-water jugs, &c., I leave unstained or varnished, and allow them to be washed and scoured, when soiled. I of course use, but don't like, glasspaper, my ambition being to get a surface with the chisel. Inside work, however, turned plank-wise, seems to require a lot of it. How would "M. A." chuck a bread platter, both sides turned without leaving a mark?

I have a great desire to see hook tools properly used, and shall take the earliest opportunity I can get of visiting King's Cliffe. I am looking with interest for "Tuebor's" spiral cutting.

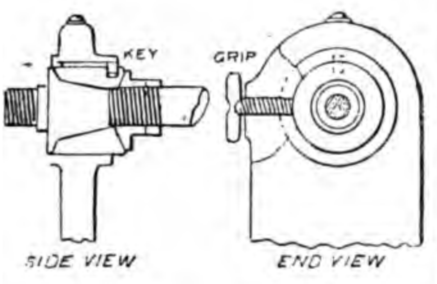
Copeaux.

THE DIVISION PLATE, &c.

[25266.]—MY critic (25204) will see that I contemplated a more complete plate than my first letter led him to suppose. The number 13 was used suggestively only, but with proportioned segments would give a fair variety. Five, or its multiples, would be perhaps most used for screw-cutting gear, and other numbers for various purposes.

Though the plate multiplies any errors, the liability to error is reduced by the decreased number of holes, and by manipulation the number can be kept low, redundancy being avoided. Thus, 12 × 3, 4 × 9, and 6 × 6, each are 36, but require 14, 12, and 11 holes respectively; taking 6 × 6, one hole more can be eliminated (or nearly so), as it is an even number with one hole bisecting the segment, and one bisecting or × 2 hole will do for each circle.

9 × 4 would only need 11 holes against the usual 36. The multiplication is rather large, as an error in the circle repeats each time it goes round, and one in the segment affects the whole circle; but some check might be devised, as the multiplication of the error might be availed of to detect it effectually in order to remedy it. A double-pointed pawl would also work correctly and reduce errors in the segment, though a central hole would be needed in all even numbers; this would halve the error, or rather spread it over two holes. But I think that, practically, a well made plate would do as good work as the ordinary, and that a well spread error is a better fault than one or two pronounced ones, especially for mill purposes.



SIDE VIEW END VIEW

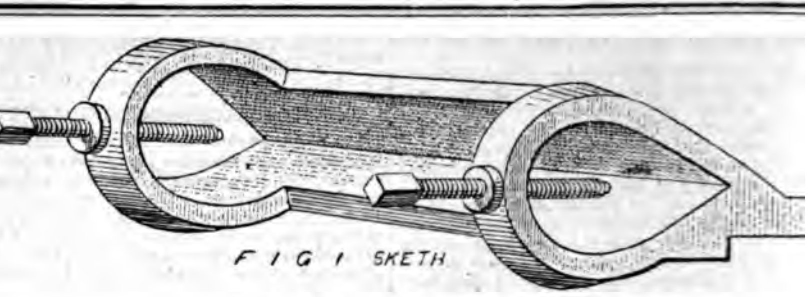
I use a triangular drill for the holes, as it theoretically ends in a point and is not liable to run out, re-sharpening to go lightly all round at the finish—to shape and depth all alike.

I thought that part of the "Screw Question," yclept of Mr. Wenham, "the eccentricities of a drunken mandrel" was worn pretty threadbare some numbers back. Reichel's method for trueing screws with uniform wave lines in their length cannot have much general application. I should consider such bars as cut uniform wave lines are very rare, and are not the best to be got or made for screw-cutting. As regards critical work, I should think their place was more the shears or pot than the lathe. The method also seems to require a true lead-screw to begin with, the existence of which is problematical, and it could not be self-generated. A fixed cutting tool is a roughing implement only, and grinders do not require other variations than those of the times of acting on the hard and soft places. So far as Reichel's method is concerned, I should say the claim to supremacy for the method of producing accurate screws is without foundation.

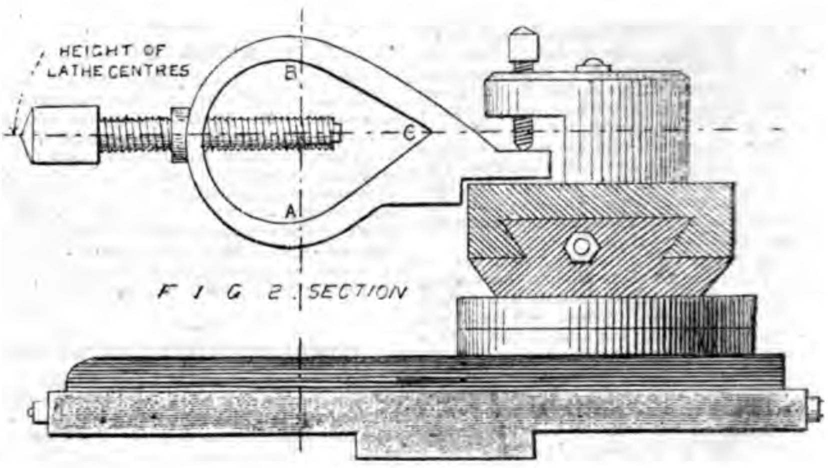
I venture a sketch of a sliding mandrel arrangement, specially designed for home making; perhaps "O. V." will find it suitable. The mandrel is coned and adjusts for wear, &c., the collars slide; the key and grip are shown in sketch, and details may be suited to the maker's notions.

Vulcan.

LATHE MATTERS.



F I G I SKETH



F I G 2 . SECTION

[25267.]—MANY young beginners in the use of the lathe, like myself, must have been sorely vexed or disappointed when trying to drill iron or brass rods longitudinal or sectional, or in boring tool handles or other things straight and true in the lathe, and having no other appliance to assist them, and I therefore beg to submit to them a handy little tool I made for attaching to the slide-rest, which effectually gets over the difficulty.

Fig. 1 is a sketch of the clamp (if I may so term it). Fig. 2, a section, from which it will be seen at once that if the angle A B C of the clamp be so constructed (for height) that the line of the centres of the lathe truly bisect it, anything geometrical in shape that will go into the clamp is bound to centre itself for height, the lateral position being effected by the slide-rest.

It can be used to drill at any angle, and practically anything that can be carried by the slide-rest may be drilled in almost any position, and many things which won't go in the clamp may be fastened on a mandrel, and the mandrel held in the clamp.

The one I made is of cast-iron, and is adapted to a 4in. Britannia Co. slide-rest; but a shank may be substituted for the flange for attaching to other patterns of rests.

I have never seen or heard of a similar tool, and I sincerely hope some of our accomplished correspondents will improve upon it and give us young beginners the benefit of their experience, as they have so frequently done before.

G. W. D.

LATHE MATTERS—FLYWHEELS AND OVERHEADS—AUTOMATIC COUNTING INDEX.

[25268.]—MY remarks may appear rather out of date, but as I live more than 3,000 miles from 332, Strand, it is always rather late when I receive my weekly ENGLISH MECHANIC.

I quite agree with "O. J. L." that the number for December 4th was a good one. Since the very able and most interesting letters from Dr. Edmunds on "Mandrel Screws, &c.," we had but little on lathe matters till late in October, when the discussion on flywheels and overheads was started. I have watched the correspondence since then with great interest. I am one of those who think that a large proportion of American lathes are turned out with flywheels both too small and too light.

For a lathe to be used only for ornamental turning in hard wood and ivory, I would have a moderately heavy wheel and a large diameter—say 50lb. to 60lb.—with 30in. to 34in. diam. for a 5in. centre lathe. For a lathe to be devoted exclusively to metal turning and heavy work, I would have the driving wheel heavy, but of small diameter, and a second wheel of large diameter to act as a flywheel only; but many amateurs require their lathe to be suitable for all work, and for them I think a flywheel must be both large and heavy.

For wood-turning, and for driving drills and cutters by the overhead, a large wheel is a great advantage. For drilling and fly-cutting, the speed can hardly be too high. For metal turning, the speed from a large wheel can be reduced by back-gearing. I have a wheel of 33in. diam. and about 180lb. weight on a 5in. centre lathe.

I believe for wood-turning and light work this is too heavy, but I do a good deal of tolerably heavy work as well as a certain amount o mental turning in hard woods and ivory. small and light wheel, then a large light but I find the present wheel the most sati My wheel has no weight to balance the and I rarely touch it with my hand to s lathe.

I do this by putting the toe of my left one of the arms of the wheel. The shaft wheel runs in brasses, and when I get a fa speed up the wheel (without the belt on) for three minutes and a half.

I read the very practical letter from "J (p. 223), November 13th, with great inte can keep my wheel just going at 11 or 12 r minute; but I could not do any work at thi

I would like to have the opinions of other on the weight of my wheel.

I have seen a good many overheads, and confess a weakness for the old-fashioned p lever at the top of an upright, with a weight and endless cord running direc driving-wheel over two pairs of pulleys pulley on cutter. This plan is simple, con and very cheap to make.

By having a long lever and a modera weight the tension on the driving-band ca gulated so as to suit the work being done. amateurs keep a heavy weight at the extre of the lever for all work, whether a light o cut, and so cause a deal of unnecessary w friction in the pulleys and cutter-spindle cord adapts itself to the cutter in the slide spherical rest in all positions on the la without any extra guide pulleys, &c.

My great objection to this arrangement the small pulleys throw the oil about, an ivory or light-coloured wood in the lathe t cause serious injury. I find this sometimes h though I am most careful in oiling the pull

I have no doubt that the overhead descri recommended by Holtzapffel in his fifth would run very lightly; but the two band great source of trouble. I don't see how it arranged that both will always have th amount of tension. I would prefer the pla trated and described on p. 109 of the same and which is very similar to the overhead de by Mr. Evans (p. 193) on Nov. 6, 1885.

This ought to work well, I think, a simple arrangement; but the guide pulleys in my opinion, be inclined to throw the oil

Mr. Evans says there is no trouble on th and I am only an amateur, and, of cours with all due deference to his opinion and exp Holtzapffel, however, seems to think this the objections to guide pulleys.

In Mr. Evans's plan, I think the guide might be arranged to work in a stirrup on so that they might accommodate themselve angle at which the driving band would the slide rest in doing long fluting or I like the form of overhead described (Nov. ah. For many c it wou The ban on a of the of the fast pulley when driving the overhead pulleys, but I suppose "Tuebor" finds it sufficient.

To me there seems to be many very obvious reasons why overheads should be where they are usually placed by lathe makers. In working on a cylinder with the drilling instrument, eccentric, vertical, or fly-cutting, there is no trouble in bringing the band to the cutter pulleys from overhead, but I do not see how the band could be conveniently brought from a back shaft except for doing face-work with drill or other cutters.

Any motion low down is, more or less, in the way of the light, as most amateurs arrange to have their lathe before a window. Besides, any motion that is in the way of the bench or board behind the lathe bed is a disadvantage, for we all know what a convenient place this is to have tools, &c., handy.

Several correspondents have referred to the expense of the spiral apparatus. Of all the chucks for doing ornamental work, the spiral seems to me the most simple to make. It is all plain turning; there are no slides to require planing and accurate scraping. With the exception of the screw-nose, I made my own spiral chuck and apparatus, and the whole did not cost me more than about 25s. The reciprocater I added later at a trifling cost. They both work very well, and I will be glad to give particulars if there are any who wish for them.

The automatic counting index, described by Mr. Evans (page 271), Dec. 4, would be a great addition to any lathe; but the expense must be considerable, and there are many lathes to which it could not be applied. Something is wanted which will utilise the existing dividing plate on lathes. In Vol. IV. of Holtzapffel's work there is a description of a counting index, but though this would prevent many mistakes being made, it would not save the constant bending over the division plate.

In Vol. II. of the *Journal* of the Amateur Mechanical Society Mr. John Rivington gives a description and drawing of a very ingenious plan for an automatic index; the expense in that case is also an objection. Unlike Mr. Evans's plan it requires both hands to work it, which is another disadvantage. I am at present busy making an automatic index for my lathe, and if I find that it is a success I will be glad to send a description of it to the ENGLISH MECHANIC. **E. B. F.**

PLANERS, CUTTING-FRAMES, &c.

[25269.]—THE notion for a planer given by "O. J. L." should, I think, be taken up and put into practical shape by one of our lathe makers. The arrangement sketched out is, I think, the simplest yet proposed, and the pump-handle movement quite as convenient a way of applying muscular force as the treadle. The apparatus looks as if it might be produced for £6, and it would then be about half the cost of any other planer in the market. I take it the scheme is put forward as a design only, and therefore we need say nothing about details. I think, however, that as all flat work could as easily be turned on the faceplate as planed on the planer, its real use would be to plane V-slides, edges, &c., where the pressure of cutting would come on the sides of the tool; and, therefore, if there is to be a hinged tool-box, it must be a good one and perfectly firm, into which any tool can be fixed, whether its shank be planed or not. What do our friends consider a proper proportion for the lever about 4 to 1 for iron and 2 to 1 for brass?

As to "A. F. H.'s" remarks upon overheads, he hits upon the very objection to Holtzapffel's overhead that I felt. We know, however, that they work very well, and the reason appears to be that it is not necessary for the roller-shaft to be horizontal, so that you can tighten whichever band you wish. An old Holtzapffel lathe belonging to a friend has the movable pulley; but they are now made with rollers. The pulley, no doubt, drives the band the best; but probably the pulley does not slide sideways quite readily enough. I presume "Tuebor" only uses the jib in his arrangement when fluting on the cylinder with the driller. Now, the driller requires very little power, which explains why he gets power enough even when but about ⅛th of the circumference of the driving-pulley is embraced by the band. The idle-pulley arrangement referred to by "A. F. H." would be unsatisfactory unless the band were of such a leength that the tightening-pulley caused it to lead up straight from the driller. In Mr. Evans's arrangement, p. 193, the band leads straight up; but here we have two guide-pulleys, and consequently slightly more friction. The compound overhead with two shafts is the least "simple" of all, and the most expensive; a good example of it may be seen on the frontispiece of "The Lathe d its Uses." I think lightness of running so ortant for ornamental work that I should prehe Holtzapffel form to any other. Will not [illegible] " give us his opinion?

[illegible] indebted to "W. R. W." for [illegible] d example of a wheel- [illegible] ment; but of course that would not be required if it were used with a vertical slide. The details are most carefully considered, even to making one guide-pulley a trifle larger than the other to keep the belt from rubbing against itself. I was surprised to learn that the top centre would harden, surrounded like that with gun-metal. Will "W. R. W." say a word about the cutter that looks like a ⅜in. neck, and is probably made to suit some stardard? The slot, too, will weaken it a good deal. Will not the band fly off the guide-pulleys when these are tilted 30°, and what kind of work would he do which requires the frame inclined at the quadrant? What additional powers should we gain if there were an inclinable slide between frame and quadrant?

F. A. M.

RAILWAY ACCIDENTS—STOPPAGES OF TRAFFIC.

[25270.]—THE *Times*, in a leading article which appeared on the 13th inst., directed attention to the very great unnecessary inconvenience caused to passengers by their being allowed to proceed by train at a time when the railway companies' officials know perfectly well that a breakdown or other obstruction will prevent such train reaching its destination in the ordinary course. The practice of despatching train after train simply to be delayed upon the line for several hours at some out-of-the-way station or signal-box became so serious five years ago that on the 27th of January, 1881, Mr. Cohen, M.P., brought the subject under the notice of the House of Commons, and on the 3rd of February the Board of Trade forwarded a circular (R. 1393) to the companies relating to this inconvenience, and stating that "It appears to the Board that in all cases when it is in the knowledge of the officials of the company that a line of railway has become blocked, by accident, stress of weather, or other cause, the passengers, or intending passengers, should be made acquainted with the fact, and be informed that if they decide to proceed with their journey they must do so at their own risk."

It was at that time considered satisfactory that the "replies" to the circular appeared to show that the companies concurred with the views of the Board of Trade, and many of them issued instructions accordingly, and for a time one great cause of serious and unnecessary inconvenience to passengers was removed, as they at least had an opportunity to postpone the journey until the line was clear, or to travel by an alternative route. However, some companies are gradually sliding back to the original practice, and the inconvenience caused to the public is nearly as serious now as it was five years ago. It is therefore to be hoped the attention given to the matter in *The Times* may lead to a much required improvement.

Clement E. Stretton, C.E.
Vice-President Amal. Soc. Ry. Servants.
Head Offices: 306, City-road, London, E.C.

RAILWAY COUPLINGS.

[25271.]—YOUR correspondent ("A Railway Servant") in his letter (25192) respecting the above, seems surprised that more attention is not given to the subject; probably I can let a little daylight into the cause of this seeming apathy. Several years ago I invented a coupling suitable for spring buffer waggons, and through the kindness of the late W. E. Hutchinson, Esq., once chairman of the M. R. Co., was allowed to fix it on two of the M. R. Co.'s trucks, then standing on a siding at Messrs. Richards and Son's ironworks at Leicester. The apparatus worked admirably, both when the waggons were pushed together gently or banged together with great force by an engine. It was automatic, and the waggons were attached as soon as the buffers touched each other, and disconnected by levers on both sides the waggons.

An inspector was sent from Derby to examine, and seemed perfectly satisfied with the arrangement—at least, there was no objection except *expense*. He quietly asked me on one side if I had calculated what it would cost the company to adopt either mine or any other (for there are scores) patent to effect the same object. I answered "No," but understood him to say it would amount to some hundreds of thousands, and neither they nor any other company were likely to go to the expense unless *forced* to do so. This is the grand secret—*expense*.

Leicester, Jan. 12. **Jas. Frank Smith.**

AMERICAN v. ENGLISH LOCOMOTIVES.

[25272.]—THE compounds seem to me to parallel on a small scale Brunel's "Great Eastern," and to be the result of over-confidence in their own abilities on the part of the designers; else, why attempt the highest class first and produce such a number? Mr. Worsdell's seem to be somewhat of an exception, though I am not familiar with the details of the different types.

Though in some cases designers tie English firms down injuriously, as Mr. Stretton says, there is also the other side of the question. Take the 10 ton extra weight put in by the makers of the N. Z. engines that have recently been mentioned in our columns, for instance.

I believe that what the better American loco. builders claim, and that correctly, is that their engines are superior to English under certain conditions, with a point in their favour on account of outside cylinders. I consider the best American loco. or the best of Continental or even Colonial make, about equal the best English, though none, I think, figure for the same export or output of that class, as yet at any rate. The differences are more of style than merit, and are due to the varying conditions under which they have been developed. Probably all consider their own preferable, in some points correctly and in others not so. The American locos. are the best for an uneven road, like those that they have been originally made to suit at home, and hence are better fitted to Colonial or thinly populated countries, to the which their engines are mainly exported. Not but that they can do well on good road, such as has developed the English loco., but they are not super-excellent thereon, nor do I think, quality for quality, of lowest price.

I am not aware that Sir J. Vogel is particularly competent to pronounce an opinion on the merits of locomotives, though the N.Z. road is more adapted to the American type than the English, and makers here would have to depart further from their usual lines to make suitable engines than the aforementioned would. The N.Z. opinion ought to be that they ordered in the wrong quarter in England, and a very right quarter in America. But as Mr. Stretton says, English work fails to do in foreign countries what is expected of it; but it is said by those who ought to know something on the subject, that some of that work that brings discredit here is only native as regards the brand; that, however, is unfortunately only a partial excuse. The "E.M.," who drew our attention to this subject a few numbers back, seems to be one of those persons who are astonished and feels resentful at English work not being held in the same esteem abroad as at home. It is not very different all round; but I can assure him, in case my supposition is correct, though I hope not, that there is plenty of room for discount in the esteem in which many English manufacturers hold their own products. **Vulcan.**

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

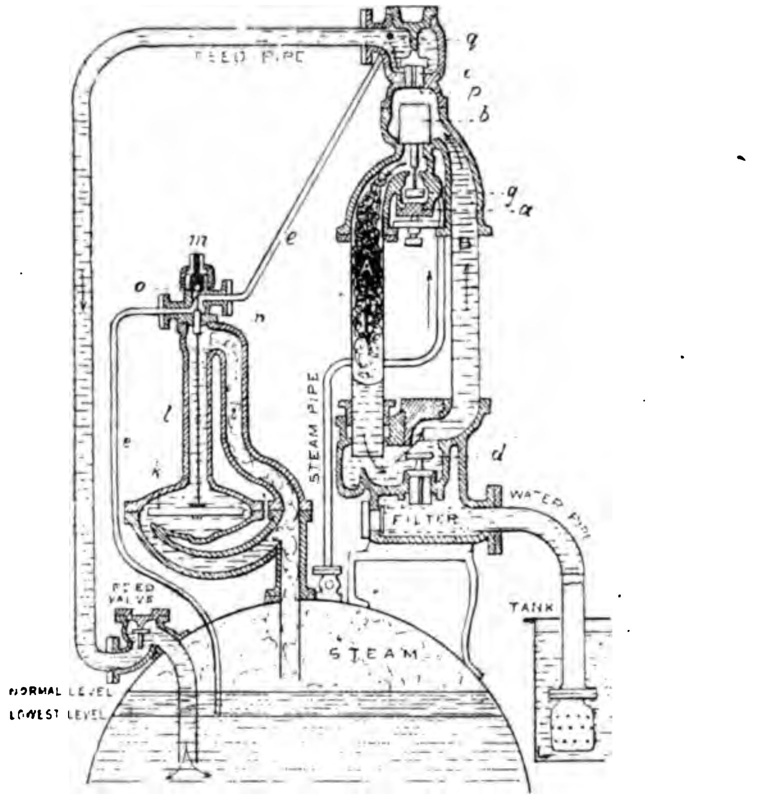
[57519.]—**Semi-Fixed Engine (U.Q.)**—Mean effective pressure (if cut off = ¾ and back pressure = 3lb. above atmosphere) = 30lb. Area of 1½ = 1·77. I.H.P. = $\frac{30 \times 1{\cdot}77 \times 3 \times 2}{33{,}000} \times 400 = 3{\cdot}86$ for each cylinder, if run at 400 revolutions per minute = 7·72 H.P. for the two. Area of 2 = 3·1416. H.P. of single engine, if run at 400 revolutions, would be $3{\cdot}86 \times \frac{3{\cdot}5}{3} \times \frac{3{\cdot}1416}{1{\cdot}77} = 8$ I.H.P. Assuming that tubes are 25½in. long, and that firebars are 7½ from crown of firebox, your heating surface = about 8·2 square feet, and if you can keep such small tubes clean, this will be ample. I do not know about dynamo, but should think either engine could do much more than you require.—GLATTON.

[57523.]—**Painting on Velvet (U.Q.)**—Judson makes special colours for this purpose with a metallic lustre. They can be obtained at oil-shops.—GLATTON.

[57532.]—**Speeding Pulleys (U.Q.)**—I do not know of a work treating exclusively on this subject. Rankine's "Machinery and Millwork" is useful; also Box's "Mill Gearing." I should think Unwin's "Machine Design" would be the best for you, as, besides millwork, it contains most valuable information on all branches of machine design.—GLATTON.

[57567.]—**Compressed Gases (U.Q.)**—I have consulted a friend who uses the above, and he is quite satisfied with the arrangement. He buys the gas ready stored in iron vessels, returning the empty ones to be refilled, so can give no information as to pump, &c. A Bourdon gauge would be best to show the pressure.—GLATTON.

[57863.]—**Boiler.**—Thanks to "A., Liverpool" for his explanations in No. 1,083. I inclose sketch of a self-acting feed apparatus, patented in this country, which might interest him. Chambers A and B always communicate at bottom; their communication is, however, interrupted at top by the distributing valve *b* at every turn of the feed process. The apparatus is mounted on top of boiler.



As soon as steam is allowed to enter the apparatus part of the water contained therein will fall through its own weight, passing from A to B, then through valve *c* in the feed-pipe (this is the principle of the siphon). The chamber A gets full of steam instead of water. This steam is admitted through valve *a*, connected with valve *b* by a rod. At the beginning of the work the valve *b* is pressed upon its seat by a well-regulated spring; it is lifted only when the difference of weight in chambers A and B is such as to exert a greater pressure on the lower valve than the pressure of the spring on the upper valve. Valves *a* and *b* are connected so that one closes whilst the other opens. The result is that steam cannot enter into the apparatus after *b* is lifted (and *a* closed as a consequence). Valve *b* being open, A and B communicate in their upper part; the water contained in B rushes into A and condenses the steam; this condensation causes valve *d* to lift, and water is aspirated from the tank. The reopening of the steam-valve *a*, and the simultaneous shutting of *b* will take place when the pressure of the boiler is established again in the apparatus. This operation is done by the accessory apparatus, called "level regulator," the pipe *i f* of which gets into the boiler as far as the normal level of the water. In this pipe *i f* penetrates either steam or water, according to the existing level in the boiler, and a change is thus obtained in the weight of the volume. This variation in the weight acts strongly and regularly on the thin membrane K. This membrane K, according to the difference of pressure on it, closes or opens valve *o*, according to whether the end of *i f* is in the water, or above the water in the boiler. The water contained in pipe *l*, and in serpentine *h*, protects the thin piece K against effects of heat. Hoping the above description might interest "A., Liverpool," and other steam users, I must declare that I am in no way responsible for the exactitude of the description, or the statements contained therein, and I am not prepared to enter into any discussion on the subject.—BELGIAN.

[57875.]—**Small Copper Boiler (U.Q.)**—From the data given on p. 235 of last volume, it appears that if joints are all thoroughly well made the boiler would burst with a pressure = $5{,}000 \times \frac{\cdot049}{4\cdot25}$ = 57·7lb. per square inch. Test with water pressure to 24lb., and if it stands this, work to 12lb. per square inch.—GLATTON.

[57887.]—**Model Engine Making (U.Q.)**—Draw the centre-lines of cylinder at each side position. They will form a V, the point of which crosses the trunnion. Divide the angle of the V into four equal angles. The port in cylinder may be made as large as possible so long as it is not wider than two of these fourths. If you draw it down, I think you will be able to answer the rest of the first question for yourself. As to slide valves, see pp. 126, 301.—GLATTON.

[57894.]—**To Mr. W. H. Eaves.**—I am glad you have made an improvement in your dynamo, but you must not expect much from so small a machine. I think that the space between the ends of pole-pieces is too wide. I have noticed that Edison has his armature nearly inclosed by the pole-pieces; but the reason is a merely structural one. In my own practice, using wrought-iron pole-pieces and F.M.'s, I leave the space between pole-pieces very wide, and find it a great improvement, especially in the larger sizes.—W. H. EAVES, Coventry.

[57907.]—**Pneumatic Ejector.**—The very best proportions can only be ascertained by trial. If the cone, after passing a point about half-way between E and B C, begins to open out again, you will increase the effect.—GLATTON.

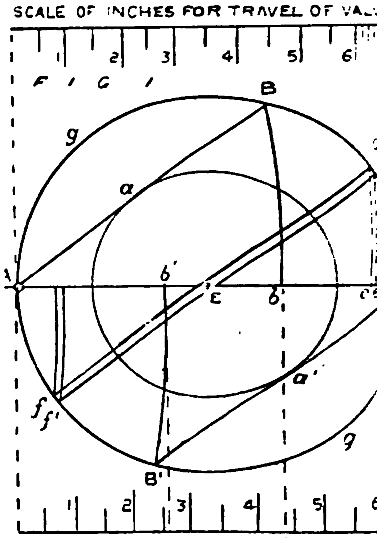
[57965.]—**Carbon in Ferro-manganese—Eggertz's Method (U.Q.)**—Unless I mistake, the answer to this query is a matter of simple arithemetic. $1\frac{1}{2}$ grains were taken, and portions gradually thrown away until a solution measuring 20c.c. contained only $\frac{1}{8}$ of $1\frac{1}{2}$ grains = $\frac{3}{16}$ grain. Now this $\frac{3}{16}$gr. when in 20c.c. of sol., gave as deep a colour as 3gr. of the standard steel when in 16c.c. of sol. ∴ $\frac{4}{5} \times \frac{3}{16}$gr. of the f.-m. contain as much C as 3gr. of the standard steel. ∴ 1gr. f.-m. = 20gr. standard steel. ∴ Percentage in f.-m. = 8 per cent of C.—B. B.

[57973.]—**Winding Engine (U.Q.)**—If stroke and revolutions are the same, the area of each of the smaller pistons will be half that of the larger one. Area of 24in. = 452·4. $\frac{452\cdot4}{2} = 226\cdot2$ = area of a piston about 17in. diameter. If the proportion of stroke to diameter is to be the same as at present, multiply all the dimensions of present engine by $\frac{1}{\sqrt[3]{2}} = \cdot794$, the revs. being supposed to remain the same.—GLATTON.

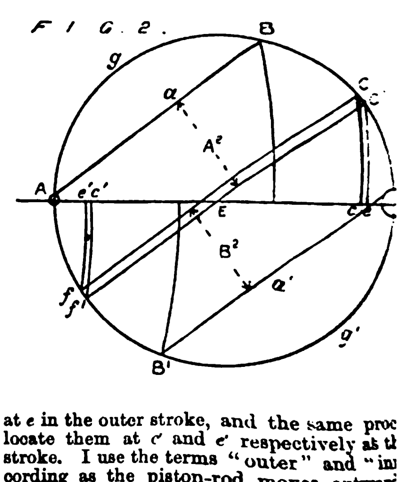
[57974.]—**Cleaning Prism of Binocular Microscope (U.Q.)**—Use new soft wash-leather. The prisms are generally fixed in a brass mount, which can be slid out when it is desired to use one tube as a monocular microscope. It is not possible for me to say how yours is fixed without seeing it. —GLATTON.

[58094.]—**Unable to Sleep.**—It is not easy to determine from an ex-parte statement what would be held by a Court to constitute a "nuisance," though it seems clear enough, if your querist is unable to sleep in consequence of a farrier's noisy operations, that they constitute a nuisance to him. The only thing that can be said, I think, is to take the advice of a solicitor, who can inquire into all the circumstances of the case.—LIMB O' THE LAW.

[58161.]—**Exhaust.**—"Young Fitter" can best ascertain the function of the valve by the graphic method as follows:—Draw circle A B C D B′ of any convenient diameter, preferably equal to the valve travel or some multiple of it; but the larger the better for accuracy, particularly for those not accustomed to accurate drawing. By a scale like the one above the diagram, according to which the circle equals the valve travel, set the comp the steam lap (which, in the present case, from the measurements given to be 2$\frac{1}{16}$i strike the smaller circle shown, or, at leas arcs of it near points *a a′*. Next, with the or assumed lead in the compasses (which no given I have assumed to be $\frac{1}{16}$in.), accordin valve travel scale as before, draw the smal at A and D at diametrically opposite poi through them, and through the centre A E D, continuing it to one side (to the lef present case), a distance equal to abou times the diameter of the large circle. Ne A B tangent to the under side of the lead and also to the smaller, or lap, circle at given, the point of cut-off in the orbit of t pin at B, and the same operation from D line D *a′* B′, locating the corresponding cut-off in the other stroke. To locate the cut-off in the strokes proper, set a pair of the length of the connecting-rod, accordi scale like that below the diagram, by w larger circle equals the stroke of the pis from the prolongation of line A D d locating it at *b*, A D being the stroke.


SCALE OF INCHES FOR TRAVEL OF VAL
1
2
3
4
5
6
FIG 1
B
g
a
b′
E
b
a′
f
f′
g
B′
1
2
3
4
5
6
SCALE OF FEET FOR STROKE OF PIST

manner it is located at *b′* in the other strok latter corresponds to the stroke in which th moves from the shaft, and the lay-out show takes place earliest in that stroke when are equal at the two ends, as shown. To lo points of exhaust and exhaust closure, exhaust lap in the compasses, according valve travel scale (which by the dimensio is $\frac{1}{16}$in.), and with it draw the small circl Next draw lines tangent to this circle, at sides, and parallel to A B and D B′, as show the intersections of these lines with th circle at C and C′ draw the arcs C *c* and C will locate the exhaust closure at *c* and the



at *e* in the outer stroke, and the same proc locate them at *c′* and *e′* respectively as th stroke. I use the terms "outer" and "in cording as the piston-rod moves outwar wards. These arcs are, of course, struck a for the former ones, B *b* and B′ *b′*, i.e. tinuation of line A D with the conne a radius. The angular advance of the will equal the angle bet A D assumed the valve equal leads, leav with all the ine length of the co not having been given, I have assumed it to r three times the stroke. If it be desired to effect of trying to equalise any of them y or partly, more lead must be given at D sponding to the end towards the shaft); but oper procedure is to first locate the events it ired to equalise, which I will suppose to be chaust closures. These were found to take at about 10in. to 7¼in. at ends A and D re- vely, so we may average them at about 8¾in. are accordingly so placed, with the exhausts, 1in. later as before. Arcs c C, e C′ c' f' and now drawn locating lines f C and f' C′, from we learn, by the distance of the latter from E, that we will now have about $\frac{1}{16}$in. nega- chaust lap at the end farthest from the shaft, the distance of f C from E that there will out ¼in. positive exhaust lap at the other. lines A B and D B will no longer be at equal ces from E. To locate them we make A B t from f' C′, and D B′ distant from f C equal width of the lips of the valve, which are equal, so that A^2 and B^2 are equal. We now at the price of equalised exhaust closures is ¼in. lead at D against about $\frac{1}{16}$in. negative A. The cut-offs lack about $\frac{1}{16}$in. of being but few would care to carry equalisation rther. Probably in most cases the symme- lay out in Fig. 1, or at most a slight depar- om it in the direction of Fig. 2, would be red. I think "Young Fitter" and others sted in such matters will find no difficulty in ining all the possibilities of the slide-valve above process. I should have said that a g g' are the port openings.—J. W. THOMPSON.

07.]—**Grinding Machinery.**—In reply to S." *re* Carter's disintegrator, if he will do d—viz., call on Messrs. Carter—when I was sing, they will explain machine, and make ointment to grind anything he may submit presence. The weak part of the machine, in perience, is not in the beaters, but in the s; but these are cheap. I have found that bolts have been dropped into machine acci- ly the bolts have suffered very considerably han the beaters; being, in fact, knocked out shape. Any smith can make the beaters; re very simple. Will "A. J. S." advertise dress, and I will write him more fully?— Bristol.

26.]—**Colouring Brass Fishing-Reels.**— I have found much difficulty in obtaining arsenic, the following recipe will be found useful:—After laying your brass reels in soda-water, and rinsing in cold water, make llowing pickle: ¼lb. bluestone, ¼lb. blue as, half a pint spirits of salts; crush the one and copperas, and then add one pint of water. When cold, lay your reels in until when black, rinse in cold water, polish with ead, then lacquer with green lacquer. I feel obliged if some readers would kindly recipe of a pickle for Florentine or red , as this is my great want, and that of many readers of the "E. M."—LONGING TO

40.]—**Watercloset Drain.**—According to iblic Health Act, "drain" means any drain or the drainage of one building only, or for rpose of communicating therefrom with a into which the drainage of two or more ngs occupied by different persons is conveyed. r" includes sewers and drains of every de- on except the "drain" specially excepted as Hence "S. B.'s" drain is a sewer. Section he Act says, "All existing and future sewers the district of a local authority . . . . est in and be under the control of such local ity." There are certain exceptions; but the ne which can affect "S. B." is "sewers made person for his own profit, or by any com- for the profit of the shareholders." "S. B." y that the sewer was made for "his own If so, the question arises, did he also make in long enough to convey the sewage away. it empty into a public sewer? If the latter, self a "public sewer."—S. R.

44.]—**Life at Great Sea Depths.**—The ons propounded in this query have all been ed in articles inserted in back numbers: of them on p. 96, ante. "At Sea" forgets ne air-pressure permeates all parts, even n the atoms.—W. H. M.

47.]—**Tartaric Acid.**—The ordinary tar- id of commerce is prepared from the crude potassic tartrate deposited during the fermen- of grape juice. Citric acid is prepared almost y from lemon juice, and this is obtained from windfalls or imperfect fruit. I fancy rist has an idea that these acids are manu- d [illegible] he can easily procure; but [illegible] processes, I will see if

[58255.]—**Protecting Iron.**— Might possibly make a coat of ganister to protect the iron.—T. J.

[58258.]—**White Coating on Galvanised Iron.**—Can't be prevented, but is easily removed. —T. J.

[58265.]—**Black Picture Moulds.**—This is only the ordinary moulding compo. made of glue, rosin, linseed oil, whiting, and pitch, rendered black by some cheap pigment. If W. Saysell wishes to make, I will give him a recipe, or he can copy from back volumes, and have the advantage of choosing from several.—NUN. DOR.

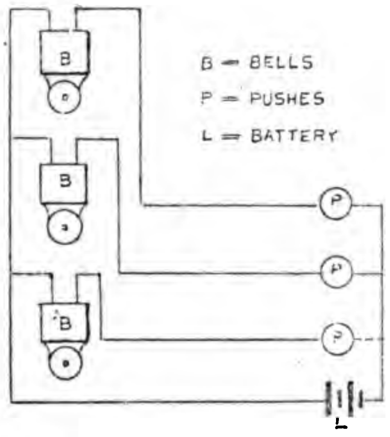
[58268.]—**Steam-pressure Gauge.**—In reply to "E. E. W.," I think the fault he finds in my reply is that I gave myself the trouble of giving full particulars to inquirer, instead of writing a few words only, and leaving him in the dark as before. Unfortunately, this is the case with many replies. I read my reply over again, and cannot imagine where "E. E. W." found that I said that the fact of the pointer coming back to zero does prove the gauge to be correct. I never thought so or said so. One thing I am certain of is, that if pointer does not come back to 0 when steam is off, and gauge allowed to communicate with open air, there is something "incorrect which must be noted and allowed for" some way or other, according to the case under observation. Would "E. E. W.," who seems to know much about steam, explain why copper tubes are often used instead of ordinary iron pipes for connecting boiler to cylinder? If rust is an objection, would galvanised iron pipe do?—BELGIAN.

[58286.]—**Bicycle Repairs and Alterations.** —Why not exchange the racer for a roadster? If it has been really built for a racer, you will have to alter nearly all parts to make it suitable for road work. Never trust a jointed rubber tire, unless it is bound on.—ESSAR.

[58301.]—**Magic Lantern.**—Will not the description of the lantern on p. 257 supply this querist with the hints he requires?—A. B.

[58302.]—**Peroxide of Hydrogen.**—If this querist will look through the indices for references to hydrogen peroxide or oxygenated water, I think he will find a great deal of useful material, and as he intimates indirectly that he wishes to manufacture on a large scale, perhaps he will not consider it too much trouble.—NUN. DOR.

[58315.]—**Electric Bells.**—"A. R. F. K." will find the accompanying plan for arranging his bells



will not entail the laying of so many wires as is required by the one given by "C. W. R.," nor will it cost so much as that of Mr. S. Bretton. Mr. S. Bretton's plan necessitates the use of three relays with their three secondary batteries. This is hardly necessary for short distances, unless "A. R. F. K." particularly wants to ring all his bells *at the same moment*. If he wishes to do this, however, and, as Mr. S. Bretton says, make a good job of it, he cannot do better than follow the relay plan.—STEATITE.

[58352.]—**L. T. and S. R. Engines.**—There is only one class of engine used on the above line, which, as stated by "W. B. P." in your issue of the 8th inst., is a 10-wheeled tank. These engines were designed to work both passenger and goods traffic, and, it is well known, are doing excellent work. "W. B. P." was not correct in stating that the coupled wheels are 6ft., and the bogie and trailing 3ft.; it should be 6ft. 1in. diam., and 3ft. 1in. diam. There are 199 tubes. I am given to understand that Mr. W. Adams designed these engines, but in the last 12 engines many details have been improved, and a combination of good design and efficient maintenance has brought them to the front rank for low consumption of fuel, the consumption being (vide the published returns) 26lb. per mile. The engines are now being fitted with the Westinghouse brake. They were built by Sharp, Stewart and Co., Manchester.—BOGIE.

[58368.]—**Recovering Oil.**—The process consists in causing carbon bisulphide to percolate through the greasy waste, &c., in closed vessels. The bisulphide, when charged with oil, is allowed to stand to deposit any sediment; then distilled in closed stills, fitted with proper worm and refrigerator. By these means the carbon bisulphide is not lost, and can be used over and over again. A proper plant of still, press (to express all the oily matter from the waste, &c.), would cost about £150. A very good account of the process is to be found in Roret's "Encyclopédie," under the heading of "Huiles."—S. BOTTONE.

[58369.]—**Ammonium Bichromate.**—All I can say to "Search" is that I have Mr. Thompson's authority for my answer, which he characterises as an "absurd statement," and decidedly prefer to rely on the accuracy of a man who is a member of so many scientific societies, and whose chemical knowledge must be beyond question, rather than on the *ipse dixit* of "Search." If "Search" had acted up to his name, he would have seen that the words I quoted were taken verbatim from the report of the Cantor Lectures in the "E. M." of October 9, 1885 (No. 1072), p. 118.—S. AND S.

[58384.]—**Magneto Machine.**—TO MR. BOTTONE.—If you will turn to p. 20 of my book "The Dynamo," you will find figured and described what you require. If you have not my book, and will repeat your query *in extenso*, I will answer you in the pages of the ENGLISH MECHANIC.—S. BOTTONE.

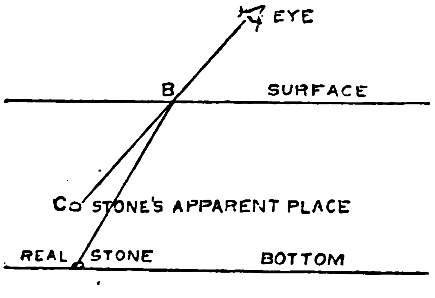
[58436.]—**Ten Acres (and a Cow).**—Referring to the figure on p. 410, it is obvious that C A will not be a tangent to the circle A D E, but will cut off a small segment which "M. I. C. E." has not taken any stock of in his solution. These segments will be very small, so that the result given will be approximate; but we shall not be able by this method to carry on the approximation to any degree of accuracy.—RATIO.

[58437.]—**Resistance.**—Certainly, I will forgive you, Mr. Bottone, especially as you have such interesting facts to communicate. I must confess that this is the first time I have heard of Mr. Edison's chalk cylinder battery, and I, for one, should be pleased if you would send a description of it to the "E. M." With regard to the statement you make, that the res. of an armature is less when running than when stationary, I wish to say that terrestrial magnetism may have something to do with it, and I should like to hear the result of an experiment with the shaft of the armature placed parallel with the dipping needle. If, when placed in this position, the res. of the armature should be less when running than when still, the result would indeed be interesting. I should also like to know, if the speed varies, does the resistance rise or fall?—W. H. EAVES, Coventry.

[58455.]—**To W. H. E., Coventry.**—The wire you are to wind on armature is of course B. W. G. In order to compound the machine, use for the shunt coils 26lb. of No. 19, and after this is on wind over it two layers of No. 12 for the series coils. Be sure that the cast iron parts are well annealed, and that the armature runs as closely as possible to the pole-pieces. — W. H. EAVES, Coventry.

[58456.]—**Battery.**—From the description, this appears to be Niaudet's chloride of lime battery, and should be charged as follows:—Zinc, half-saturated solution, common salt, carbon, fragments of broken carbon, and chloride of lime moistened with hydrochlorous acid.—C. D. R.

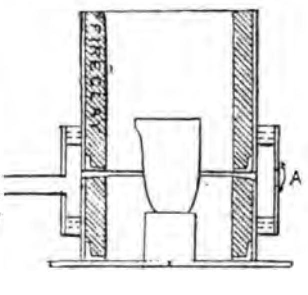
[58461.]—**Perspective.**—The explanation quoted and the accompanying figure are altogether misleading. What is seen when looking at an object



at the bottom of a vessel of water depends on the following two principles: (*a*) The eye sees an object in the direction which the ray last took when impinging on the eye; (*b*) a ray passing from a dense medium into a rare, as from water to air, is bent *from* the perpendicular to the common surface of the media. Hence the ray by which the stone is seen reaches the surface at B, and is refracted, as in my figure, to the eye. The stone is therefore perceived in the direction B C, and it may be shown that C is approximately its apparent place, in a vertical line above its real place. Every point in an immersed stick must be treated in the same manner as the stone to obtain a correct conception of the cause of its bent appearance. The figure on p. 371 is unintelligible.—F. B. ALLISON.

[58468.]—**Furnace.**—See Mitchell's "Manual of Practical Assaying" for description of "Griffin's oil blast furnace," which appears to be what you desire.—W. H. S. S.

[58468.]—**Furnace.**—I made a small furnace for melting metal many years ago from a sketch in Ure's Dictionary. One, "the size of a man's hat, can be worked with a pair of ordinary house bellows." I have made various sizes from 5in. diameter to nearly 2ft., and they all worked equally well. I send a sketch which I hope will necessitate very little description. The blast goes into either a narrow belt all round the "cupola," or an outer casing. In the latter case the blast gets heated before entering the furnace, which may be an advantage. The "tuyere" is a slit completely round the furnace. It is well to have holes covered with sliding doors, as at A, through which the slit can be cleaned with a thin "slice." I have melted scraps of pig-iron or copper in from seven to ten minutes in such a furnace 5in. diameter. I should think Mr. Fletcher could work up this idea most effectively with his high-pressure gas-blast. Ordinarily, coke or charcoal is used. The slit is from $\frac{1}{16}$in. to $\frac{1}{4}$in., according to size of furnace, and may be made adjustable by a simple modification of the casing.—T. F. S. F.



[58470.]—**Breaking Strain of Timber.**—Corrections to reply on p. 411: Line 3, insert "of a" before "piece"; line 5, for "inferior" read "ordinary"; line 7, insert "square of the" before "depth."—J. S. C.

[58487.]—**Short Circuit Bells.**—The ordinary trembling bell is made with short cores and light armature. Is your indicator connected up in series with the bell? Put another cell on to your battery. You don't appear to have power enough. You can fit a relay outside the indicator if you want it, but you don't require one.—C. D. R.

[58493.]—**Microscopic Objectives.**—Many thanks to S. Bottone and "No Sig." I have again spent a considerable time with my highest powers, and I think the $\frac{1}{20}$ immersion all right. It is by a good maker, and is advertised as 180 angle of aperture. I shall, nevertheless, be glad to know how to test the angle. I fancy it is in the illumination that I get wrong. My condenser is one made by Beck about three years ago, and has five combinations of angle. This firm is not now making this pattern. I find it very difficult to manage, and cannot always repeat the same effect. I am not sure that I have correctly resolved Amphipleura pellucida; but all the others I have since resolved, though when I wrote before I found a difficulty with Navicula rhomboides and Surirella gemma, because they were balsam mounted, but I now find them all right in monobromide. I shall be glad to know the best kind of substage condenser to get.—F. E. F.

[58501.]—**Stohrer Medical Battery.**—If the cells are connected in series, the zinc of one should be connected to the carbon of the next, and so on with the whole 20, which will leave a carbon at one end and a zinc at the other face to fasten the wires to. It is very probable that the cells require recharging. Has it been used much?—C. D. R.

[58504.]—**Gas Queries.**—Much obliged to 'C. E.' and "T. T. W." for replies, which give me all the information I require. The pressure of 3·5in. was observed on a Sunday afternoon at 3 and 3.30 o'clock. The lowest pressure observed during the past fortnight has been 2in. Our gas is very cheap; but I am inclined to think the authorities take care we receive a large quantity of it.—STEATITE.

[58508.]—**Dynamo Tests.**—TO MR. BOTTONE OR W. H. EAVES.—In the first place, your friends, if they knew anything about the subject, would have agreed. The one who advocated increase of current was very wrong. If you use a large current you require large leads, and that is expensive. The same thing applies to the dynamo, as a small wire will carry more current in proportion to its area than a large one. Also remember that the current heats the wire, and not the E.M.F. The statement of the firm you quote is correct, and the result is far from economical; 100 volts and 70 ampères = 7,000 watts, to produce 100 × 16 = 1,600 c.p. Some makers claim that their lamps take $2\frac{1}{2}$ watts per c.p. If this result had been attained, the energy absorbed would have been only 1,600 × $2\frac{1}{2}$ = 4,000 watts. Mr. Jones's laminated H armatures are very good for small machines, but are not suitable for large sizes.—W. H. EAVES, Coventry.

[58511.]—**Moscrop Recorder.**—This machine gives a continuous record of the action of a steam-engine, showing the instant of starting and stopping, and is therefore an invaluable timekeeper. It shows the true condition of the engine, as to whether it is balanced in its several parts or otherwise, and, unfortunately, in 95 per cent. of the engines it is found to be otherwise. The recorder also shows whether the valves are correctly or incorrectly set—in this matter it is far superior to, and is fast superseding, the ordinary indicator; the best running engines are all watched and set by the recorder. The recorder further shows the exact speed an engine runs every moment of the day or night. Most engines vary from 5 to 15 per cent.; say an engine supposed to be constantly running 50 revolutions per minute is found to be going all the way from 47 to 53, and averaging on a "counter" 50, this is either losing time by being too slow, or spoiling work by being too quick. Some engines vary much more than above stated. By applying a recorder and arranging the governing gear of the engine, it is possible to get a uniform and unalterable speed of 50, or, better still, to increase the speed to 53, with the clear assurance that the speed is never less and never more, and thus improved quality is secured, and an increased production of 3 to 5 per cent. is obtained.—JAMES WILLIAMS.

[58512.]—**Steam Governor.**—The weight on spindle has a constant pull downwards, while the small, quick-moving balls overcome this by the speed they have. But the whole thing—the weight and moving balls—is so evenly balanced that one or the other assert themselves when speed varies the least bit, and the speed being high, the least alteration in speed of engine is multiplied greatly, and so the governors act very quickly, or are very sensitive.—T. C., Bristol.

[58512.]—**Steam Governor.**—High-speed governors are more sensitive than the long (slow) pendulum governor, and act sooner upon the throttle valve. For instance, if the engine runs eighty revolutions per minute, and the governor only forty, and if the engine be increased in speed two revolutions per minute, it will only affect the governor one revolution; but if the governor be double the speed of the engine, it will act sooner, and give a more regular speed to machinery, &c. I may also say that the high-speed governor requires a good equilibrium throttle-valve. Avoid all tight packing, &c., so that they can act upon the steam without having any resistance to overcome.—W. H. T.

[58515.]—**Dynamo.**—To "W. H. E."—I understand from your query that you wish the machine to be series wound. For this purpose No. 16 will not do, if, as I understand, you wish to connect all the F.M. coils in multiple arc. The resistance of armature will be about 1 ohm to 2 ohms. The resistance of the F.M. coils all in multiple arc will be about ·39 ohm; so you must couple the coils, two in series and two in parallel arc, which will give a resistance of 1·56 ohm. With these quantities you will get a good working dynamo. When one layer only is used on armature, the field must be very powerful and the core of the armature very massive.—W. H. EAVES, Coventry.

[58517.]—**Myopia.**—I certainly am in the same fix as "Ess Jay" seems to be. I was always somewhat nearsighted, and have during the last few years had numerous pairs of glasses. My first endeavour was to get a pair which would enable me to see music the length of my arm away. I went to a working optician and tried every glass he could fix up without success. I bought the nearest pair I could get for the trouble I had given, and left unsuited. I repeated this at various London opticians, always with the same result. My next step was to go to a professed occulist. He examined my eyes, pronounced astigmatism present, gave a paper marked "9 *c* ⊃ axis horizontal, both eyes," had glasses made at a cost of 12s., found I could see much better, but from the dazzling effect, could not walk with the glasses on. Tried back again and was recommended "R—9 *c* ⊃ × 48 sph. L—9 *c*." This was great improvement; but the eye-aching pains after wearing them takes all the immense advantage of improved sight away. Next tried "9 *c* ⊃ 48 sph., both eyes," and get perfect sight; but the headache after wearing the glasses still continues. My experience with opticians has certainly been an expensive one, and I shall be deeply grateful if any of "our" experienced correspondents can suggest whether the present glasses are suitable, and how I can make a reliable test of my own sight for alteration if necessary.—TILLETT.

[58518.]—**Bichromate Batteries.**—This query has been answered hundred of times; look up back numbers. Do you leave the zincs in the liquid? If so, take them out when the cells are not in use. The solution will only last a few hours on continuous work; perhaps you expect too much.—C. D. R.

[58523.]—**Link Motion.**—If you have double eccentric, strike radius of link from centre of crank-shaft. If only one eccentric with movable rod, from valve-spindle; then strike radius from centre of pin in valve-stem when valve is in mid position. Make link stiff is principle for proportion.—T. C., Bristol.

[58525.]—**Oxide of Iron.**—The use of oxide of iron in the purification of gas is attended with a distinct chemical change. The oxide of iron and sulphuretted hydrogen (one impurity) are both decomposed, the oxygen of the oxide of iron uniting with the H of the H_2S. whilst the S unites with the iron, forming the sulphide of this metal. The purifier, however, for a certain length of time, may be renewed by withdrawing the impurer material from the purifiers and exposing to atmosphere, when it liberates a portion of its S, and absorbs oxygen to form again oxide of iron.—W. H. S. S.

[58532.]—**Physics.**—There is an evident muddle in the last sentence of my answer to this query last week, for which I do not think I am altogether responsible. It should read:—And since heat developed varies as velocity², ∴ ans.² = [illegible] × ·033 × 100. This gives the answer rather over 16,000 centimètres per sec.—BANGOR.

[58532.]—**Physics.**—Your correspondent "Liege" falls into the initial error of supposing that the querist wanted the target, as well as the bullet, heated to 100°, and he also seems to be under the impression that the energy of a moving body varies directly as the velocity, whereas it is proportional to the velocity squared; and this error also vitiates "Bangor's" reply. In order to check my answer, I will go over the calculation again, using English units. Let *v* = velocity of body in feet per second, *m* its weight in pounds, and *s* its specific heat. Then its energy in foot-pounds is $\frac{m v^2}{2 \times 32}$. Now Joule's constant in foot-pounds is 1390; hence the heat developed by stopping. the body is $\frac{m v^2}{2 \times 32 \times 1390}$ pound-degrees centigrade. This will raise the bullet—

$$\frac{m v^2}{2 \times 32 \times 1390 \times m \times s} = \frac{v^2}{2 \times 32 \times 1390 s}$$

degrees. Hence we have—

$$v^2 = 2 \times 32 \times 1390 \times 100 \times {\cdot}0314$$
$$= 528{\cdot}52 \text{ft. per second.}$$

Converting this into centimètres, we get [illegible] which agrees closely with my results, using C.G.S. units.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[58533.]—**Iron Tank.**—If possible, get the bottom of tank dry and cover it well with hot pitch inside. Apply to sides of tank with brush whilst still hot for 2in. or 3in.—D. A.

[58533.]—**Iron Tank.**—I am afraid you must put in a new bottom: it will be cheapest in the end. The water will always find its way out [illegible] less.—C. D. R.

[58533.]—**Iron Tank.**—I should advise [illegible] cement, and still use Portland. I, in common with many others, have mended bottoms of pails with it, and always found them tight.—T. C., Bristol.

[58534.]—**Metal Moulds for Vulcanite.**—What I should like to know in reference to this matter is this, How is the vulcanite prevented from adhering to the tin? I did not use grain tin, I used bar tin; and found it very difficult to separate the tin and vulcanite. The Cantor Lectures on "Indiarubber Compounds," published some time since, are all very well for general information, but they don't go into details like this; there must be some little wrinkle which we cannot get hold of. The gentleman who delivered those lectures could doubtless give us this information if he is at liberty to do so.—Os.

[58536.]—**Bisection of a Triangle by a Straight Line drawn through a Given Point Within or Without it.**—If the solution given by "Elag" were correct, it would follow that a triangle would be bisected by any straight line through the centre [illegible] and therefore [illegible] straight line drawn [illegible] parallel to one [illegible] obvious that t[illegible] two parts in the tooth flanks. But it is usual to make the flanks of mortise teeth straight and parallel, and to strike the points only with a radius.—J. H.

[58576.]—**Aluminium.**—There is practically no method by which this metal can be obtained, except the usual one, which consists in reducing the double chloride of Al and Na by sodium, and this method is given in all the textbooks, in which also the querist will find an account of the physical properties of the metal. If it be true, as was recently stated in "Ours," that sodium has been produced cheaply by electrolytic decomposition of the fused chloride, then we are within a measurable distance of cheap aluminium. All attempts to obtain the metal without sodium have been practical failures. I should think that "Chloro-Bromium" could buy the metal cheaper than he could produce it on a small scale.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[58577.]—**Soda Caustic Manufactured by Electricity.**—Refer to address column.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[58578.]—**Violin Query.**—It is not likely that a mere change of soundpost would deteriorate a violin so much as "Perfection" indicates. If he examines it thoroughly, he will probably find an opening somewhere. As to the difficulties of fitting pegs and feet of bridge they only exist in imagination. A penknife will do all that is necessary, so far as their being a good fit will do anything to improve the tone. Have you ever tried a glass soundpost? I have, and like it.—B. SC., Plymouth.

[58578.]—**Violin.**—Having tried most materials during my experiments upon soundposts, I found that nothing is better than a piece of straight-grained deal, about $\frac{3}{16}$in. in diameter, and to set it up I drill a hole no larger than will take carpet thread, $\frac{3}{8}$in. from the top end, put a knot in the middle of the thread, slip on the post, and inserting that end of the thread into *f* hole at bass side, shake until you get it out at treble do., push in the post, fettle it into position, and then pull out the thread from the bass side which has the knot on it. Having placed it where you think that it ought to be, and making sure that it is exactly behind the centre of the treble foot of the bridge, about $\frac{1}{8}$in., and most particularly that it be no tighter than will keep it from falling until the pressure of the strings comes on it, tune up all the strings gradually, and if not satisfied proceed to experiment. No man ever lived who could tell "exactly" where the soundpost ought to be in each separate instrument, as $\frac{1}{16}$in. will make a great difference for or against the just balancing of all the strings, and I find that the handiest way to shift it is to use as a lever the thin steel blade of a mitre square, or any similar piece of thin stuff, with a piece of rag or paper around it where it fulcrums upon the *f* hole. The nearer the bridge is to the post, the purer is the tone, and the farther from it, the louder and coarser. I fit the feet to belly with a sharp penknife, and thin the part where the strings rest upon to say $\frac{1}{16}$, running out about $\frac{1}{4}$ down. I make no notches where the strings rest upon it, as they make their own bed in a short time, but am careful to have the E and the G strings exactly over the centre of each foot, and then space the D and A equally between them; also I use a gauge so as to have each string of the recognised proportions, and I have generally found it to improve the tone by choosing a thick third string; also see that the notches at key-end are not deep; if they are, file away until just sufficient to keep strings *in situ*; lay a straight-edge upon finger-board, which I often find to show that it is very hollow in the middle from being sprung in the glueing up; if it be so, knock off the notched piece with the flat side of a chisel and a smart blow of a light hammer, and flatten by means of fine glasspaper held over a flat strip of wood. Tap the instrument all round the edges with, say, the ivory handle of a knife, especially where the chin and the hand rests upon it, as the perspiration often loosens the glue at these parts, which is fatal to the tone; and if so, get some good thin glue, spring open the place with a penknife, apply the glue, work it up and down quickly before a fire, and then slip on a little clamp until it is dry. The pegs should be made of boxwood, and if the violin is an old one, they ought to be turned to fit the holes; if a new one, you should have a sharp half-round taper reamer of same taper as the pegs, and if they are inclined to slip put a little powdered chalk upon them.—A., Liverpool.

[58581.]—**H.P. of Compound Engine.**—Nominal H.P. of compound engine is the nominal power of low-pressure cyl. only. Some time since "Lancashire Fitter" gave a good rule for power of compound engines as follows:—

·0000666 area of l.p. cyl. × stroke × revs. by $\frac{\text{Initial pressure}}{\text{ratio of expansion}}$ × [1 + hyp. log. of expansion minus backpressure] which in the given example, is as follows. Supposing steam cut off at half-stroke in h.p. cyl., expansion would be, say, 8 times

$$\cdot0000666 \times 113 \times 131\tfrac{1}{4} \times \frac{95}{8} \times [1 + 2{\cdot}079 - 2{\cdot}5]$$

say, 7H.P.—T. C., Bristol.

[58581.]—**H.P. of Compound Engine.**—Let the steam be cut off at $\frac{1}{3}$ of stroke in h.p. cylinder, and at half-stroke in low-pressure cylinder; 80lb. pressure with 15lb. added = 95lb.; take 5lb. off for working margin, &c. Then the high-pressure piston will have 90lb. initial pressure, and being cut off at $\frac{1}{3}$ will have a terminal pressure of 30lb., and 63lb. average pressure upon the piston. As the steam must now go to the low-pressure cylinder, where it will be cut off at half-stroke, as the cylinders are in proportion as one to four, the initial pressure will be 30lb. ÷ 2 = 15lb. This being cut off at half-stroke, will give a terminal pressure of 7·5lb. and an average pressure of 12·7lb. As the initial pressure in the low-pressure is 15lb., this will also be the back pressure in the high-pressure cylinder. Then the average pressure upon the pistons will stand thus: h.p. cylinder 63lb. − 15lb., back pressure = 48lb., effective pressure l.p. cylinder 12·7lb. − 3lb., back pressure = 9·7lb. average pressure upon the piston. Speed of piston, $\frac{7}{12}$ft. × 2 × 225 revolutions = 262·5ft. per minute. Area of h.p. cylinder $6^2 \times \cdot7854 = 28{\cdot}27$in., area of l.p. cylinder $12^2 \times \cdot7854 = 113$in.

High Pressure:

$$\frac{\text{Area } 28{\cdot}27 \times 48 \times 262{\cdot}5\text{ft.}}{33{,}000\text{lb.}} = 10{\cdot}78 \text{ I.H.P.}$$

Low Pressure:

$$\frac{\text{Area } 113 \times 9{\cdot}7 \times 262{\cdot}5\text{ft.}}{33{,}000\text{lb.}} = 8{\cdot}7 \text{ I.H.P.}$$

Total I.H.P.... 19·48

The nominal H.P. is now almost obsolete, and rightly so, as it only misleads. However, you should have 22in. piston area for one horse-power for condensing engines, and 220ft. piston speed, and 7lb. average pressure. This is Watt's rule, so your engine will be about 6·5 nominal horse-power. —W. H. S.

[58584.]—**Magnetic Belt.**—All so-called magnetic belts are humbug. Don't waste your time in endeavouring to construct such rubbish.—C. D. R.

[58584.]—**Magnetic Belt.**—Did it ever occur to "Jolo" that the belt without the magnets might answer his purpose equally well? If he knows anything about the properties of electricity, he must be aware that these magnetic belts, pads, tooth-brushes, &c., &c., are rank quackery.—DOCTOR MEDICINÆ.

[58585.]—**Cold Feet.**—Do you suffer from a disordered liver? If so, this will account for your cold feet. You will find that the stomach is the real seat of your sufferings. Ask Dr. Allison through the medium of the *Weekly Times and Echo.* Give him full particulars of your habit and occupation.—C. D. R.

[58585.]—**Cold Feet.**—Let "Sufferer" plunge his feet in cold water one at a time immediately on getting out of bed in the morning, and then rub with rough towel till circulation returns. If that will not do, dust inside of socks with mustard daily. But of all the remedies for cold feet nothing equals, in my experience, the wearing of thick woollen socks and clogs. The latter can be made with leather soles below the wood, and nice uppers, so as to be indistinguishable from ordinary boots.—DOCTOR MEDICINÆ.

[58586.]—**Medical.**—Loss of reflex action, described by "C. O.," is often one of the symptoms of disease of the spinal cord. He should consult a specialist on nervous diseases. "M. B." gives a list of these in his answer to No. 58476.—B. SC., Plymouth.

[58586.]—**Medical.**—The loss of the patellar tendon reflex is often a symptom of grave disease of the spinal cord, but its absence is no proof, in my experience, that anything is wrong, especially as "C. O." does not complain of any other symptoms. People have it in different degrees, and a skilled practitioner would probably elicit it in "C. O.'s" case; but I should strongly advise "C. O.," as he values his peace of mind, to leave his knees and his pulse alone, and if sick, to refer the matter to his regular attendant. A little knowledge is often a dangerous thing.—DOCTOR MEDICINÆ.

[58591.]—**Voyage to Australia.**—If "A. F. N." will advertise his address, I will gladly write to him, having been in Australia and New Zealand; but would strongly advise him to try a winter or two in Arcachon, near Bordeaux.—W. R. K.

[58591.]—**Voyage to Australia.**—A good line of sailing ships is Aitken, Lilburn, and Co., Buchanan-street, Glasgow, who will send a small circular on application giving a list of necessaries for the voyage. Some friends (sufferers from chest complaints) have gone out in these ships and been well satisfied. Sorry I cannot give information as to Australia; but one or two friends had to move about before finding a suitable residence.—SILO.

[58591.]—**Voyage to Australia.**—Like "A. F. N.," I was sent to Australia some years ago for lung disease, and it may comfort him to know that I have never since then—seventeen years ago—had any return of it. I went in one of Green's ships—a wooden one, and such are much cooler in tropics, and warmer down south than iron ships. I was very comfortable, both going and returning. For clothing let him take a couple of suits of summer clothes and plenty of warm winter ones, especially a good Ulster coat, a seaman's waterproof coat, leggings, and sou'-wester hat. The clothes for use on shore will depend upon what colony he is going to, recollecting that it is often very cold in Victoria, Tasmania, and New Zealand, and that at any time it is best to err on the side of warm clothing, and always to wear flannel. As to where he should go, and how he should live there, he should consult his medical attendant; but certainly he should not live in a town. From personal experience, I should say that the climate of Cape Colony or the Orange Free State is much more suitable for lung disease than any part of Australia.—DOCTOR MEDICINÆ.

[58593.]—**Melting Snow.**—(*a*) Because iron is a better conductor of heat to the snow; (*b*) Because wood is a better radiator of heat, and thus becomes chilled.—BANGOR.

[58593.]—**Melting Snow.**—Snow melts quicker on a good conductor of heat than on a bad one, and iron, being a much better conductor than stone or wood, the melting proceeds much faster. I am, however, doubtful whether all things being equal, hoar frost would not show itself more on iron than on wood or stone, though, of course, once the sun was up, it would disappear more quickly from the iron.—DOCTOR MEDICINÆ.

[58595.]—**Moulding.**—The best sand I know is Birmingham sand, from the Birmingham Cemetery Company, Key Hill, Birmingham. It is not necessary to use coal dust in your sand, and it is better not to dry the moulds at all, unless you can dry them thoroughly. For castings weighing $\frac{1}{2}$ cwt. it would be better for you to wash the moulds with a mixture of whiting and plumbago, and thoroughly dry the moulds. A great deal depends upon the metal you use; if you are using old scrap, you will have a trouble to get a good face on your castings. If you are using new metal, the above sand will give you all you desire.—W. F.

[58595.]—**Moulding.**—In answer to "Practical Brass Caster," the best sand to use is loam, as used by iron moulders. The sand he has used has been too strong. Get some black sand, or, as we call it, metal moulder's green sand, that has often been used—the more often the better, as new sand is too strong for brass; get a $\frac{1}{4}$ riddle, and put it all through to take out pieces of metal that may be in (I am supposing the sand to be moist for use); then work it well or turn it well over; then take a portion in a sieve and place a shovelful over your pattern, so as to get a fine skin. When your mould is made up, get a machine-knit cotton stocking leg (an old one), put a mixture of flour and lime dust (slaked), dust over your mould, then blow the contents off with a pair of bellows. You need not dry them, unless for yellow brass or lacquered casting. If they are cocks, valves, &c., with cores in, empty the boxes while hot (blood red), and take them with a pair of tongs and draw through a bosh or tub of clear cold water, then you will have a casting clean as possible, with sand and core blown out. If it be done properly, they need no fettling.—BRASS FOUNDER.

[58596.]—**Sarcina Ventriculi.**—This alga found in the stomach, is not a disease, but a symptom of some chronic affection; (2) a $\frac{1}{8}$th objective will show it; (3) its appearance is transparent, consisting of cubic or prismatic masses sometimes irregular, composed habitually of 8, 16, or 64 cubic cells. Each face of these is divided by four light indentations (called frustules by Mr. Goodsir) in the form of a cross. The diameter of the cells is ·008 of a millimètre.—B. SC., Plymouth.

[58597.]—**Fretwork Pattern.**—Lay a piece of rather stout paper over the fret, and rub with a block of blacklead.—ESSAR.

[58597.]—**Fretwork Pattern.**—Put on a piece of paper, and rub over with a soft lead pencil; the pattern will be clearly shown. This is an old schoolboy trick, and is just the same principle as monumental brass "rubbings."—B. SC., Plymouth.

[58597.]—**Fretwork Pattern.**—Take [illegible] white lining-paper, lay it on the fretwork [illegible] sign of which you wish to copy. [illegible] paper firmly in its place [illegible] cobbler's heel ball [illegible] wood [illegible] as "hellebore" (which is the right way to spell it, I believe, though what they call it is "heel-ball"), which can be obtained from any shoemaker, and, having placed a piece of white paper over the fretwork, rub the back all over with it. This will give a perfectly distinct copy of the pattern, which can afterwards be improved, if desired, by means of a pen and pencil. If the pattern is glued up (a bracket, for example), it must be taken to pieces to do it properly.—R. A. R. BENNETT.

[58599.] — **S.W. Engines.**—Photographs of No. 9 can be had of Mr. Dodson, 58, Regent-street, New Swindon. I am sorry I have not the dimensions, or would have been pleased to send them. The new broad-gauge engine is, I understand, being built to be converted either into a broad or narrow-gauge engine, and is not yet out of the shops. I hope soon to be able to send a sketch of it.—ALFRED R. TURNER.

[58599.]—**G.W. Engine.**—Boiler length, 10ft. 9½in.; diameter, 4ft. 8in.; plates, thickness of, ½in.; firebox, outside length, 6ft. 6in.; firebox, outside breadth, 4ft. 1in.; firebox, inside length, 5ft. 10½in.; firebox, inside breadth, 3ft. 6½in.; top of box to grate, 5ft. 10in.; bottom of box to grate, 4in.; smoke-box, length outside, 2ft. 8¼in.; smoke-box, breadth outside, 5ft. 0½in.; chimney (bottom and top), 1ft. 6in.; height of top from rail, 13ft. 1½in.; No. of tubes (iron), 263; diameter, 1⅝in.; length, 12ft. 1in.; cylinders, 18in. by 26in.; diameter of driving-wheels, 7ft. 8in.; diameter of leading and trailing, 4ft. 2in.; total wheel-base, 18ft. 4in.; frame, extreme length, 27ft. 6in.; frame, extreme breadth, 6ft. 10in. I cannot say whether any more of this class are being built, and have not heard of a new B. G. by the name of "Centaur."—W. R. G.

[58601.] — **Geometrical.** — Assuming for a moment that of all triangles inscribed in a given circle upon a given base the isosceles is the greatest, it will be readily seen that the equilateral is greater than all others. For let A B C be any triangle inscribed in a circle, and suppose B C the base fixed; then for all triangles having this base that of greatest area, from our assumption, is the isosceles, so that if A B is not equal to A C, we must make them equal before we can have the greatest triangle with base B C. Arguing similarly with base A C, we see that triangle A B C cannot be the greatest, unless A B B C are equal, and similarly for base A B. Hence for any triangle A B C, if any two of the sides are unequal the triangle is not the greatest. This, in other words, says that the equilateral triangle is the greatest in area of all others inscribed in same circle. The assumption is readily proved, for the altitude of the isosceles is greater than that of any other triangle on the same base, by the perpendicular interval between the vertex of the latter and the tangent to the circle parallel to common base. For the solutions of the above, and many others of a similar nature, I think "Puzzled" will find benefit from a perusal of the chapter on Maxima and Minima, in Constable's "Geometrical Exercises for Beginners," Macmillan and Co.—S. CONSTABLE, L.S.A.

[58605.]—**Nitrate of Soda Battery.**—Only the clear liquor is to be used; but I notice (for the first time) the receipt I gave was not quite correct. The proportions are: Nitrate of soda, 1 part; sulphuric acid, 3 parts; water, 3 parts. I think then you will find all the crystals will dissolve; if you do have any over, you can make some fresh solution with it.—P. C., Hornsey.

[58606.]—**Ball Bearings.**—I can inform "One Anxious to Learn" that he need not be the least uneasy about the loss of one or two balls in his bearings, as I have run machines so for months without any damage or signs of friction.—DOCTOR MEDICINÆ.

[58606.]—**Ball Bearings.**—I should advise "One Who Wants to Know" to get another ball, because, though the wheel may run easier when suspended, the reverse would be the case when riding, because the balls would spread at the top, and have a tendency to jam. The reason they do not when the wheel is suspended, is because the balls keep close together at the bottom, so the loss of one ball would not make much difference. But as "One Who Wants to Know" says the wheel runs easier without it, I should say the balls are too close together. Most makers leave a space of about half a ball between each row, and some keep them apart by means of a perforated brass cage, which I consider to be the best plan, as it keeps the balls in their proper places, and at equal distances from each other.—G. TOWNSHEND.

[illegible]—**Wimshurst Influence Machine.** [illegible] machine?

points or sharp edges from which the electricity may escape, and afterwards work the machine in a darkened room to further ascertain where the leakage may be. If he is then not successful, let him give the results obtained from these suggestions, and I will then try and help him further. —J. W.

[58614.]—**Magneto Machine.**—See reply to 58384, page 388, by Mr. Bottone.—C. D. R.

[58614.]—**Magneto-Electric Machine.**—The coils should not touch the magnet, but should be as close as possible. See letter from Mr. Bottone (page 388), two weeks since; but I should like to ask Mr. Bottone further as to the relative positions of the armature and the contact breaker—that is, whether contact should be broken when the armature is opposite or between the poles of the magnet?—Os.

[58619.]—**Engine Power.**—The relative area of the single cylinder to that of the 2 cyls. is as 1 is to 1⅜; consequently you will have power in that proportion, and would take the same proportional amount of extra steam, as you cannot efficiently use any cut-off in models.—T. C., Bristol.

[58619.]—**Engine Power.**—You do not mention the size of your boiler; still, I presume that it raises sufficient steam to drive the cylinder of 1in. bore by 1in. stroke, and keep up the speed. In substituting two smaller cylinders with an area even equal to that of the one, supposing your boiler capacity and heating surface to be the same, no advantage in power would be gained, because with the pair there is greater friction to be overcome, and they would consume much more steam than one cylinder could possibly do, and this amount of steam your boiler might not be able to supply continuously to them, and failure would result from the attempt.—AMATEUR.

[58620.]—**Saturn's Satellites.**—The misprint referred to by "W. L." (p. 414) is in the date which, instead of the 4th, should be the 5th.—THE WRITER OF THE ASTRONOMICAL NOTES.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, "Glatton" has replied to 57519, 57523, 57532, 57567, 57875, 57887, 57973, 57974; "B. B.," 57965.

57993. Telescopic, p. 229.
58021. Geometry, 229.
58030. Albatross Head, 230.

58238. Air-pump and Condenser Combined, p. 308.
58263. Gyroscope, 308.
58266. Scene Painting, 308.
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58273. Twine Maker's Size, 308.
58277. Rope Driving, 308.
58279. Bellows v. Fan, 208.
58287. Divorce.—To Mr. Wetherfield, 309.
58294. Stiffness of Cast-Iron Cylinders, 309.
58298. Boiler, 309.
58300. Legal, 309.
58306. Barometer, 309.

Optical Experiment.—A contributor to *Cosmos* suggests a curious optical experiment, which may serve to show the principle of the stereoscope. If we cut out of black paper two similar figures—two crosses, for example,—and then place them, their extremities almost touching, at about 3in. from the eyes, before a sheet of white paper, we shall see three crosses, the middle one being dark and completely separate. This phenomenon is explained by the simultaneous vision of the two eyes, and it is easy to show this by looking at the objects successively with one eye. The experiment becomes still more interesting when, instead of black figures, we employ complementary colours,—red and green, for example. In this case we must use a dark background, and there will appear a white cross in the middle.

Toughening Paper. — A plan for rendering paper as tough as wood or leather has been recently introduced on the Continent. It consists in mixing chloride of zinc with the pulp in the course of manufacture. It has been found that the greater the degree of concentration of the zinc solution, the greater will be the toughness of the paper. It can be used for making boxes, combs, for roofing, and even for making boots.

Electric Railway on Mont Saleve.—A concession has been granted by the Swiss Government to a firm of electrical engineers at Geneva for [illegible] railway up Mont Salève, near that city. [illegible] be laid with a central rack, very [illegible] of the Righi Railway, but the [illegible] the locomotive which gears into [illegible] driven by steam, will be worked

QUERIES.

[58621.]—**Locomotive (Model).**—I want to know whether a pair of ¾in. bore by 1½in. stroke cylinders would be too large or not for a brass well-riveted loco. boiler, total 10in. long by 3in. dia., and firebox 3in. by 3¼in. with ½in. water space all round, and five brass tubes, 5¼in. long, ⅝in dia. inside from firebox to smoke box, depth of firebox outside, 5in., to crown of firebox inside, 4¾in. from ashpan; pressure, 45lb. per sq. in.? Any information on this will oblige—LINCUMPUMP.

[58622.]—**Architectural Designs.** — TO SIR E. BECKETT.—Knowing this correspondent to be an author and authority in building matters, and at the same time to be a member of the legal profession, would he kindly inform me what is the law relating to the selection of designs for public buildings erected at the expense of the nation? Does the selection rest entirely with the Crown, or has Parliament any controlling power in the matter? In the latter case, what course is Parliament to take in order that the design selected be one approved by themselves? At present it would seem that the selected design may not only be of the most repulsive and deformed character, but may even be one that won't admit the light of day into the building. It is bad enough that the so-called "Gothic Revival" and the stupid mania for reproducing Mediæval remains and pitching them hotch-potch together should destroy all architectural effect; but that it should also be allowed to destroy the practical utility of a building, seems to me a piece of stupidity for which the councils of no civilised country should make themselves responsible.—ARCHITECT.

[58623.]—**Induction Coil.**—TO MR. ERNEST BAUGH.—I have just completed an induction coil, which does not work at all satisfactorily, and should feel extremely obliged if you would kindly assist me. The dimensions are: core, 1¼in. diam., 12in. long, well annealed, bound together with silk tape, soaked in paraffin wax for one hour; primary, three layers of No. 16 silk-covered copper wire, also soaked and placed in ebonite tube, just fitting loosely, 12in. long and ⅛in. thick. On the tube are 26 sections of No. 20 B.W.G. sheet ebonite, 4¾in. diam., which are paraffined ½in. deep from tube, and all filled to about 1in. deep with about 4lb. No. 36 silk-covered copper wire wound through hot paraffin wax. The portion of tube taken up by secondary is 5in., besides ebonite ends, which are 6in. diam. and ⅜in. thick. Condenser, 70 sheets tinfoil, 10in. by 11in., placed between well paraffined paper, which is 1in. larger at the two sides and one end of foils, and so arranged that half or whole can be used with large or small battery power. Contact breaker after pattern by Apps. Result: five pint Bunsens, 1¼in. spark; two cells ⅜in. The only defects that I can possibly think of are: (1) tinfoil used for condenser very thin; (2) contact breaker does not vibrate readily after a few seconds, although core is powerfully magnetic; the hammer on spring is solid. I see in some books it is spoken of as being a cylinder. Should I find a mercury break better? (3) Would there be any chance of a hole being punctured through ebonite tube and spark leaking to primary? How could it be proved? (4) On placing the paraffin wax on bottom of sections before commencing to wind, I found a difficulty in getting the same thickness, and also when winding in the wire the paraffin would adhere to side of sections, the consequence being sections filled more in one place than another, and also not filled so closely as they should be. If I have to reconstruct the coil, I intend having a second ebonite tube, about 6in. long, to fit tightly on the other, and then cut it into washers and place a disc between each one and cement all together with shellac varnish before winding. What depth should the washers be on centre of ebonite tube, which is ⅛in. thick, and how should they vary as the ends are approached in order to have secondary the right distance from primary? (5) The secondary wire used was 2lb. of old wire and 2lb. of new, but not baked or warmed before paraffined. (6) If I make the coil again, had I better have 4lb. of new wire for secondary, and should it be all the same size?—W. J.

[58624.]—**Iron Music Stand.**—Will any kind reader inform me how to make an iron music stand to rise up and down? A brass one would suit as well as iron, as long as it is an easy pattern.—VIOLINIST.

[58625.]—**Storage Cells.** — Will some of "ours" please tell me how to make the red-lead paste remain in the holes of lead plates for storage cells? I find, when put into liquid that it all comes out, therefore cannot make them work satisfactorily. Do the plates require to have much liquid, or would the cells answer, say, ¾in. wide?—PUZZLED.

[58626.]—**Fire Grenades.**—What is the chemical composition of the contents of the hand grenades used for extinguishing fires in dwelling rooms, &c.?—S. STEVENS.

[58627.]—**Dynamo.**—I have a dynamo made from Jones's castings, with laminated armature. It is well made, and insulation perfect; but I don't seem to get quite as much from it as I ought. It takes nearly one horse-power to light three 20-c.p. 45-volt incandescent lamps, with 2,000 revolutions. Wire on fields, 15lb. No. 16 d.c.c. on armature, which is laminated H. 3½lb. No. 18. Will some of "ours" tell me where it is likely the fault may be? Are the relative resistances of armature and fields correct? They are coupled in series. Jones calls 160 c.p. in his list. Armature is 4¾in. dia. and 5in. long. Also, there is rather more sparking at brushes than I like. Should I improve the machine by making Gramme A.? If so, would be glad of particulars—i.e., quantities of wire, number of coils, &c.—PUZZLED.

[58628.]—**Making Taper Pins.**—I have a large quantity of taper steel pins to make from 14 B.W.G. wire, and about ½in. long. If any correspondent will describe a contrivance that will taper them quickly, he will confer a boon on—AMM.

[58629.]—**To Mr. Wimshurst.**—I have made a machine as described by you a few weeks ago, but cannot get more than 3½in. spark from it. It has 17in. plates. Do you think it would give a longer spark if I varnished the Leyden jars? I am afraid they leak through the glass.—AMM.

[58630.]—**Length of Focus of Concave Lens.**—How can the length of the focus of a concave lens be correctly found? An answer would oblige—SINE.

[58631.] **Sunk Key Beds.**—Would "A. Liverpool," who answered "Belgian" on the above subject, please give a little more information how they are cut in the lathe with a flat drill? I have tried with a drilling machine and slide rest; but the drill enters very badly, seems to push the work to one side, and not to cut parallel to the shaft. A few hints as to entering the drill and depth of cut and speed for the drill to run would greatly oblige. A few articles upon "Engineering Workshop Practice" would be highly esteemed by numerous subscribers by a practical hand, such as those by "Hand Rat," now in your journal.—AN INTERESTED SUBSCRIBER.

[58632.] **Photo.-Litho.** Could any of "ours" inform me how to get a good, clear photo. transfer? I have several recipes for preparing the sensitised paper, but I cannot get a satisfactory transfer with it. I get a good photo. I have tried spare inking, and succeed pretty well with line work; but I fail in washing off or developing the fine shaded work. What can I do? A. H. M.

[58633.] **Dynamo.**—To W. H. EAVES, OR S. BOTTONE.—I have finished a small dynamo of the following dimensions: the armature (ring form) is laminated 5in. external diam., with 16 sections, and wound with 360ft. of No. 16 B.W.G. double c.c. wire, 22½ft. in each section; the electro-magnets, two in number, are wrought iron, 7in. long by 1½in. diam., and wound with 4½lb. of No. 14 d.c.c. wire, 4½ in each leg. Are the wires in proportion to length? I can melt 12in. of No. 30 B.W. gauge iron wire in the main circuit, but cannot light a 10-candle-power lamp, Swan's; but if I put 16in. in the main circuit and the lamp in shunt, I can make it white hot, but not to its full power. Please to tell me about how many 10-candle lamps it should light, and the E.M.F. in volts and current in ampères, as I can get a very good light (arc) from two small carbons. NOIL.

[58634.] **Sound Plate.** I want to make a sound plate. Would one of your kind readers say what metal is most suitable, the best size and thickness, and would the metal be best cast or rolled? AN OLD READER.

[58635.] **The Lantern Mixed Gases.** I am not quite satisfied with the power I get from the above light as compared with the blow through jet, and what I have seen in other lanterns. Can I obtain a more brilliant light by enlarging the nozzle aperture of the mixed jet (it seems so very small)? I should be willing to burn more gas. What kind of lime cylinders are the best—hard or soft? LANTRA.

[58636.] **Legal.** Will Mr. Wetherfield kindly answer the following, on which two opinions totally irreconcilable have been received? A testator left certain funded property to his wife for her life, and after her death to trustees for the use of his son, A. J. K., for his life, after his death to his children. In the event of his not leaving any child, to C. M. T. absolutely. C. M. T. died lately, leaving A. J. K. his sole legatee. The widow and A. J. K. are still living. If A. J. K. dies unmarried in the life time of the widow, on the death of the latter, to whom will the property go, whether to the legatee of the widow of A. J. K., or the then next of kin of the testator? If A. J. K. outlive the widow, upon his death unmarried, to whom will it then go? DELTA.

[58637.] **Wimshurst Machine.**—Will Mr. Wimshurst, or any other capable person, kindly explain the action of the high tension discharger, attached to the positive induction of the latest form of machine? and will any correspondent, who has been able to give a fair trial to both, say whether the results of the Wimshurst are distinctly superior to those of the Voss? W. J. B.

[58638.] **To Mr. Wimshurst.** Will you kindly tell me if the plates of a vulcanite induction machine of your pattern require varnishing? If so, what is the best receipt, and may the varnish be applied cold, or must the plates be heated? HIGH TENSION.

[58639.] **Cleaning Quicksilver of Copper.**—Would someone please tell me how to clean quicksilver from copper goods without heating them? Some parts are soldered. R. O.

[58640.] **Machine-cut Dovetails.** Can any fellow reader inform me how to set out dovetails to cut with vertical moulding machine? I saw some at the Health Exhibition which fitted beautifully, but could not learn anything about the way they are gauged, or the form of the cutter used. I have vertical spindle, which runs from 4,000 to 5,000 revs. per minute. CABINET MAKER.

[58641.] **Gelatine and Turtle Soup.** Would some scientific correspondent impart to me the process (from mammalian animals) of making gelatine? Also the mode of preparation of tinning turtle meat to make turtle soup?—COOK.

[58642.] **Soldering Copper.** I have to make some balls of thin copper, and should be much obliged if any correspondent will inform me how to make an air-tight joint. I have made them in two halves, and soldered them; but the mercury oozes out, even without pressure from the inside. A substitute for solder would be gratefully received. Could I have them stamped out with a thread, as I have seen the caps of glycerine bottles, &c.? I had better mention that the balls have only to be about 1½in. diam. SPHERE.

[58643.] **Black Polished Marble Columns.** I have some of the above, which I wish to repolish. The columns have been painted, and I find this was done because the polish had gone off and would cost 25s. a piece to repolish. Could any of your readers tell me of a cheap way of putting a polish on, and one which would last? They will stand in a hall when done. A CONSTANT READER.

[58644.] **Glycerine.** What is the specific gravity of glycerine, usual quality, and pure? What is the index of refraction of glycerine, usual quality, and pure? What oil, or combination of oils, having an index of refraction of 1·528, would furnish a good medium for an oil immersion objective? [illegible]

[58645.] **Combined Carbon.** Can any of your chemical correspondents tell me the composition of the colouring matter produced by the action of dilute nitric acid upon [illegible]. [illegible]

[58646.] **Platinum Electrodes.**—Perhaps "Sigma" or some other of our able electricians will kindly tell me which is the best mode and material for [illegible] platinum electrodes from each other when placed in a high temperature, or whether there is any cement that is a good non-conductor of electricity, and will also set hard and bear a high temperature and pressure?—MOTOR.

[58647.]—**Cemented Floors.**—A cemented floor, covered with Russian matting, yields a considerable amount of dust. Could I remedy this, and at the same time prevent damp by painting it, or brushing it over with oil, and, if the latter, what kind of oil is most suitable? I propose to cover it with floorcloth; but fear that the floor cloth may rot if placed upon the bare cement.—OCULUS.

[58648.]—**Indiarubber Tubing.**—Every time I use the hose for watering a fernery, I find my hands and clothes covered with white powder from the outside of the tubing. Is there any method of preventing this powder from coming off the hose?—OCULUS.

[58649.]—**Dynamo.**—Would Mr. Bottone, or any of your electrical correspondents, kindly give me advice as to the following? I am desirous of making a dynamo to drive my lathe, and as I may want eventually to place it in a small boat, I should like it to develop ½ H.P., and be so made that by using more battery power I could make it develop 1½ H.P. I should like it to be as light as possible and the battery to be economical, clean, and handy. I am a good mechanic, so need not fear the construction so long as I could know the dimensions, &c.—FILE.

[58650.]—**Intensification.**—A method of removing silver nitrate stains from the skin was recently published in one of the journals. The stained part was to be first brushed over with a solution of potassic ferricyanide, and then with a solution of hypo. It said this was suggested by a new formula for intensifying negatives. I have seen nothing about it in the "E. M." Has any correspondent heard of potassic ferricyanide being used for the above purpose?—GATTON PARK.

[58651.] **Intensification.**—I should be much obliged if any photographic correspondent would give me a formula for an intensifier for pyro.-developed plates. I do not wish to use $HgCl_2$, as it is rather dangerous. Mr. Hepworth, in his little book, recommends one made by adding $FeSO_4$ to the alum bath and a solution of $AgNO_3$; but I do not understand whether this latter has to be added to the alum bath, or simply flowed over the plate. I tried adding it, and obtained a turbid mixture, which I threw away in disgust. GATTON PARK.

[58652.] **To "Sigma."** I have made an accumulator, consisting of one cell; size of lead plates, 10in. by 8in.; number of same, eight; sq. in. of surface, 1280. Will you please say if it will be large enough to light one 10-c.p. lamp? If not, how many of same size will be required? I have plenty of current to charge it. SPARHAM CAMP.

[58653.]—**Relative Heating-power of Gas and Coal.** Can any correspondent give me the number of cubic feet of gas which is the equivalent of one (1) ton of average bituminous coal in heating power? To avoid misapprehension, I do not ask for the amount of gas which various qualities of coal produce. I can find nothing on this point in the textbooks at my disposal, and the information is needed in the prosecution of some exhaustive experiments on the subject.—THURSTON G. HALL, Sarnia, Canada West.

[58654.] **Liquid Silex.** TO MR. GREY.—I can purchase this from the dental depots (for coating models to prevent adhesion of rubber in vulcanising). Can you tell me its chemical composition? I fancy it must be one of the liquid silicates, but do not know which.—DENTIST.

[58655.] **Trigonometry.**—If the reading of a level or clinometer is 0 when the instrument is placed horizontally, what would be the reading when the instrument was directed to a point 100ft. distant and 1ft. below the horizontal line? Is there any formula for obtaining such angles, which does not depend upon trigonometry, which querist does not understand? T. K. W.

[58656.] **To Mr. Wimshurst.**—I am making a 17in. disc influence machine. There are a few points that I do not clearly understand, and an answer to the following questions from Mr. Wimshurst would greatly oblige:—How am I to test the glass discs to know if they are a good non-conductor? How near to the sectors should the collecting points of combs be placed? Does the driving spindle run in the woodwork of frame, or should there be metal bearings? In what way are the glass discs kept their proper distance apart? I am thinking of screwing two thin brass washers to the inside of bosses with a little cement, as an additional support for glasses. Will it do to let the washers run together? If not, what should there be to keep the glasses in place? J. R.

[58657.] **Induction Coil.** Will any correspondent help me in the following? I have made one 4½in. long, between ends. The core is of soft iron wire, ⅝in. dia., and the primary wire is wound on to a paper tube, about 1-16in. thick. The P.W. is composed of two layers of No. 18 s.c. wire, and the S.W. 18 layers No. 36 s.c. wire; no condenser. When the coil is connected to a gallon-size bichromate cell, the contact-breaker works; but I cannot get any spark. Is there too much wire on for secondary?—BOLTON.

[58658.] **Æsop.**

A tortoise once (or Æsop lies)
Ran with a hare and won the prize:
The hare, in the first minute's space,
Four furlongs ran of th' destined race,
While far behind her foe crept on,
And only crawl'd the fourth of one:
Puss, looking back, observes the case,
Disdains her foe, and slakes her pace:
In the next minute she ran o'er
But half the ground she ran before:
And in the third was only reckon'd
One half the space she went the second,
Decreasing still (as artists call)
In ratio geometrical:
Meantime the tortoise still crept on,
At the same rate as he began:
Now deign to show, ye learned fair,
In what time he o'ertook the hare.

RATIO.

[58659.]—**Glucose in Leather.**—Will some chemical correspondent kindly tell me how to detect glucose (grape sugar) in leather?—KARL.

[58660.]—**Edison's Chalk Cylinder.**—In last number, I see Mr. Bottone mentions Edison's chalk cylinder. Will Mr. B. kindly give me dimensions, &c., to make said cylinder?—[illegible]

[58661.]—**Windmill.**—Will some of our readers who have, or may be using, windmills [illegible] upwards kindly give their experience [illegible] particulars as to shape, &c. [illegible] some idea of the power [illegible] with a moderate wind? [illegible] power for generating electricity [illegible] others by coming forward and helping [illegible]—[illegible]

[58662.]—**Brass Founding.**—[illegible] give me a little advice in the following [illegible] been brass-moulding lately [illegible] perfect in cast and cleanliness [illegible] colour. What sort of sand [illegible] use some that I got from a practical [illegible] should I dust the mould with [illegible] moulds. Is this right for small work [illegible] I had some jobs to cast [illegible] steps; but they sank in [illegible] a little new copper and zinc [illegible] reason for this? Also a few [illegible] for bearings, as I have got a few [illegible] dynamos? I am a member [illegible] trade names.—MOULDER.

[58663.]—**Breakage of Loco. Slide Rods.**—Will some of "ours" inform me as to the cause of breakage of loco. slide rods? We have an engine here which seems to be always doing so; and, in conversation with the driver he cannot explain why such is the case. Again he says that he has known this engine, running down the bank with the steam shut off, to commence slipping as though working. Can this be done? If so, what is the cause?—NETTAP.

[58664.]—**Photo. Lenses.**—I am an amateur photographer, and have one lens, a rapid rectilinear, which I use for everything. I want to photograph a hamlet, C.D.V. size, and in order to do so must go back [illegible] yards to get in all the houses. Would a wide-angle lens give a better picture by enabling me to take it much nearer, and so reduce the uninteresting foreground, which the lens I possess gives? Would persons' doors, windows, &c., be more distinct with short-focus lens than with the other?—R. B.

[58665.]—**Stereoscopic Pictures.**—A book I am reading on this subject says: "The principle of ster. pic. depends on the production of two pictures taken of the same object at slightly different points of view." When using the same camera twice, what is the difference, say, in taking a view about 100 yards distant? Is the camera moved a little to one side on top of stand, or is stand and all moved a few inches, feet, or yards?—R. B.

[58666.]—**Incandescent Lighting.**—TO MR. BOTTONE, OR MR. EAVES.—Having castings for Gramme dynamo, I wish to fit them up for incandescent lighting, and shall be glad to receive any information respecting fitting and winding, size and quantity of wire, mode of connections, &c. I have wires No. 16 and 18 d.c.c.; will they do? Also power required and number of 10-candle lamps it will run. Field magnets, usual shape, weight 46lb.; armature, 4¾in. dia., 2in. wide, containing 16 sections, weight 3¼lb.—DYNAMO.

[58667.]—**Electric Light for a Piano.**—Can some correspondent give me a hint how to fit the electric light to a piano? How many batteries shall I want for two incandescent lamps of about two candle-power each to last for about six or eight consecutive hours at a stretch?—G. CANS.

[58668.]—**Lighting Vacuum Tubes.**—Will any brother readers, who have used the Wimshurst machine to light vacuum tubes, kindly favour me by stating how they connected the tubes with the machine, and their opinion of the result? I ask this information to guide me in some experiments I am about to make.—F. TAAFFE.

[58669.]—**Diamagnetism.**—Can any of your obliging correspondents give me particulars of an electro-magnet powerful enough to obtain diamagnetic effects with copper? By stating size, best form, quantity and size of wire, and battery power required, they would greatly oblige—EQUIVOLT.

[58670.]—**Porcelain.**—Information as to the making of above would greatly oblige. What kind of furnace is used, and what temperature and how long must it be maintained? Also, what clay and what kind of glaze is used? Sketch of furnace would greatly assist—EQUIVOLT.

[58671.]—**Calorific Intensities.**—Can anyone give me the calorific intensity of the sulphides, sulphates, chlorides, oxides, nitrates, and silicates of the following metals: aluminium, sodium, zinc, copper, iron, calcium, magnesium, and potassium, or such of them as have been observed? Also, in what have the researches in this direction been published?—EQUIVOLT.

[58672.]—**Chemical Affinity.**—Will Mr. Grey kindly give his promised papers on above subject? It would, doubtless, be an inestimable boon to the majority of the readers of your valuable paper.—EQUIVOLT.

[58673.]—**H.P. of Engine.**—I am much obliged to "Norton" for his kind explanation. He is happy to give further particulars. A friend of mine is making a small engine. How am I to tell when the stroke is [illegible] cylinder [illegible]! It will be driven from the engine boiler. [illegible] press. It is the short stroke which troubles me. How and where did the Admiralty rule for H.P. originate? [illegible] answered: diam. of cylinder by [illegible] speed of piston in feet, divide by 6,000. That does not correspond with the other formula, though the former is more like [illegible] than if done by Admiralty rules.—ADMIRALTY.

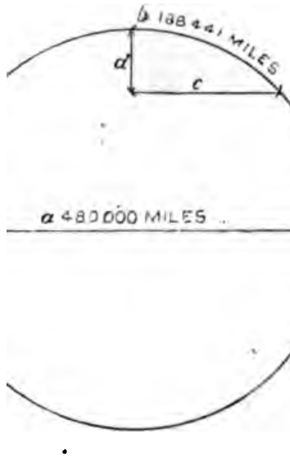
[58674.]—**The "Richardson" Arc Lamp.**—To "C. W. R."—I beg to thank you for the trouble you have taken in obliging me with sketch and particulars of the above arc lamp. You will further oblige if you will answer the following: What current and E.M.F. will these lamps take for 2,000 c.p.? Will they work in series?—[illegible]

[58675.]—**Wimshurst Influence Machine.**—Would Mr. Wimshurst kindly give a little information upon these points? (1) Glass discs, after [illegible] ing, to be dried by heat? what temperature [illegible] applied? (2) [illegible] to be [illegible] of thin brass [illegible] or vulcanised [illegible] what should be [illegible]

?erfect-Tuned Piano.—Thanks to "Clock hers, for answers to question in relation to ıld "Clock Key" further oblige by explaining e on which he has tuned the section of his r to Brinsmead's?—J. K.

Numismatic.—I have recently come across r coin. On one side there is a bust of a man Above the head it says: "G. B. Rodney." On de there are two ships, evidently in action. ıips is inscribed: "Rodney for ever." Does know anything about such a coin? If so, ə by giving its history.—B. C. J. N.

Formula.—Will some kind reader give the nd the following? Let *a* be the diam. of a



,000 miles, and the circular arc *b* 188,441 miles. ıd *d*.—W. H. T.

Kitchen Range.—I have two kitchen t 14ft. apart. The one directly under chimney ut the other one, leading into same chimney by lue, will not draw. Will someone tell me if it run that plagues the cook?—SOMERSETSHIRE.

Defective Stove.—I had erected recently on stove for harness room. Although it has stovepipe, it will not draw at all. First the t., then a low, level run of 20ft., and then a rise l someone tell me where fault is?—SOMER-

Estimating Gold Chloride.—Some $AuCl_3$ of unknown strength has come into my How can I ascertain the number of grains per in a simple way?—HEREWARD.

Lucigen.—Could some reader kindly give regarding the new light called the "lucigen"? burner in section would oblige—BEETLES.

Beam-Engine Query.—I want to make a e, 2in. bore, 3in. stroke, 10in. beam. Will some rs inform me the right sizes and lengths of the The eight parallel rods, piston rod, connect-ank shaft. What distance should there be e cylinder and the bearings? What height bearings be? What length and width of bed-w to mark off the eccentric ½in. stroke? What ports will this engine take? The sizes and ese and how to get them in a simple way will it—YOUNG BEGINNER.

Card Trick.—Will someone explain, by therwise, how the following happens? Take d lay them down in three packs of seven. By particular card, and the packet containing hem all together again, taking care that the k be placed in the middle of the other two, and ıis three times, the card that you chose will be h one down.—ACHILLES.

Strength of Materials.—Will someone w to get the proper thickness of metal (iron or a davit, to lift 10cwt., and to be 6ft. high, and gradually taper on the curved top?—NEMO.

To Mr. Bottone.—I am making an Edco ording to the size given—viz., two cells 12 by 8 ld you tell me what lamps it would light best? nd where to get them? Also how the carbons to sides, as it does not state? Could you let here to procure the porous cells? Also cost, by 3, and how to attach the terminals?—CONDER.

Venous Congestion.—Can any kind reader of any cure for this disorder?—H. B.

Elastic Varnish.—Can any readers of the ECHANIC tell me how this is made, and what ntities of the different compounds, say, for 20 Perhaps Mr. Bennett could answer.—ROTUNDA.

Workman connected with the Building ing a Situation should advertise in "THE BUILD- published every FRIDAY, price Fourpence, at 332, on, W.C.

ILDING NEWS" is the Principal Journal repre- tects and Builders, and has the largest circulation of nal Journal in the kingdom.

kman should insist on seeing "THE BUILDING y week at his Club or Coffee House. He will find of Tenders" for new work in it every week than in iper, and can thus judge where work is likely to be [illegible] invited to make use of "Intercommunica- [illegible] ing about his trade; to write to [illegible] to make, and to advertise in

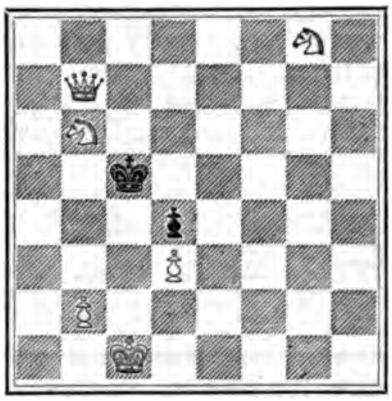
Shilling for s after.

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLXXV.—BY W. COATES.

Black.



White. [6 + 2

White to play and mate in three moves.

SOLUTION TO 972.

White.	*Black.*
1. Kt-K 4	1. Anything
2. Q or Kt mates	

(Four variations.)

SOLUTION TO 973.

White.	*Black.*
1. R takes P	1. P takes R (*a*)
2. Q-B 7	2. Anything
3. Q or Kt mates	
	(*a*) 1. K-K 4 (*b*)
2. Q-K B 4 (ch), &c.	
	(*b*) 1. B takes P (*c*)
2. Q-Q 2 (ch), &c.	
	(*c*) 1. B-Q 4
2. Q-Kt 2 (ch), &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 972, by Avon, F. W. Dunn, V. S. Pochin (an extremely good problem), John S. N. O., J. J. Spence, A. A. E. Lecluse (ingenious and very pretty), James Palmer, and J. Ough; to 973, by James Spillan, Tommy Atkins, and A. Bolus (a magnificent problem; a worthy successor to 966); to 974, by G. W. Middleton and James Ough.

V. S. POCHIN.—You are right as to solution of 971: Kt-Q 4 should be K-Q 4; then follows Kt-Q B 7 (ch). By "best" is meant that Black has no better move than those given.

A. A. LECLUSE.—We think, although the measure dealt seems hard, that you ought to have *proved* the position to be impossible. The mere statement corresponds to giving merely the key move to a problem without the play in the variations. We reciprocate your good wishes.

L. WHALLEY.—Thanks for the problem; it shall be examined, and, if sound, inserted.

A. B.—We agree with you in your criticism of Mr. Fison's problem, 973: "When one says the problem is worthy of him, there is nothing further to be said."

C. TOMLINSON (Rochdale).—Where is the mate if 1. $\frac{\quad}{\text{K-K 4}}$?

J. PALMER.—If 1. $\frac{\quad}{\text{K-K 4}}$ 2. $\frac{\text{Kt-K B 3}}{\text{K takes P}}$ there is no mate.

A. APPELBEE.—You have failed to give Black his best play. Where is the mate if 2. $\frac{\quad}{\text{K-Q 6}}$ or 1. $\frac{\quad}{\text{K-K 5}}$?

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Indexes for Vols. I., VI., VII., VIII., and IX., 2d. each. Post free 2½d. each. Indexes to Vol. XI., and to subsequent vols., 3d. each, or post free, 3½d. Cases for binding, 1s. 6d. each.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 20, and unacknowledged elsewhere:—

DR. SNOWDEN.—M. Glover and Co.—J. Harris.—L. Bros.—G. Williams.—J. Bewley, jun.—Rev. A. E. Gillett.—Rev. T. Calliphronas.—Rev. A. Willan.—R. Hughes.—Rev. H. R. Forster.—Cassell and Co.—Ten Years' Subscriber.—C. B. Davies.—Verbum Sap.—W. R. Brown.—Lammachan.—Ignotus.—One Who has Tried.—Quæsitor.—W. H. Eaves.—R. J. C. S.—W. H. H.—Meliora.—Fred. Carre.—L. H. R.—A Fellow of the Royal Astronomical Society.—W. G. P.—E. M. Nelson.—G. Stening.—Pegandredstuff.—Les Enfants.—J. F. Leighton.—J. W. Bullock.—S. Bottone.—E. H.

ALFRED ROODS. (We have some idea that the engraving from which you inclose a tracing, is copyright. At any rate, it is sold separately by the publishers of the serial from which you derived it; and hence, even apart from other considerations, we should not be justified in using it. Moreover, it would monthly occupy space wholly disproportionate to its value, and would require re-drawing and re-engraving at intervals as the Saturnian system closed up and began to open again on the other side of the rings.)—CHAS. A. PALMER. (See Hints No. 4. If you have applied to our advertisers for silicate of soda and failed to obtain it, you will, no doubt, succeed if you put an advertisement in the "Wanted" column, though we suspect the small quantity is the real difficulty.)—CHRISTIAN LANGE. (We mentioned your invention on p. 422, No. 1060.)—L. E. PRIESTLEY. (The only way we know of keeping coals "glowing red hot" is to have a good draught or a blast. You have simply discovered the defect of slow-combustion stoves, and if you do away with the hot chamber you will no doubt find the coals burn all right. As it is, after a time they are slowly converted into carbonic oxide—a poisonous gas—instead of into carbonic acid. More air is needed.)—H. S. G. (Equal parts lead and tin. See p. 247, No. 947.)—A BEGINNER. (If you had looked at our "Astronomical Notes," on p. 354, you would have guessed Venus.)—W. E. A. (Three parts coke, two parts peroxide of manganese.)—A SUFFERER. (If it has existed for some time, better seek the advice of a surgeon.)—J. W. L. ("Bitters" are prepared from special recipes; but the articles used are selected from calumba, cascarilla, chamomiles, gentian, hops, orange peel, quassia, wormwood, &c. Some of these are steeped in weak spirit, and a little syrup is added, and the tincture strained.)—T. A. (We cannot form any opinion without reading the MS., and "four chapters on elementary physics wherein the luminiferous ether assumes its proper position as a natural force," does not read very promising.)—F. S. (See p. 217, No. 998.)—16 YEARS' READER. (Any newsvendor will procure them for you, or the railway bookstall.)—S. AND C. (The ordinary printer's roller composition is made of glue and treacle. The proportions vary—in summer, 3lb. glue to 8lb. treacle (green); in winter, 2lb. glue to 8lb. treacle. Soak the glue until it has absorbed all the water it will; melt and add the treacle. Glycerine is added by some makers.)—A BEGINNER. (By measuring. See recent numbers and indices.)—B. W. (The information you require has been given many times. There was a reply on the subject only the other week. See the articles on the "Indiarubber and Guttapercha Industries" in Vols. XXXI. and XXXII., and the indices under headings "Ebonite," "Vulcanite," &c. 2. Perhaps you used the wrong kind of naphtha. It should be mineral naphtha, and the rubber should be light-coloured and shred fine. 3. Copal varnish, Prout's glue, rubber solution, or guttapercha cement would do.)—GALLIUS. (We do not express opinions of the kind, and we do not think there is much of a livelihood to be made out of it.)—OPAQUE. (You can do it with curtains of black twill, lined with yellow twill. Boarding off a corner would do very well, and the match lining will be cheap and easily fitted up. The cost varies; but you can easily ascertain by inquiry at a timber-yard in your district.)—J. T. (See many illustrations in recent numbers, and the back volumes. 2. About three strokes of the feeder should fill the reservoir. As large as possible within the other dimensions.)—D. B. S. (See many recent replies for hints.)—LIVERPOOL YOUNGSTER. (Suitable directions will be found in back volumes; but when you ask how to make a "full-sized magic-lantern," it is necessary to know how much information you require.)—J. BLAKE. (Have you tried the coupler experimentally? We suspect not, though we think the idea is new.)—J. G. (The arrangement of doors is bad; they are too much in line. We should try a Boyle's chimney-cap first; then a pipe from the external air delivering just under the grate. By "close range" we understand a kitchener. What are the dimensions of the throat of chimney? Might possibly find a remedy by narrowing that. You should have sent an elevation showing position of chimney-pot as regards roof of house, as it is possible that a long "tall boy" to deliver the smoke as high, at least, as the ridge of the roof, would do.)—JUDY. (It is not likely that you would prevent baldness by that means. See p. 456, No. 1,061; p. 334, No. 951.)—STEEL. (It is the "new" arrangement adopted on the G.N.—the semaphore being pivoted in the centre of its length: illustrated on p. 595, No. 883.)—TREBOR. (You must have an engine or power to wind up such a spring. A windmill would do it in its own time.)—JARVIES. (We do not know; it is a matter for experiment. Probably the joints affected the articulation. Gutta-percha tube is frequently used; but zinc is preferred by some.)—W. MIDLANDS. (The best investments there are in businesses which have a practical monopoly, owing to competition being crushed by the excessive tariff. There is, however, no lack of capital for them; for the others, the best thing to do is to leave them alone. See p. 474, No. 984.)—YOUNG FITTER. (Both matters have been frequently dealt with. See indices.)—T. J. A. ("The Lathe and Its Uses" appeared in Vols. III. to VI.)—POENITET. (You should consult a medical man. By personal examination he may be able to do something for you.)—TONY. (Nothing more than the stomach out of order. We have heard nettle-tea recommended, but simple diet and plenty of exercise will probably answer.)—CONSTANT READER. (Strange, you do not know; or perhaps you have forgotten! If it is an invention, you can patent it at a cost of £4 plus incidental expenses. If a design, you can register it for about the same sum for five years.)—COOKE. (Morocco, sometimes; American leather cloth very often. Obtainable from dealers in skins and bookbinders' materials. See Post Office London Directory.)—H. W. EVERINGHAM. (We do not answer through the post, nor give addresses. See Hints No. 4 and 5. The query has been frequently answered—so recently as p. 126, No. 1,072.)—CIRIL DUNCOMBE. (We shall do what we can; but the lectures, revised by the authors, are published by the Institution.)—HUGO. (We answered the question as soon as possible on p. 394. It is impossible, even if it were advisable, to insert every question that correspondents are kind enough to send.)—G. HUDSON. (Thanks, but we have heard something of the "new" process before. The other matter you will see we have noticed. That was written by someone who understands the subject.)—CHEMICUS. (It is a lithographic ink, used thin.)—J. D. R. (See p. 394, No. 980. There is an electrical method, but it should be practised only by skilled manipulators.)—W. W. W. (Procure one of the handbooks advertised in our columns, and the "Rules" from the Sale Office, Cursitor-street, E.C., price 7d. post-free. If you have anything worth patenting it will be advisable to procure the assistance of a patent agent.)—SHEF. (It is a high-class work, but scarcely *the* standard textbook nowadays.)—JOHN BULL. (It is apparently asthmatical. See indices for suggested remedies; give up smoking and alcoholic beverages; and consult a medical man.)—EYES WET. (Probably a stoppage of the lachrymal duct, which a surgeon can easily remedy; at any rate, let a medical man examine them.)—A SUFFERER. (We can only refer you to the letters you mention.)—WAVERLEY. (See indices, or No. 1,031, p. 373.)—FITTER. (You must procure a proper vulcaniser—such as dentists use. See indices.)—S. MORRIS. (The dried plant is pounded with water into a pulp; it is stimulating and intoxicating.)—YOUNG STUDENT. (Directions for making street coils given many times: see p. 302, No. 923.)—BEACONSFIELD. (As the Metropolitan Building Act does not define what is to be considered a "building," you can hardly expect an answer to your question. Greenhouses and glasshouses have been held to be buildings, so have fowlhouses; but a garden frame, standing out in the clear or against a garden wall would, we imagine, be exempt from the provisions of the Act. The fact that your frames have a bar resting against the house would, we suspect, make the construction a "building.")—EDWARD TAYLOR. (The subject has received attention in our columns. If you will refer to p. 32, in the number for September 11 last, you will discover that your method is neither new nor commercially practicable. Perhaps you can answer the letter on p. 32 ante.)—T. W. E. (For hints about the banjo, see pp. 312, 391, Vol. XXXVIII. 2. Yes, with the help of a good instruction book; but progress is more rapid after instruction from an expert.)—PENDLETONIAN. (You want japan and a stove for baking it. There is no book on such a subject, but much information in recent volumes on japanning and gilding.)—LEARNER. (The use of the condenser in the case given is to make the capacity of the artificial line or rheostat equal to that of the actual line. The condenser is made up of groups of plates, so that the rheostat circuit can be varied to suit the varying strength of the inductive discharge from the line. The matter is fully explained in Culley's book; but is too special for long description in our columns, being of interest only to telegraphists engaged in duplex working.)—INK. (Neither oil nor grease, but glycerine. Add a little by degrees, and you will soon find the quantity which gives the best results.)—EQUIVOLT. (The *Chemical News*, we suppose, will suit.)—T. R. S. (You appear to want something better than already exists. No doubt there are plenty of business men who want the same thing, and finding it, would speedily introduce it as a commercial article. We have described fully all the copying processes, and quite agree with what you say of them; but at present there is nothing better.)—T. HUGHES. (Recipes for all sorts of writing inks in back volumes. 2. Wash the gluten out of it by putting into a fine muslin bag, immersing in water, and squeezing. Rather too troublesome, no doubt; but the difference is that corn-flour has been deprived of its gluten.)—CH. RABACHE. (You had better have nothing to do with the correspondent mentioned. He has disappeared from these columns for some time, and readers in times past who have opened private communication with him have generally, we fear, found the result rather to his advantage than theirs.)—TESTATOR. (If the wife dies before the children, their next of kin would become their guardians if you do not appoint trustees. You had better consult a solicitor, and tell him exactly your circumstances.)—J. BOWEN. (Traders in such photographs are liable to be sued for the value of each copy they sell.)

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Holloway's Pills have marvellous power in giving tone to debilitated and nervous constitutions. They dislodge all obstructions in the bowels and elsewhere, and are, on that account, sought after for promoting regularity of action in young females, and delicate persons who are naturally weak, or have from some cause become so.

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First-class **Lantern Transparencies**, direct photographs, in exchange for Photographic Apparatus, Lenses, Microscopes, Microscopic Accessories and Slides, or other Lantern Slides—Apply, PIGGOTT, Chemist, Huddersfield.

Offers requested in exchange for **Steel Tricycle**, specially designed for the application of mechanical power, cost £35.—W. H., 46, Newborough-street, York.

Wanted, good **Launch Hull**, about 20ft., also half h.p. Silent Otto. Exchange high-class Binnial and accessories.—ECONOMY, Billingsgate Dock Wharf, Greenwich.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Wanted, **Insect Cabinet**. Exchange 13 Vol. ENGLISH MECHANIC, unbound, commencing Vol. XVII., £1, Johnston's "British Zoophytes," 15s. Micro. Cabinet, to hold gross, flat, &c.; difference cash.—C. JAMES, Island House, Painswick, Gloucestershire.

Double Cylinder **Engine**, each 2⅝in. by 5in., metallic piston, mahogany lagged, turned flywheel, all bright. Exchange Engineer's Tools to 150s.—Apply, CYCLE WORKS, Bridge-street, Macclesfield.

"**Kangaroo" Bicycle or Coventry "Rotary"** TRICYCLE wanted. I will give in exchange Front-steering Tricycle and cash.—E. A. NORTON, Alexandra-buildings, Cardiff.

Bicycle, 50in., bright. Exchange for Drilling Machine, steam power, or shafting. What offers?—RODGERS, 152, Bermondsey-street, S.E.

New Jones' or Singer's **Sewing Machines**, with covers, cost £5. Want offers.—STAFFORD, Repairer of all kinds of Sewing Machines, 17A, Bradshaw-street, Shudhill, Manchester.

One of Patrick's 6—8 c.-p. **Dynamos**, equal to new, cost £11. Exchange for Turning Lathe, 4 to 5in. heads, single speed.—65, Reform-street, Dundee.

A very fine **Metal Sextant**, equal to new, cost £8 10s. For Turning Lathe, Lathe Heads, Small Engine for Boat, &c.—65, Reform-street, Dundee.

Wanted, new or second-hand **Microscopical Apparatus**, by good makers, also Scientific Books, in exchange for first-class Micro. Slides.—C. COLLINS, Bristol House, Harlesden, N.W.

52in. **Bicycle**, perfect, ball bearings, and Microscope, standing 9in. high, mahogany case, complete, for Facile Bicycle, or any new make.—H. FITZGERALD, Lismore, Ireland.

Compound **Slide-Rest** for 4in. centre Lathe, perfect order, never used; what offers in exchange?—Apply, OLDHAM, 24, Atlantic-avenue, Belfast.

Galvanised Iron Piping, 7 yards long, 10 inches diameter, good as new, cost 53s.: exchange.—W. SCHOFIELD, Blackley, Manchester.

"**English Mechanic**," 500 numbers, from 586 to 1,066, clean, unbound. What offers?—STUBBIN, Buckshorn Oak, Alton.

Offers for 70lb. of **Stream Tin Ore** (Cassiterite), assays over 60 per cent. tin. Wanted, Minerals for blowpipe analysis.—C. R. BEAUMONT, Tomes House, Rochdale.

Exhange, powerful **Electro Motor**, Chaster's form, as described in E. M.—Offers to J. SMETHURST, 4, Oak-street, Radcliffe, near Manchester.

"**English Mechanic**," 1876 to date, unbound. Will exchange for Photographic Apparatus, or offers.—J. BOWSKILL, 74, Kilton-street, Battersea Park.

Strong **Nursery Guard and Gas Bath**, with copper boiler and gas burner, for a good Watch.—JAGGS, 15, Turner road, Lee, Kent, S.E.

What offers for 32 Numbers of the "**Engineering**," from the 22nd May to Dec. 25, 1885, clean, cost 16s.—P. WALKER, 54, Roe-lane, Southport.

Darker's **Lantern Kaleidoscope**, in case, and Wheel of Life, 3 designs. Offers—H. COLLINS, Canterbury.

Really good Working Model **Horizontal Engine**, 1in. stroke, all brass, for good 6-keyed Piccolo; no rubbish.—H. NICHOLS, Junr., 16, Flannel-street, Rochdale.

What offer or exchange in Books for "**Imperial** GAZETTER OF THE WORLD," cost £5, edited W. G. Blackie, F.R.G.S.—JAMES MEEK, 7, Rosebank-road, Dundee.

Splendid Working Model **Horizontal Engine**, 1in. bore, 2in. stroke, all brass, worth £2. Exchange small lathe, or offers.—T. PEDDER, Lord-street, Millom, Cumberland.

Induction Coil, ½ spark, with commutator, condenser, &c., nearly new; also Electric Bell, new; offers.—Letter, G. B., 18, Hindon-street, Pimlico.

Electric Machine, cylinder, 12 by 9, mahogany stand, conductor, &c., well finished, for a good Microscope, complete.—Y. M., 99, High-street, Gosport.

Wanted, first-class Slide-rest **Lathe**, about 4½in. centre. Will give good Gold Jewellery in exchange.—LOWE, 3, Will street, Hunt's-lane, Birmingham.

Lathe Wheel, 27in., 4 speeds, turned gut, crank and treadle. Breechloader, top lever; ENGLISH MECHANIC posted Sunday. Offers, approval.—W. SMITH, Bilston-road, Wolverhampton.

Splendid **Musical Box**, cost £10; exchange ¾-plate Lever; also fine Front-steerer Tricycle, cost £21; exchange screw-cutting lathe, parallel vice.—F. UNDERWOOD, Beverley.

Bicycle, 56in. Club, elliptical back bone, nickelled, suspension saddle, balls front, cones back wheel, good condition; offers.—R. COLE, 6, Jesus-terrace, Cambridge.

Newtonian **Telescope**, 8½in. metal speculum, 7ft. focal, fully equipped, matchless performance, cost £70; offers.—4, Park-street, Church-street, N.

Newtonian **Metal Mirror**, about 9in. in diameter, 7ft. focal, performance unsurpassed; offers.—X., 9, Balls Pond-road, N.

Wanted, a **Model Press**, No. 3, 4, or 5, instead of an Albion, &c., and cash.—J. R. JAMES, Cardigan.

Incandescent Light **Breast Pin**, with accumulator and batteries, complete, cost 42s. Exchange small Dynamo to value. What offers?—T. A. C., Fairfield House, Warrington.

What offers for "**English Mechanic**," Vols. VIII., IX., X., also, stitched together, April, 1871 to 1875. "History of Central and Southern Africa." "Beeton's Dictionary Universal Information," 3 vols.—W., 7, Southwell-terrace, Hampstead.

Pamphengos Lamp, 200 candle-power: exchange for complete quarter-plate Camera, or good value for 35s.—JAMES MULLIGAN, Middlegate, Penrith.

5in. **Lathe**, half-horse Vertical Engine, Hand Gun 6ft. long, adjustable brace for shoulder or beam. Offers required.—W. T. HORTON, Frith Ville, near Boston.

3in. **Slide Rest** small Bench Drilling Machine, grooved flywheel and drills; both in perfect condition; useful exchange wanted.—SPENCER, below.

Sun Electric Arc Lamp, with stock of marble and carbons; cost £35. Lot of Crooke's Incandescent Lamps. Exchange.—SPENCER, below.

Shuckord **Electric Motor**, armature not wound, commutator fitted, Leclanche agglomerate batteries, lot of zinc rods and mounted carbons. Exchange.—SPENCER, below.

Cuttriss **Electric Motor**, large size, and Batteries, very powerful Ayrton and Perry ditto. Exchange.—SPENCER, 5, Chetwode-road, Upper Tooting, S.W.

Wanted, small **Bench Lathe**, about 2½in. centres and tools, for metal turning. Various good exchanges.—SPENCER, 5, Chetwode-road, Upper Tooting, S.W.

Fan, by Ayaland, to work smith's fires, 22in., in good working order. What offers?—RODGERS, 16, Riley-street, Bermondsey, S.E.

Wanted, **Drilling Machine**, steam power, to drill up to 1in. Will give Bicycle.—RODGERS, 152, Bermondsey-street, S.E.

Stocks and Dies, Ratchet Brace, and Twist Drills to be disposed of. What offers for same?—16, Riley-street, Bermondsey, S.E.

Exceedingly delicate **Galvanometer**, by Apps, silk suspension, silvered dial, on rosewood stand, with levelling screws and reading microscope.—SPENCER, below.

Latimer Clarke's Standard **Element Galvanometer**, with ebonite fittings, under glass shade, and 12 Keys Contact Keys. Together or separate.—SPENCER, below.

Splendid **Magnetic Shunt**, on ebonite stand, under glass shade, beautifully made and very delicate.—SPENCER, 5, Chetwode-road, Upper Tooting, S.W.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

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Lathe Castings, &c.—See T. Taylor's advertisement in ENGLISH MECHANIC every other week. Established [illegible]

Perspective, do you understand? "Knight's Practical Guide," 1s.—SIMPKIN and MARSHALL, or of J. P. KNIGHT, Art Master, Cheltenham.

Mica or Talc.—RICHARD BAKER and CO., 9, Mincing-lane, London.

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English Combination **Cupboard Locks**, dials, ornamental, brass, strong, 3s. [illegible] —BALDWIN, [illegible] chapel, Preston.

Hunter's Safety Clothes [illegible] save time, fuel, labour, space; [illegible] Penrith.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 29, 1886.

AN INTRODUCTION TO SCIENTIFIC KNOWLEDGE.*

AN introduction to scientific knowledge is in reality an introduction to a knowledge of common things—the beginning of an acquaintance with Nature—the commencement of an understanding of the phenomena we see around us, which, perhaps because they are so common, are called "scientific," and in our elementary schools are considered to be subjects outside the ordinary curriculum. The Germans and the French, much wiser than ourselves, make a study of natural phenomena a principal item in the education of the young, and the result is that the pupils of their schools, as a rule, know more of the world in which they live than the average pupil of our elementary and even of our middle-class schools. In its English dress the famous work of M. Paul Bert, which is used in practically all the schools in France, is not perhaps to be commended from a typographical point of view, but it is an admirable textbook, so far as the matter is concerned. Mdme. Paul Bert is a Scotch lady, and in translating the work of her husband has, so we gather from the preface, modified it so as to render it suitable to the requirements of English schools without changing the general plan. The modification might with advantage have been carried still further, by adopting the English style of printing, and by making the teacher still more independent of the questions and imaginary answers of the pupils. Still, taking the book as it is, we can say that it is an admirable educational work, and shows that M. Bert is a born teacher, for few can read these pages without learning something they did not know before, or, knowing the facts, had but a cloudy comprehension of their meaning. The book contains about 350 pages of small octavo, and innumerable illustrations, the latter figured separately in each division, and not remarkable as works of art, though as a rule they serve their purpose. M. Bert starts with natural history, and commences with animals as being more likely to interest his pupils—children—than planets or stones. In a way which must be described as *more suo* he contrives to convey an enormous amount of information in a few pages, and by the charm of his manner attracts and, as the saying is, rivets the attention of his pupil. Thus, after briefly sketching the chief attributes of animals, he says, "Can we crush a fly? Oh yes, very easily, and nothing remains but the external parts—the skin, the legs, and the wings. Could we do the same with a horse? I know very well that we have not in ourselves sufficient strength. But suppose a house were to fall on it, would it thereby be crushed and reduced to a sort of pulp, as was the case of the fly? No, and why? Because the horse has inside its body hard parts, bones that cannot be crushed, whilst the fly has none, not even very tiny ones." The pupil does not forget this lesson: it is brought home to his mind that while the fly and the horse are both animals, the latter is an animal that has bones, and has consequently a skeleton, thus differing from the fly. Further, if a fly be pricked, a colourless liquid comes from the wound; but if a horse is pricked blood, a curious red liquid, flows, and the pupil learns that animals which have [illegible]ve also blood. A step further and the pupil understands that he also is an animal; his interest is aroused, and he begins to appreciate the difference between vertebrate and invertebrate animals, and is prepared to comprehend the distinction between animals with bones and red blood, and those which have bones but are obviously different from others. Thence by easy steps the pupil acquires a knowledge of the characteristics of mammalia, birds, reptiles, amphibians, and fishes, and is taught to remember that although his intellectual faculties separate him by an immeasurable distance from the monkeys, so far as his body is concerned he possesses a great resemblance to those denizens of the woods. We, however, walk upright and stand erect on our two legs; we have strong and yet delicate hands, and our bodies are practically bare except the head and part of the face. Some monkeys—the orang, the chimpanzee, and the gorilla, which have no tails—endeavour at times to stand erect like a man; but, as a rule, they walk with both hands and feet, and are thus distinguished as quadrumana—the feet being more like hands—while man belongs to the bimana, or two-handed, group of animals. M. Bert devotes about a page and a half to the bat; but in that small space contrives to point out why it belongs to the mammalia, and cannot be reckoned amongst the birds, though it has wings, composed of the skin of the back and breast stretched out and sustained by the prolongation of the finger-bones—certainly a very odd kind of wing. The poor little creature is a friend to farmers and gardeners, and deserves to be protected, according to M. Bert, who also has a good word for the mole, which never eats the roots of plants, but swallows countless numbers of destructive larvæ and worms that live in the earth. It will probably surprise not a few readers to learn that the most perfect and complete type of the race of Carnivora—the best organised for the chase—is the cat, with her sharp, cutting claws, never exposed except when required for use, and her long, strong, and pointed teeth with which she holds her prey firmly, while others cut the flesh like scissors. The tiger and the lion are merely "enormous cats," says M. Bert, and with the help of well-drawn illustrations the reader is able to form fairly correct impressions of the various animals, though, as in most other works of the kind, no scale is appended. In a few instances indications of size are given in the letterpress, as, for instance, where the elk is said to be as large as a horse, the bison as large as an ox, the giraffe 18ft. high, &c. Coming to birds, we find such facts mentioned as that nocturnal birds of prey have a soft, downy plumage, which allows their flight to be quite noiseless, while parrots have fleshy tongues, which allow them to articulate words, and toes turned two backwards and two forwards, which enable them to climb with ease. Referring to the usefulness of toads, M. Bert says that they are often cruelly and stupidly destroyed; but advises his readers not to touch them, as the milky-looking liquid which can be made to ooze from the skin is "venom, and most pernicious." This statement requires some modification, for there is no positive evidence that the toads found in this country are venomous, though they come within M. Bert's wide-sweeping statement that "all amphibians have more or less venom in their skin." Fish, insects, worms, molluscs, and radiates have each a chapter or section, and to give an idea of the profuseness with which the work is illustrated it may be mentioned that there are no fewer than 208 engravings in the division appropriated to the animal kingdom. The space devoted to plants is necessarily more limited; but it suffices to give an insight into the principles of botany (vegetable physiology is separately treated), and teaches such facts as that the area occupied by pith in the old trunk is no greater than in the young stem: in no case whatever does the pith grow bigger as the tree grows older and increases the number of wood layers; that while apple, and other trees with which schoolboys are familiar have conical trunks, bark, and hard wood in the centre, palm trees have cylindrical trunks which never grow thicker, and are not woody, though the threads or fibres which correspond to the wood of other kinds of trees are in sufficient number to enable the stems to be used as timber. In this section it may be noted that a drawing of a snapdragon has been given as a sample of the Scrophulariaceæ, and has been labelled "foxglove." Part III. treats of Stones and Soils, in which it is clearly demonstrated that there are two kinds of stones, those that dissolve in acids, giving vent to gas, and those that are not affected by acids. The methods of burning chalk to lime and gypsum to plaster are illustrated, and then we have little sketches of the manner in which marl is spread on fields and salt is obtained from the evaporation of sea-water. "Rocks" forms a section of this part, and a great deal of useful information is conveyed in a few pages, including notes with illustrations of fossils, stone implements, and sketch-maps of England in the primary and in the secondary epoch. Part IV. commences the wide subject of Physics, and then follow Chemistry, Animal and Vegetable Physiology, which complete the seven parts into which the work is divided. M. Bert makes the distinction between physical and chemical experiments—between mixtures and combinations—very clear to the mind of the pupil by such simple experiments as dissolving salt in water and reproducing the crystals by evaporation, and by dissolving iron wire in sulphuric acid and producing an entirely new body. As a rule the experiments which M. Bert chooses can be performed with the simplest materials, and may be safely trusted to even young pupils; but the work is intended for the use of teachers, who, if they grasp the principles, will have little difficulty in devising a large number of "brilliant experiments" to illustrate lectures. A piece of iron, one end of which is red hot, cannot be held with comfort because it is a good conductor, but a short piece of charcoal, one end of which is incandescent, can be held with ease, because it is a non-conductor. A piece of tinfoil placed on a card and held over a lamp melts, because the tin is a good conductor, and absorbs all the heat, whilst the card, being a non-conductor, does not keep enough to take fire. The principles of sound, light, electricity, and magnetism are similarly taught by some telling experiment; but the chapter on weight and gravitation, though excellent in its way, has no feature of novelty; neither, perhaps, has that on chemistry; still we should not care to have them eliminated from the book, which many may consider to contain too much. In these days, however, an educated man should know all the facts detailed by M. Bert, if only to understand why he is the superior of the brute creation around him. "Feeling," says M. Bert, "can really be said to exist only when our intelligence enters into action, in order to make use of the sensitive powers of our skin. Generally it is with the hand we touch or feel things. This five-armed compass, which man alone possesses, is a most marvellous instrument, not only with which to grasp powerfully or handle delicately, but also to give a pretty accurate idea of the body it touches. See, here is an apple. I lay my forearm on it. You will easily believe that were I blindfolded it would cost me a good deal of time and observation to ascertain, by means of feeling with the skin of my forearm alone, that I have to deal with a rather hard, roundish, and polished body; whilst I should find out all those facts in an instant were I to take the apple in my hand, because

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* [illegible] Knowledge. By PAUL BERT, [illegible] Translat[illegible]SEPHINA [illegible] Lond[illegible]hers.

I would bring a great many points of its surface in contact with my skin." It is neither the hand nor the tongue, says our author, that makes man what he is: it is intelligence and his brain. Questions printed in the shape of footnotes are appended to many of the pages, and at the end of each subject there is a "Summary," with lists of subjects for "compositions," which render the work suited to the teacher. We have said enough, we think, to show that it is admirably adapted to the wants of young pupils, and justly merits the title "First Year of Scientific Knowledge."

ASTRONOMICAL NOTES FOR FEBRUARY, 1886.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon. Right Ascension.	Declination South.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	0 13 50·68PM	21 0 19	17 1 54	20 46 27·95
6	0 14 19·52 ,,	21 20 30	15 32 32	21 6 10·72
11	0 14 28·06 ,,	21 40 22	13 56 34	21 25 53·49
16	0 14 17·05 ,,	21 59 53	12 14 54	21 45 36·26
21	0 13 48·00 ,,	22 19 7	10 28 22	22 5 19·02
26	0 13 3·26 ,,	22 38 5	8 37 48	22 25 1·78

The Method of finding the Sidereal Time at Mean Moon at any other Station will be found on p. 353.

Spots, &c., appear on the Sun's disc at somewhat less frequent intervals.

Towards the end of the month the Zodiacal Light may be looked for after sunset, over that part of the horizon beneath which the sun has disappeared.

The Moon

Is New at 3h. 15m. in the early morning of the 4th, and enters her First Quarter at 2h. 46·2m. a.m. on the 12th. She will be Full at 6h. 15m. p.m. on the 18th, and enters her Last Quarter at 5h. 11·3m. in the evening of the 25th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	27·2	10 9·2 a.m.
6	2·4	1 55·3 p.m.
11	7·4	5 42·0 ,,
16	12·4	10 27·8 ,,
21	17·4	2 16·6 a.m.
26	22·4	6 28·9 ,,

The Moon will be in Conjunction with Mercury at 8 p.m. on the 2nd; with Venus at 7 p.m. on the 5th; with Saturn at 9 p.m. on the 14th; with Mars at 6 a.m. on the 20th; and with Jupiter at 2 a.m. on the 21st.

Mercury

Is a Morning Star up to the 18th, subsequently to which he Souths after the Sun, with which, however, he does not come into Superior Conjunction until 4 p.m. on the 24th. He is very badly placed for the observer during the entire month—at the beginning of it from his considerable South Declination, and later on from his proximity to the Sun. His angular diameter varies imperceptibly from 5″ on February 1st to 4·8″ by the 7th, regaining the 0·2″ by the 25th again.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	19 56·4	22 10·9	11 10·1 a.m.
6	20 29·6	20 50·4	11 23·6 ,,
11	21 3·4	18 55·0	11 37·6 ,,
16	21 37·6	16 24·0	11 52·0 ,,
21	22 19·0	12 35·9	0 6·7 p.m.
26	22 46·8	9 36·2	0 21·7 ,,

Hence it will be seen that, starting from a point on the confines of Sagittarius and Capricornus, the planet will traverse the last-named constellation and the major part of Aquarius, without, however, approaching any very conspicuous star. At 4 a.m. on the 19th he will be in conjunction with Venus.

Occultations of (and a near approach to) Fixed Stars, and Occultation of Uranus by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
10	B.A.C. 741	6½	6 6 p.m.	Dark	141	157	7 12 p.m.	Bright	258	286
12	48 Tauri	6	8 40 ,,	Dark	66	93	9 40 ,,	Bright	312	347
12	γ Tauri	4	10 45 ,,	Dark	89	128	11 47 ,,	Bright	282	323
13	71 Tauri	6	1 43 a.m.	Dark	58	95	‡2 25 a.m.	Bright	311	345
14	111 Tauri	5½	1 51 ,,	Dark	124	164	2 34 ,,	Bright	235	273
14	117 Tauri	6	3 10 ,,	Dark	95	130	‡3 59 ,,	Bright	265	297
18	ξ Leonis	6	2 19 ,,	Dark	63	95	3 21 ,,	Bright	259	296
19	48 Leonis	6	3 44 ,,	Bright	54	87	4 43 ,,	Dark	264	301
20	τ Leonis	5	1 5 ,,	Bright	27	23	2 0 ,,	Dark	285	293
20	13 Virginis	6	9 36 p.m.	Bright	109	72	10 23 p.m.	Dark	210	176
21	URANUS	—	5 53 a.m.	Bright	19	51	6 34 a.m.	Dark	299	334
23	κ Virginis	4½	1 3 ,,	Bright	352	325	1 20 ,,	Dark	323	298
25	49 Libræ	5½	†2 13 ,,	S. by W.	343	313				

‡ Stars have set. † A near approach.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
2	*III*	*Ec D*	10	19	23PM	12	II	Ec D	3	43	24AM	21	II	Tr I	2	29	A.M.
3	III	Ec R	1	14	22AM	13	I	Sh I	4	34	,,	21	I	Ec D	3	46	49,,
3	III	Oc D	2	19	,,	13	I	Tr I	5	23	,,	21	II	Sh E	3	55	,,
3	III	Oc R	5	1	,,	13	*I*	*Sh E*	6	51	,,	21	II	Tr E	5	13	,,
3	II	Sh I	6	43	,,	13	III	Tr E	10	3	p.m.	21	*I*	*Oc R*	6	39	,,
5	II	Ec D	1	7	39,,	13	II	Sh I	10	33	,,	21	I	Sh I	12	56	p.m.
5	I	Ec D	5	32	9,,	13	II	Tr I	12	12	,,	22	I	Tr I	1	35	a.m.
5	II	Oc R	5	47	,,	14	II	Sh E	1	22	a.m.	22	I	Sh E	3	13	,,
6	I	Sh I	2	40	,,	14	I	Ec D	1	53	36,,	22	I	Tr E	3	50	,,
6	I	Tr I	3	36	,,	14	II	Tr E	2	56	,,	22	I	Ec D	10	15	8PM
6	I	Sh E	4	57	,,	14	I	Oc R	4	54	,,	22	II	Oc R	11	38	,,
6	I	Tr E	5	51	,,	14	I	Sh I	11	2	p.m.	23	I	Oc R	1	5	a.m.
6	*II*	*Tr I*	9	53	p.m.	14	I	Tr I	11	49	,,	23	IV	Ec D	4	40	46,,
6	II	Sh E	10	49	,,	15	I	Sh E	1	19	a.m.	23	*IV*	*Ec R*	6	40	,,
6	I	Ec D	12	0	28,,	15	I	Tr E	2	4	,,	23	I	Sh E	9	41	p.m.
6	II	Tr E	12	38	,,	15	*II*	*Oc R*	9	19	p.m.	23	I	Tr E	10	16	,,
7	I	Oc R	3	8	a.m.	15	I	Oc R	11	20	,,	27	III	Sh I	11	57	,,
7	*I*	*Tr I*	10	3	p.m.	17	III	Ec D	6	15	25AM	28	III	Tr I	2	10	a.m.
7	I	Sh E	11	25	,,	19	II	Ec D	6	19	20,,	28	III	Sh E	2	59	,,
7	I	Tr E	12	18	,,	20	*I*	*Sh I*	6	28	,,	28	II	Sh I	3	40	,,
8	*I*	*Oc R*	9	34	,,	20	III	Tr I	10	48	p.m.	28	II	Tr I	4	44	,,
10	III	Ec D	2	17	10AM	20	III	Sh E	11	1	,,	28	III	Tr E	4	50	,,
10	III	Ec R	5	11	8,,	21	II	Sh I	1	6	a.m.	28	I	Ec D	5	40	7,,
10	III	Oc D	5	50	,,	21	III	Tr E	1	28	,,	28	*II*	*Sh E*	6	29	,,

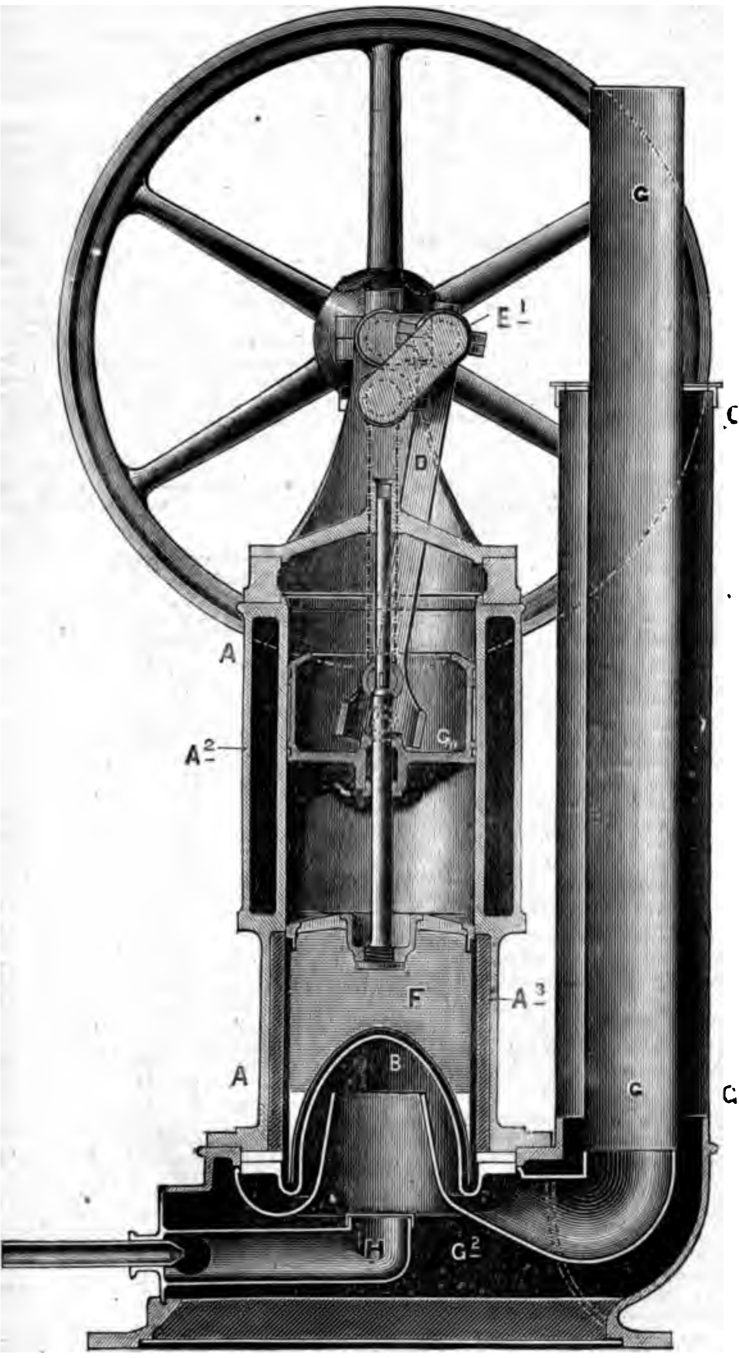
Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight, or from Jupiter's proximity to the horizon.

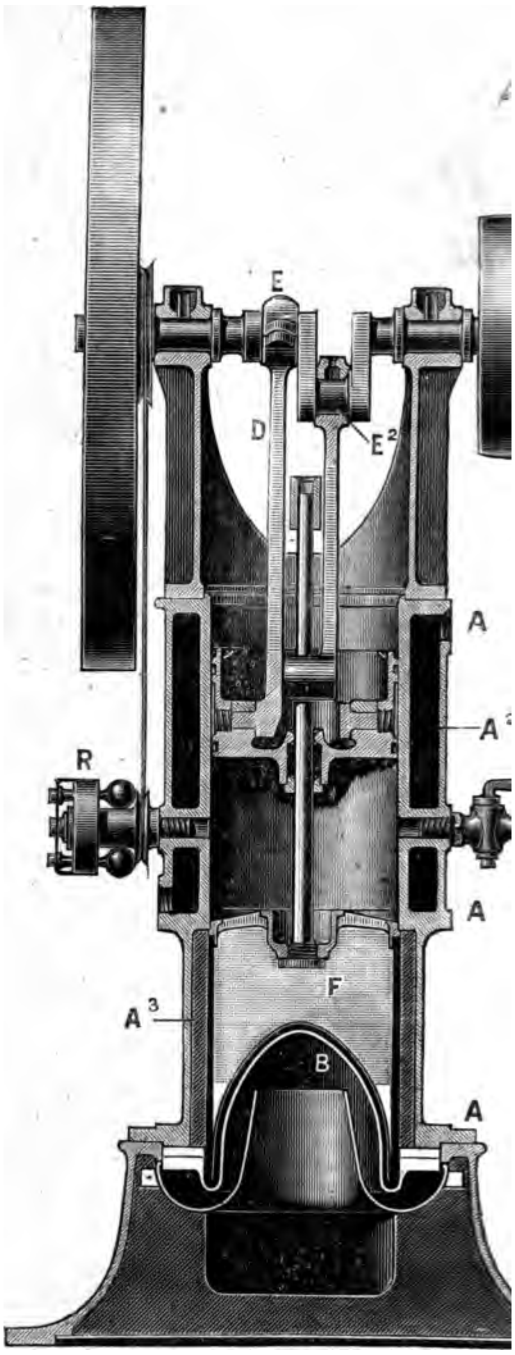
Approximate Times of the Greatest Eastern Elongations of Saturn's Five Inner Satellites.

Day of Month	Name of Satellite.	Hour.	Day of Month	Name of Satellite.	Hour.	Day of Month	Name of Satellite.	Hour.
1	Enceladus	6·4 p.m.	9	Tethys	2·6 a.m.	19	Dione	4·5 a.m.
2	Dione	6·5 ,,	9	Mimas	8·0 p.m.	20	Mimas	4·8 ,,
3	Enceladus	3·2 a.m.	9	Enceladus	11·6 ,,	20	Enceladus	10·7 p.m.
3	Mimas	5·7 ,,	10	Mimas	6·6 ,,	21	Mimas	3·5 a.m.
4	Mimas	4·3 ,,	10	Dione	11·5 ,,	21	Dione	10·2 p.m.
5	Mimas	3·0 ,,	10	Tethys	12·0 ,,	22	Mimas	2·1 a.m.
5	Enceladus	9·0 p.m.	11	Mimas	5·2 ,,	22	Mimas	12·7 p.m.
5	Rhea	9·7 ,,	12	Enceladus	5·4 ,,	23	Rhea	11·2 ,,
6	Mimas	1·6 a.m.	12	Tethys	9·3 ,,	23	Mimas	11·3 ,,
6	Mimas	12·2 p.m.	13	Dione	5·2 ,,	24	Mimas	9·9 ,,
7	Tethys	5·0 a.m.	14	Enceladus	2·3 a.m.	25	Enceladus	1·3 a.m.
7	Enceladus	5·9 ,,	14	Tethys	6·6 p.m.	26	Tethys	3·3 ,,
7	Mimas	10·8 p.m.	14	Rhea	10·5 ,,	27	Tethys	11·6 p.m.
8	Dione	5·9 a.m.	16	Enceladus	8·1 ,,			
8	Mimas	9·3 p.m.	18	Enceladus	4·9 a.m.			

Venus

Is an Evening Star up to the 18th, on w day she Souths 4 minu after Noo 7 o'clock on the evening o in Inferior Conjunction this time she will be some





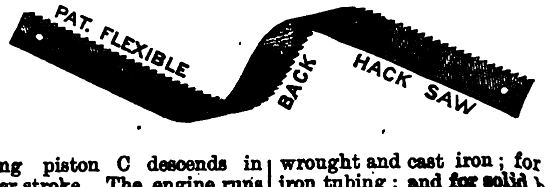
six London, and many provincial, water companies; it has been severely tested, and commends itself to all householders who have had experience of the vagaries of the old-fashioned lever and ball valves.

THE ROBINSON PATENT HOT-AIR ENGINE.

WHEN noticing the Engineering and Metal Trades Exhibition in No. 955 we briefly mentioned a new hot-air engine worked by gas, and as the subject has recently attracted some attention in our columns, we give two sectional views of the latest form of the Robinson engine, as manufactured by Messrs. Robinson, of Albert-street, Manchester. The illustrations show the engine in sections taken at right angles to one another, and the letters represent similar parts in each. A is the cylinder surrounded at one portion of its length by a water-jacket A^2, and fitted at the other portion with a liner A^3 of non-conducting material, to prevent the heat being transmitted too readily to the outer shell, and also to cut off the heater B from the cooled or upper part of the cylinder. G is the chimney shown in proportionate size, and G^1 is an outer casing forming a space communicating with G^2—a sort of "firebox" lined with a non-conductor. H is a Bunsen burner, which can be withdrawn for lighting, and which is supplied with hot air from the casing G^1, and the firebox G^2. The working piston C is connected to the crank-pin E^1 by rod E, and the regenerator F to crank-pin E^2; the crank having a double throw, as will be seen. When the engine is started, the regenerator F is moved from the hot part of the cylinder, and the air passes through it and over the heater B, which at once increases its temperature, and causes it to expand, thus driving the working piston C upwards. By the motion of the crank the regenerator F is driven downwards, and the air in passing through gives up some of its heat to the regenerator, and then becomes cooled in the upper part of the cylinder, producing a partial vacuum, into which the working piston C descends in readiness for another stroke. The engine runs steadily, with little noise, and is controlled by the governor R. A one-man engine, running normally at 270 revolutions, costs about a half-penny per hour for gas; while a two-man engine burning coke or coal will cost penny a day, according to the price fuel in the locality.

FLEXIBLE-BACK HACK S

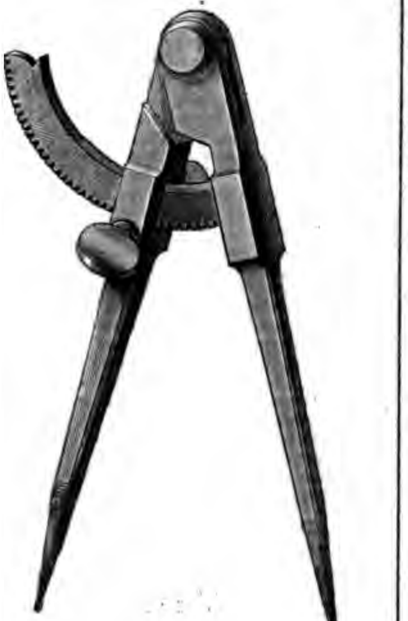
AN improved method of tempe saws, patented by H. G. Tho Sons, of New Haven, Conn., has ena to produce an article which will be by all mechanics—viz., a hack saw cutting through iron or steel, and bent, as shown in the illustration breaking. Messrs. Churchill and Co. street, Finsbury, are introducing th which are made in three grades—i.e., wrought and cast iron; for brass, or iron tubing; and for solid brass cast chief points in a good hack perfection in these teeth are of the sible to break the


PAT. FLEXIBLE BACK HACK SAW

ɔack of the blade is, in fact, quite soft, ɔe saw can be bent double and straightened ɡain in the fingers without injury. The ː are 8in. long, but they can be easily to smaller frames, as, the metal being ɩnother hole is easily drilled.

IPROVED WING COMPASSES.

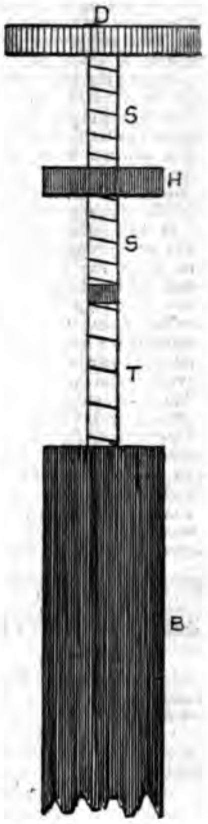
IANDSOMELY got up catalogue of tools and appliances, together with cabinet- oundry and hardware, has just been issued Melhuish and Sons, of Fetter-lane, E.C., ill be found useful by both professionals nateurs. The modern styles of saws are



lustrated, and are accompanied by patent ts; iron-planes, and several of the in- s American devices will attract atten- s will also the new chisel and plane-iron r, for holding the tool at the right angle grindstone. The amateur carver and t-cutter will find that their wants have ɔoked after, and so will the turner and ıeral engineer. As a specimen of a useful ıich Melhuish and Sons are introducing, we ıte a cheap wing compass made strongly l, with, as will be seen, a rack and pinion fting the leg, besides the usual set screw. ers and joiners are not the only workers ill appreciate this improvement, which s the distance apart of the legs to be d at once with the greatest nicety, and t the annoyance experienced when rather inted compasses move half an inch instead sixty-fourth or so which was required. talogue occupies nearly 280 pages, and of illustrations of articles of utility and ty, such as mechanics of the first quarter century never dreamt of.

REV. JAMES CAMPBELL'S FINE ADJUSTMENT.*

VE much pleasure, on behalf of my friend, Rev. James Campbell, in bringing before invention of his, which, I feel sure, will o be a permanent benefit to microscopy. ention relates to that most important part instrument—viz., the fine adjustment. describing it, permit me for just a moment t your attention to those already in use. If asked to classify microscopes, I should do eir fine adjustments. The first division of pes into two classes would obviously be, th fine adjustments, and those without. thout fine adjustments are, I regret to w in number that we may pass on, merely what I have often said before, that a roscope, with a well-made coarse adjust- a better instrument than most of those e both coarse and fine adjustments, and [illegible] double the money. Microscopes with fine adjustments may be again divided into two classes: those which have movable nose pieces and those which have not. Of those which have movable nose pieces, those of the bar-movement type were, until quite recently, the only efficient ones. The action of the screw was slowed down by means of a lever contained in the arm. Especially in Messrs. Powell and Lealand's form great steadiness is obtained by the means employed in the fitting of the movable nosepiece in the body. The other model, which has received such a large amount of unmerited praise, greatly injuring the cause of microscopy, is the Jackson Lister. I never saw one of these models, with the abominable side-lever fine adjustment, that was capable of properly focussing a $\frac{1}{4}$in. o.g. of 90°. This microscope had an innings for about 30 years, owing to the undeserved laudations it received at the hands of several persons, whose microscopical experiences were limited to lenses not higher than 1in. in power. About the year 1876 we see the Jackson arm cut for the purpose of getting rid of the defect spoken of; but this introduced a greater evil than that sought to be cured. It was Swift who first put a practical fine adjustment to the Jackson Lister microscope, and it was my privilege to exhibit to the club one of the first made. But what we are more immediately interested in at this present time is the other class of microscopes—viz., those which have no movable nosepieces. This forms, as you know, by far the largest class of microscopes, for it includes those of Hartnach, Leitz, Reichert, Siebert, Zeiss, &c., on the Continent; and those called students', college, &c., over here. It is to this class that Mr. Campbell's fine adjustment is particularly suitable. In a word, it has done for this class what Swift has done for the Jackson Lister. The difficulty with this class has been that if you have a direct-acting screw with its thread fine enough to give you a sufficiently slow movement; then the screw will be found too weak to stand the wear and tear. On the other hand, if it is strong enough to stand the wear and tear, the screw will have to be too quick. Speaking for myself, I have never seen a microscope with a direct-acting screw fine adjustment slow enough in its action to work a lens of N.A. 1·25 in what I should term an efficient manner. The Rev. James Campbell has overcome these difficulties by an invention which is, at the same time, very ingenious and extremely simple. So simple is it that it will not interfere with existing arrangements; it ought not to entail any additional expense when put into a new microscope, and it ought to cost a mere trifle to adapt it to an old one. Mr. Campbell's fine adjustment consists in cutting two different threads on the direct-acting screw. Let D represent the direct-acting screw, with the upper part S having 32 threads to the inch cut on it, the lower part T having 30 threads to the inch. Then, if B represents the upright pillar of the microscope, it is evident, if the screw is turned 30 revolutions from left to right, it will advance 1in. into the pillar. But the cap H, which is fastened to the body of the microscope, is raised as the screw is turned. It would require 32 revolutions, however, to raise it 1in.; but as the screw has only been turned 30 revolutions, the body has only been raised $\frac{30}{32}$in. The combined effect, therefore, of giving the fine adjustment screw 30 revolutions, is to lower the body $\frac{1}{16}$in., or $\frac{1}{480}$in. for each revolution, which is quite slow enough for any purpose. Between H and B there is placed the usual spiral spring. If 31 threads instead of 32 were given to the upper screw, the speed would be halved, or one revolution of the screw would be equal to $\frac{1}{960}$in. A very convenient form for student's microscopes would be 20 and 25 threads, which would give $\frac{1}{100}$in. of movement for each revolution of the screw. You will see, therefore, that any desired speed can be obtained, and that too with strong screws having coarse threads. I am sure you will all admire the simplicity of design, especially the small alterations required to adapt it to existing models, and accord a hearty vote of thanks to its ingenious inventor.



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* Mi[illegible] n. 22,

THIEBAUT'S NEW GELATINO-BROMIDE PROCESS.*

WE have to bring before your notice this evening a new gelatino-bromide process brought out by M. Thiébaut, of Paris. The chief difference between this emulsion and others in the market lies in the fact that it is spread on cardboard; the cardboard is first enamelled, which enables emulsion to be spread over it evenly, and to adhere thereto with sufficient tenacity to enable it to bear the ordinary processes of exposure, development, fixing, and washing with impunity. After these processes have been gone through, the emulsion remaining on the cardboard can be detached therefrom, and the photograph is then left on a clean, perfectly transparent, and tough sheet of gelatine, from which prints can be taken from either side. Thus the weight of glass, the chance of breaking, and imperfections arising from a process in which a paper base has to be made transparent are avoided. M. Thiébaut's Pellicular cards, with which we experimented, were kindly handed to us for this purpose by Messrs. Watson and Sons, of 313, High Holborn, from whom they can be procured. We find them very light to work as compared with glass; that they are rapid in action (as rapid as ordinary commercial plates), and that for transparency and sharpness the pictures which we produced were all that could be desired. The Pellicular cards being stiff can be placed in the ordinary dark backs, no new apparatus being required for them, it only being necessary to avoid too strong pressure by the springs. M. Thiébaut claims for them the advantage that 100 cards weigh the same, and are about the same volume, as one dozen glass plates, whilst a negative, when once detached from the card, weighs almost nothing (a $6\frac{1}{2}$ by $4\frac{3}{4}$ neg. film weighs when detached 20 grains). We hand round for inspection a piece of enamelled cardboard ready for the emulsion, also some transparencies and negatives that have been detached. The process we adopted was as follows:—After exposure we placed the card in an ordinary pyrogallic developer made up with sulphite of soda (four grains of sulphite to one of pyro), neutralised with citric acid, the ammonia solution being made up of 1oz. of ammonia to 2oz. of water, with 75grs. of bromide added, or practically one-sixth proportion of bromide to ammonia. The development proceeds slowly but with great regularity, and the shadows remain remarkably clean; it is necessary to exercise patience in development if density is required, and to bear in mind the fact that the picture by reflected light looks very much denser than it turns out to be when detached; judgment in this respect is not difficult, but a few trials will be necessary to insure success. It must be remembered that the opacity of the card support absolutely prevents any examination of the film by transmitted light. After development and well rinsing in water, we placed the card, with the film thereon, in a saturated solution of alum, made by dissolving ordinary powdered alum in boiling water, and then allowing the solution to cool. After leaving the card with the emulsion still on in the alum bath for 10 or 15 minutes, we thoroughly rinsed the card again and washed in two or three changes of water, and we then placed the negative in the fixing solution, face downwards, as the cardboard has a tendency to float and to curl up diagonally, leaving the two opposite corners uncovered by the solution. We used the ordinary hypo solution, with a little chloride of gold added (1 gr.); the fixing proceeded very slowly, and it was not safe to remove the card from the fixing solution for half an hour. On removal from the hypo we stripped the film from its card support. This was easily done by passing a knife under one corner of the film, when with care it was easily detached by steadily pulling it. Even in this wet state, as first detached from the card support, the film is very tough, and can be handled without fear of tearing. After detachment the film immediately enlarges by about one-fourth in length and breadth. After thus detaching, we placed the film immediately in water, to get rid of the hypo; this we found washed out more rapidly than in the case of a plate, as the water was able to get at both sides of the film at once. After washing, the film was placed in methylated spirit for about 15 minutes. During this process the film contracts, and is reduced to about its original size. On taking the film out of the spirit, we carefully placed it on a sheet of ebonite, taking up what moisture we could with a sheet of clean blotting paper, passing the hand over this with a gentle pressure, so as to leave the film on the ebonite quite flat and free from air bubbles. The film was then left to dry spontaneously, and when dry was stripped off the ebonite in the same way as it had been before stripped off the cardboard support, the result being that the negatives and transparencies were left in the perfectly flat condition in which we place them before you to-night.

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* A paper by F. INCE and G. L. ADDENBROKE, read before the Photographic Society of Great Britain.

We adopted the procedure above described, in the absence of any instructions from the inventor. These we have since obtained, and we give you them in the inventor's own words, as follows:—

Development.

This is done either by oxalate or pyrogallic acid, in accordance with the known processes repeated hereafter. Pour the developing liquid, which must be prepared in a graduated glass measure beforehand, over the card. The white or bright parts of the negative enable the operator to watch the progress of the development, which must be allowed to go on long enough, because of the great transparency of the film. After having poured back the developing liquid, without removing the negative, rinse it twice in water, which should be changed each time.

PYROGALLIC ACID DEVELOPER.

SOLUTION A.	Parts.
Water	1,000
Carbonate of potash	45
Sulphite of soda	12

SOLUTION B.	
Water	1,000
Pyrogallic acid	12
Sulphite of soda	12
Citric acid	2

Mix an equal quantity Solution A with Solution B, and place the card in the mixture as soon as it is made.

FERROUS OXALATE DEVELOPER.

SOLUTION A.	Parts.
Warm water	1,000
Neutral oxalade of potash	300
Bromide of potassium	3

(To be filtered.)

SOLUTION B.	
Warm water	500
Ordinary ferrous sulphate	200

After solution add 3cc. of sulphuric acid in order to prevent oxidation.

Mix 80cc. of Solution A with 20cc. Solution B.

This developer may be used for developing successively two or three negatives.

Fixing.

Place the card in the fixing bath, taking care that the image be turned downwards. It requires about half an hour in order that the operation be well done. Several negatives can be fixed in the same bath provided there be liquid enough. After this, two hours of washing are sufficient, during which the water should be changed three or four times. The following formula should be strictly observed:—Warm water, hyposulphite of soda, ordinary pulverised alum; let this solution settle for several hours, and then filter it.

Drying.

This operation is very simple. After having cleaned the surface of the film with a piece of wet cotton, dry it several times between sheets of blotting paper, and then fix it firmly on a board by means of four or six pins, the image being turned towards a sheet of blotting paper. It is only after being completely dry (*this is very important*) that the gelatino film can be detached from the card by raising it at one corner, and round the edges, previously being careful to remove the holes made by the pins. It will be observed that in our experiments with M. Thiébaut's cards we differed materially from the process he describes in four particulars. (1) We placed the cards in an alum bath before fixing, and did not mix alum with our hypo bath. (2) We detached the film from the card immediately after fixing. (3) After washing we introduced the spirit bath, which is not suggested by M. Thiébaut. (4) We dried the film by itself on an ebonite plate instead of on a board with blotting paper, and with the cardboard backing still attached. In our opinion distinct advantages were obtained by the course we adopted. In the first place we consider it a distinct advantage to avoid mixing alum with the hypo bath, and to use an independent bath for the alum, as by this course and by washing the film after it leaves the alum bath, and before it goes into the fixing, the chance of liberating free sulphur is lessened. In the second place, there is a distinct gain by detaching the film immediately after fixing, as it is difficult to get the hypo out of the cardboard, and to make the film safe; if the film and the cardboard are washed together, the hypo must be extracted from both, whereas if the film is washed by itself in a detached state, the water acting on both sides of the film takes out the soda more quickly and thoroughly, and the cardboard having been got rid of all risks attaching thereto are disposed of. No doubt M. Thiébaut's object in retaining the gelatine on the card until all operations have been finished, and the negative dried, is to avoid the enlargement of the film, which takes place when the film is detached in a wet state; but, inasmuch as by placing the detached film in spirit the gelatine is reduced to its original size, and the spontaneous drying is greatly accelerated, we are inclined to think our system of manipulation better than that suggested by the inventor. Our fourth departure from M. Thiébaut's instructions—viz., drying the film after it comes out of the spirit bath on a plate of ebonite—is a distinct gain, as both rapidity in drying and an improved beauty in the surface are obtained. We have now told you all we know about the "new cardboard stripping emulsion" process; it has only just been brought before our notice, and we have had great difficulty in giving it a fair trial, for December, in this climate, is not a month favourable to the experimental photographer, and our experiments with the cards have had to be chiefly conducted by artificial light; we have not, however, spoilt a single sheet that we have tried, and although we know that we could have obtained much better results if we had had summer weather, we feel sure that these cards will turn out a great boon to the traveller, and when enamelled paper in continuous bands is substituted for the cardboard, the Eastman and allied processes will be run close if not surpassed, for the transparency of the pure gelatine is so great that one hardly imagines it can be beaten. In conclusion, we advise our friends to try some of M. Thiébaut's cards, and we shall hope to hear from them, on some future occasion, that they have been as pleased with them as we have been.

USEFUL AND SCIENTIFIC NOTES.

Pure Terebene.—Pure terebene, prepared by the action of sulphuric acid on turpentine, is a clear, colourless fluid, having the odour of freshly sawn pine-wood. It has recently been introduced as a remedy for chronic bronchitis and winter cough, and is said to be most efficacious in the treatment of the flatulence of dyspeptics. It is usually given in ten-drop doses on sugar every three hours, but as it has no poisonous action the dose need not be very accurately measured. It is agreeable to take, and is preferable in every way to the turpine-hydrate recommended by M. Germain Sée and other observers as a remedy for certain forms of consumption. It is not be confounded with the terebene employed in surgical practice and in the preparation of soaps. There is reason to believe that it will prove valuable not only in chest diseases but in many affections of the throat and vocal organs.

LIZARDS are very nearly the shape of crocodiles, and are covered with a skin which has a semblance of scales, not like the scales of a fish. A specimen of the house lizard was shown. This lizard is found in Asia, Africa, South America, and in other countries, but not in the United States. It is useful in destroying vermin, and can easily climb walls. It lays its eggs under rafters, in the thatches and under leaves. It is a mistake to think of scorpions as very poisonous; they are a little venomous. Bird spiders are somewhat venomous. Large toads which have been called poisonous have no venom. Among all the lizards there is only one, a Mexican, which is venomous, and there is some doubt of him. Most of these animals, when irritated, excrete a venomous saliva, and even frogs will attempt to bite when troubled. Toads can tell the weather better than the weather bureau. When it is dry they go down into the ground for moisture; in damp weather they come out of the ground. Lizards stow themselves away when the sun goes under a cloud, and at such a time turtles will hide.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE annual general meeting of this society was held on Wednesday evening, the 20th instant, at the Institution of Civil Engineers, Mr. R. H. Scott, F.R.S., president, in the chair.

The Secretary read the report of the Council, which stated that the past year had been one of great activity, as the eight committees which had been appointed had met frequently, and had done much for the advancement of meteorology. The number of Fellows on the roll of the society is 537.

The President (Mr. R. H. Scott) in his address, said: "That as he had treated of Land Climatology in his previous address, he proposed to deal with Marine Climatology on the present occasion, and to take up the subject at the point where he had left it in his paper, "Remarks on the Present Condition of Maritime Meteorology," printed in the Society's *Quarterly Journal* for 1876. He enumerated the various investigations which had been announced to be in progress at that date, and specified the several outcomes of these inquiries which had seen the light during the ten years. The "Meteorological Charts for the Ocean District Adjacent to the Cape of Good Hope," published by the Meteorological Office in 1882, was first noticed, and the methods of "weighting" observations of wind, &c., employed in that discussion were fully explained, as well as the mode of representation of barometrical results. The "Charts Showing the Surface Temperature of the Atlantic, Indian, and Pacific Oceans," published in 1884, and those of barometrical pressure, now in the engraver's hands, were next noticed, and it was announced that the Meteorological Council had decided to undertake the issue of monthly current charts for the entire sea surface. The wind charts published by the late Lieut. Brault, of the French Navy, were next described, with an expression of the profound regret with which the intelligence of his premature death in August last had been received by all meteorologists. The wind charts and pressure tables issued by the Meteorological Institute of the Netherlands were then explained, and also the publications of the Deutsche Seewarte at Hamburg, "The Atlas of the Atlantic Ocean," &c., &c. The series of "Monthly Charts for the Atlantic and Pacific Oceans," issued by the Hydrographic Office, Washington, were then described, and the present series of "Pilot Charts," issued by the same office, were explained.

As for projected work in 1886, Mr. Scott stated that the daily maps of Atlantic weather for the year of the circumpolar expeditions were now complete and were being engraved, a process which must take several months. The German Office had undertaken the preparation of daily weather maps for the same period for the South Atlantic. The Meteorological Office had also taken up the Marine Meteorology of the Red Sea. The Dutch Institute had announced its intention to publish an atlas for the Indian Ocean.

In conclusion, Mr. Scott stated that there still existed a lamentable want of data for the Pacific Ocean; but that, thanks to the energy of the Canadian Government in opening up their new Pacific Railroad, it was to be hoped that every year would bring a greater amount of traffic to British ports on the Pacific Coast, and thereby a greater number of observations to the Meteorological Office, while from the existing trade to San Francisco a mass of materials was quickly accumulating for certain routes at least over the vast area of the Pacific.

Paraldehyde.—Dr. Dujardin-Beaumetz, in a recent article on the "New Hypnotics," speaks highly of paraldehyde as a therapeutic agent. He usually prescribes three drachms in 6oz. of water, and orders a teaspoonful to be taken in rum, whisky, or kirsh at bedtime. The drug has a peculiar and characteristic odour, resembling the smell of a tippler's breath, and it is only by mixing with spirit in some form that this can be effectually disguised. Yvon accomplishes the same object by administering it in conjunction with camphor-water, tincture of vanilla, and syrup of virgian prune. As an enema it is greatly superior to chloral, frequently affording a good night's rest after the failure of many other remedies. It does not readily lose its remedial power, and its administration may be continued for a very long time without producing any inconvenience. Dujardin-Beaumetz thinks that it is especially indicated in strychnia-poisoning, and speaks [illegible] in the treatment of eclampsia.

THE Oregon Legislature has passed [illegible] effect that tricyclists and bicyclists [illegible] riding whenever they approach within [illegible] a team, and after dismounting [illegible] until the team has

SCIENTIFIC NEWS.

A SERIES of observations of Brooks's comet, by M. Bigourdan, at the Paris Observatory, enables him to describe it as resembling in appearance a faint nebulosity about 2·5′ in diameter, with a small nucleus, faint and rather excentrically situated in the nebulosity. According to M. Bigourdan, the perihelion passage occurred on Nov. 25th, thus agreeing nearly with the calculations of Dr. Oppenheim and Dr. Palisa, which we gave last week. The comet is in Pegasus; but is not likely to be visible much longer. This comet was independently discovered by Mr. Barnard, of Vanderbilt University, Nashville, Tennessee, the night after its discovery by Mr. Brooks.

The small planet, No. 251, discovered by Dr. Palisa, of Vienna, on Oct. 4th last, has been named Sophia.

The death is announced of Mr. Joseph Leece, managing director of Sir Joseph Whitworth and Co. Thirty-seven years ago Mr. Leece entered, as a boy, the then comparatively small works carried on in the centre of Manchester by Mr. Joseph Whitworth, and he has ever since been closely associated with the development of the works, rising from one position to another until he controlled one of the largest concerns of the kind in the kingdom—the present works at Openshaw, in the outskirts of Manchester, covering upwards of thirty-five acres, and employing some 2,000 hands. For many years Mr. Leece was prominently identified with the improvements worked out by Sir Joseph Whitworth in the construction of small arms, and during the earlier years of the Wimbledon meetings he was a regular attendant. In 1874, on the conversion of Sir Joseph Whitworth's business into a limited company, Mr. Leece was appointed to the post of managing director, and this position he continued to hold until his death. For the last two or three years, however, Mr. Leece has been failing in health, and early in November last, under medical advice, he sailed for Australia, but only lived to complete the passage; his death, at the comparatively early age of fifty-two, taking place soon after his arrival in Melbourne.

The death is also announced of Mr. J. B. Jeaffreson, M.R.C.S., who was well known in the north of London as a diligent worker with the microscope in biological science, and for some time as president of the Highbury Microscopical Society.

The Friday evening discourse at the Royal Institution on Feb. 19 will be delivered by Prof. W. H. Flower, who will lecture on the "Wings of Birds," instead of Prof. W. K. Parker, on "Birds: their Structure, Classification, and Origin."

According to Prof. Ray Lankester the colour of green oysters (those of Marennes, on the Bay of Biscay) is due to the presence of Navicula in the intestine. The bluish pigment in the Navicula is named marennin, and in early spring is of a decidedly green hue.

At the annual general meeting of the Association for the improvement of Geometrical Teaching, various reports were adopted, and certain additions to the rules, which had been proposed, were carried. The Council for the year 1886 were chosen (Mr. R. B. Hayward, F.R.S., again undertaking the duties of president), as also were the several committees. Twenty new members were elected, including as honorary members Profs. Sylvester, Chrystal, and Newcomb of Johns Hopkins University. At the afternoon sitting (Mr. R. Levett, of Birmingham, V.P., in the chair) the President read a paper on the "Correlation of the Different Branches of Elementary Mathematics." A discussion followed, in which the Revs. G. Richardson (Winchester) and J. B. Lock (late of Eton); Profs. Carey Foster, Hud- m, and Minchin; the Chairman; and Messrs. J. Ellis, Walters (Dover College), and Heppel k part.

A paper by Mr. S. P. Langley, Director of Allegheny Observatory, read at the Ann eting of the American Association ment of Science, has been issued is entitled "Observations and the Recognition of hitherto Unmeasured Wave-lengths." These observations are of much importance, and were rendered possible by the use of sundry rock-salt prisms prepared by Mr. Brashear. It was found that the whole heat spectrum from most of the sources passed through the prism at angles which the theories of our textbooks have heretofore pronounced impossible. The heat radiated from the soil is found to be of an almost totally different quality from that which is received from the sun.

The Lumleian Lectures at the Royal College of Physicians will be delivered by Dr. W. H. Stone on April 8, 13, and 15, the subject being the "Electrical Conditions of the Human Body."

At the forthcoming Indian and Colonial Exhibition, at South Kensington, it is proposed, besides the fish-hatching experiments, to exhibit the development of the turtle from the egg, the movements of the infant turtles being highly interesting to naturalists. For this purpose a large conservatory is being specially erected, in order to imitate as nearly as possible the natural conditions of the turtle's life. On the Lochbuy estate, Isle of Mull, pisciculture, which is there confined to salmon and sea-trout, has been carried on with notable success, and the waters, which at one time were almost destitute of fish, are now agitated by innumerable fins, which will ultimately find their way to the hands of the cook.

Dr. C. V. Riley, the entomologist to the Agricultural Department, Washington, has just presented his collection of insects to the United States National Museum: it is stated to contain 115,000 specimens of 20,000 different kinds or varieties of insects. The value of the collection has been set down at £5,000, and Dr. Riley has refused several offers from European museums.

Mr. A. Glendinning, the proprietor of the "Apple Tree," a vegetarian restaurant in London-wall, sends us his annual, which contains a "Miscellany of Vegetarian Varieties." The preliminary "notes" will not, perhaps, stand cross-examination; but there are a number of hints and recipes which will be useful to many. The price is, we believe—one penny.

Mr. D. Morris, director of the public gardens, Jamaica, has accepted the post of assistant-director in Kew Gardens.

The endeavours to cultivate the tea-plant in the district around Messina have, we understand, been very successful; but it remains to be seen whether the produce can compete with the growths of China and India in the open market.

The Academy of Sciences, Paris, has awarded the Delesse prize to M. de Lapparent, in recognition of the value of his geological works. This is the first occasion on which the prize has been given, and its award was partly determined by the fact that De Lapparent had for many years been a fellow-worker with Delesse in the preparation of an Annual Review of the progress of Geology.

The thirty-ninth annual general meeting of the Institution of Mechanical Engineers will be held on Feb. 4 and 5, at 25, Great George-street, Westminster. The following papers will be read and discussed: "Description of an Autographic Test-Recording Apparatus," by Mr. J. Hartley Wicksteed, of Leeds; "Description of Tensile Tests of Iron and Steel Bars," by the late Mr. Peter D. Bennett, of Tipton; "Description of a Hydraulic Buffer-Stop for Railways," by Mr. Alfred A. Langley, of Derby; and "On the Distribution of the Wheel Load in Cycles," by Mr. J. Alfred Griffiths, of Coventry.

A committee of the Birmingham Town Council proposes to erect twenty public clocks in conspicuous places—at the intersection of streets by preference—and these clocks are to be controlled by electricity, and are to be illuminated at night. The estimated cost is £2,500 for the establishment of the clocks, and £200 a year for their maintenance.

Penny Science Lectures at the Royal Victoria Hall and Coffee Tavern will be given on Tuesday evenings, as follows:—Feb. 2, Mr. W. P. Bloxam, "Fire, Fuel, and Illumination"; Feb. 9, Mr. J. M. Thomson, "Dirty Water, and How to Cleanse It"; Feb. 16, Prof. G. Forbes, "Shooting Stars and Comets"; Feb. 23, Mr. W. Lant Carpenter (subject not announced); March 9, Dr. J. A. Fleming, "Niagara."

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE THEORY OF JUPITER'S SATELLITES—SHOOTING STARS—ANEROID BAROMETER—THE "ANNUAIRE" OF THE ROYAL OBSERVATORY AT BRUSSELS—TAKING IT EASY—DR. HUGGINS ON THE SOLAR CORONA—AN APPEAL TO MR. DOWNING—"DE HAUT EN BAS'S" IDEA OF HIS CLAIM TO SIT UPON THE COUNCIL OF THE R.A.S.—BOOK AS A COMPANION TO A 3½in. TELESCOPE—FOCUS OF A CONCAVE LENS—ANGLE OF DEPRESSION—THE "JOURNAL" OF THE ROYAL MICROSCOPICAL SOCIETY.

[25273.]—I REGRET to learn, from your "Scientific News," on p. 400, that the Paris Academy of Sciences has received no papers in competition for the Damoiseau prize for a memoir on the theory of Jupiter's satellites; because until some Frenchman or American improves their theory for us and furnishes us with fresh tables, we may be absolutely certain that the old erroneous predictions of their phenomena will be ground out annually (in the true Thibetian prayer-mill style) in Verulam-buildings. For anything more absolutely mechanical than the production of the data for the *Nautical Almanac* it would be impossible to conceive.

I question if I look at the "Unanswered Queries" column once in six months; but I did happen to glance at it to-day, and my attention was attracted by the heading "Shooting Stars," which sent me back to p. 289. Having now read the query (58214) of "Cosmos" on that page, I may tell him, if it is not too late, that the apparent direction of a shooting star is a matter of perspective, and that they may be seen ascending, descending, crossing the line of sight, and, not very unfrequently, travelling straight towards the eye of the observer; in which latter case, they simply appear, seemingly remain stationary, and disappear again.

Mr. Shakespear (query 58613, p. 414) will find that the readings of a good aneroid barometer may be reduced to the sea level by the same formula as is employed in the reduction of those of a mercurial one. Inasmuch, however, as the best aneroids are already compensated for temperature, such readings must be supposed to have been taken at 32° Fahr. The little table subjoined may possibly answer his purpose.

Height in Feet.	Barometer Reading at Sea-Level.	
	30in.	27in.
10	+ ·012	+ ·011
100	+ ·123	+ ·111
1000	+ 1·208	+ 1·087

Intermediate quantities may be interpolated without much difficulty. Or a very close approximation to the needful correction may be made by Strachan's formula, which is based on the supposition that the barometer falls 0·1in. for every 90ft. we ascend.

I have just been looking through the *Annuaire* of the Royal Observatory at Brussels, for 1886, the 53rd consecutive year on which it has appeared. Containing, like its predecessors, a mass of valuable information, tabular, statistical, and descriptive, its new editor, M. Folie, seems to have introduced some changes into it which are manifestly not improvements. The first one which strikes the reader's eye is the waste of an entire column in the monthly ephemerides by filling it with a name of a Saint! for every day in the year; a large proportion of such saints being of (what our American brethren call) the most "one-horse" character, and many wholly unknown. Why, when in search of purely astronomical facts and data, the student should be compelled to read that Feb. 7th is S. Romuald's day; the 20th that of S. Eleuthère; the 26th of March the festival of S. Ludger, &c., &c., it seems impossible to conceive. No such nonsense as this ever appeared in the pages of of the *Annuaire* when it was under the able supervision of M. Houzeau. Again, I miss from its pages the usual contributions from the members of that efficient and able staff with which M. Houzeau surrounded himself; M. A. Lancaster, in one article on Meteorology, being their only representative. M. Folie himself contributes an article on the Secular Nutation of the Earth's Axis, in which he propounds his curious idea that that axis is actually movable within the earth; and that, hence the poles themselves shift measurably on the earth's surface! A paper on the period of solar activity just passed, by a new writer, the Abbé Spée, is seemingly written to confirm Secchi's views of the physical condition of the sun. If M. Folie would only be content "Stare super vias antiquas," the excellent little volume to whose editorship he has succeeded could hardly be improved upon as a work of reference. His innovation of reckoning the 24 hours consecutively from midnight is both a useful and sensible one.

By the bye, I hear that M. Folie lives at Liège, and goes into Brussels to visit the Royal Observatory about twice a week by rail. Just imagine Mr. Christie permanently resident at Brighton, and running up to pay a bi-weekly visit to Greenwich! I wonder what the Lords Commissioners of the Admiralty would have to say to him? I am a little afraid that it would neither be flattering nor couched in too suave and gentle terms.

Every student of astronomy who wishes to learn the latest outcome of research into the physical structure of the solar surroundings should obtain No. 239 of the *Proceedings* of the Royal Society, and read the elegant and instructive Bakerian lecture "On the Corona of the Sun," delivered last June by that great physicist, Dr. Wm. Huggins. As a lucid exposition of the merits of the various theories which have been formed to account for observed appearances it would be hard to surpass. It is needless here to insist on the superiority of the teaching of so original an investigator as its author over that of the mere compilations by people who have to avail themselves of other men's work to make them. Dr. Huggins demolishes Prof. Hastings (*vide* ENGLISH MECHANIC, Vol. XXXVIII, p. 58) in a manner none the less effective from being studiously moderate and guarded. The reader, too, will be able to judge for himself as to the weight of the evidence adduced by Dr. Huggins in favour of his contention that he has actually succeeded in photographing the Solar Corona in the absence of an eclipse.

Everyone interested in the welfare of the Royal Astronomical Society will learn with concern and regret from letter 25240 (p. 423), that Mr. Downing desires to withdraw from the Council, "on the grounds that" he has "now been in it for four years consecutively." Four years consecutively! Why, there are names which have figured among those of its members for *between twenty and thirty years consecutively!* My protest, and that of numerous other Fellows, against the practical monopoly by the Club clique of the government of the society is directed quite as much against the way in which they absolutely ignore it, as far as contributing to its Proceedings is concerned, as against the mere length of their service; albeit the latter in several cases constitutes a grave abuse of our 6th by-law. Let anyone study the *Monthly Notices* of the last few years, and note the number of really valuable and important communications from Mr. Downing, which appear in them, and then search the indices, in vain, for any papers—good, bad, or indifferent—by men who hang on to the Council for the benefit of themselves and their friends, and for no earthly reason whatever in connection with the advancement of astronomy. I do earnestly hope that, in the interests of that science for the promotion of which the Society was founded, Mr. Downing will reconsider his decision.

As an example of "Nisi Prius" pleading, letter 25242 (p. 423) is perfect. Premising that I have had nothing whatever, proximately or remotely, to do with the preparation of the List, which seems such a stumbling-stone and rock of offence to "De Haut en Bas" (I should have made some much more sweeping changes if I had), it may be worth while to remark that his two members "who have attended six (the full number) meetings," whose names are omitted in the Opposition List, are Dr. De la Rue and General Tennant. Perhaps, at his leisure, your correspondent will furnish us with a list of the papers contributed to the Society by these gentlemen during the time that their names have remained on the Council List, as also the number of times they have put in an appearance at the scientific meetings of the Society. Captain Abney is presumably the man who has attended five, and Mr. Rand Capron three times. Similar statistics in connection with the names of these gentlemen might also be acceptable. The "one who has attended no meetings" is Sir George Airy, who, as is perfectly well known, has appeared for some time past among our list of office-holders as a very small recognition of the imperishable services that he has rendered to astronomy. It is well understood that the distinction in his case is a purely honorary one; and if he is to be removed from our Council on account of the paucity of his services rendered, Mr. Christie has assuredly no right to remain upon it for one single hour, as a reference to the number of his *original* papers (as contradistinguished from mere records of other men's observations) will conclusively show. Then, as to the men who have made two attendances each. One of them—if the information contained in your "Scientific News," on p. 422 is correct—has recently done such valuable and important astronomical work as to have gained the gold medal of the Society. I have no remark to make on the remaining name: simply repeating that I was not consulted in the matter, and saw the list on which "De Haut en Bas" comments, for the first time when it reached me in my copy of the *Monthly Notices*. Personally, I think that the amateur element is swamped by the paid professional one in our governing body in a wholly indefensible manner. "De Haut en Bas" apparently considers that the select little party to which he belongs do the Society quite honour enough by looking in at the afternoon Council meetings, and dining afterwards at Willis's rooms, to hatch "coups d'état" and the like, leaving astronomy to take care of itself. "Quot homines, tot sententiæ."

In reply to the question with which "A Country Solicitor" concludes letter 25254, p. 426, I may say that I have not even seen Dr. Ball's book, "The Story of the Heavens"; but that, from what I have read in a review by an expert, I should say that it is simply a beautifully-illustrated popular exposition of the marvels of the sky—in fact, a book to lie on the drawing-room table. Assuredly it would *not* "be a really useful companion to a 3¼in. Wray telescope." The book, par excellence, for the latter purpose is the "Celestial Objects for Common Telescopes" of the lamented Prebendary Webb. My querist, though, may obtain Ball's "Elements of Astronomy" in Longman's "Textbooks of Science," and read it with great advantage, if he wishes to obtain a general elementary view of astronomical science, physical, mathematical, and descriptive.

The easiest way for "Sine" (query 58630, p. 435) to find the focus of a concave lens is this: Let him cut a circular hole of, say, precisely ¾in. in diameter, out of a card, and place it centrally over his lens. Now let him describe another circle of exactly double the diameter (1½in.) on another card and letting the sun shine through the hole in the first one, move the second card away from the lens until the diffused circle of transmitted light exactly fills the 1½in. one. Then will this be at the (negative) focal length of the lens from its centre.

How can "T. K. W." imagine that angular measurement can possibly be dealt with without the use of—at all events, elementary—trigonometry? Goodness knows there are enough cheap manuals on the subject. His clinometer would read 34' 23" under the circumstances detailed.

The punctuality of the appearance of the Parts of the *Journal* of the Royal Microscopical Society has hitherto been as marked as the ability displayed in its editing. Here, however, we are approaching the end of January, and, so far, the Fellows have never received the title page and index of Volume V. of the present series, which was completed by the number of last December. It would be interesting to know the cause of this unprecedented and, seemingly, inexcusable delay.

A Fellow of the Royal Astronomical Society.

μ CORONÆ — THE HARVARD MAGNITUDES.

[25274.]—THE information which Mr. Franks gives in the first paragraph of the letter referred to concerning μ Coronæ and φ Boötis is interesting. For my own part, I would not infer variability in a star, or stars, from such comparisons as he quotes, for it would seem to me that it was the *scale*, or the method of observation, which was responsible for the difference, and not the magnitude of the star, or stars. But in the case of μ Coronæ, I am inclined to believe the star variable from my own observations, inasmuch as if they be correct the star is sometimes below φ Boötis, sometimes equal to it, and sometimes above it. I have several observations of both stars, commencing in 1883. Unfortunately, although in most of the cases both the stars have been observed at the same time, in the two most important cases only μ Coronæ has been observed. The following are my observations up to September 16 last, reduced in one or two cases by the application of small necessary corrections:—

Date.			φ Boötis.	μ Coronæ.
1883.	July	27	5·0	5·3 (?)
„	„	29	5·1	—
„	Aug.	15	5·1	5·0
„	Sept.	4	—	4·5
„	Oct.	1	—	4·6
1884.	Sept.	19	5·2	5·1
1885.	Aug.	14	5·1	5·1
„	„	20	(5·1)	5·1
„	Sept.	5	(5·1)	5·0
„	„	16	(5·1)	4·9

So far as these observations go, they do not seem to show the slightest variability in φ Boötis, and I have, therefore, reduced the last three observations, which were made by directly comparing the two stars, in the case of μ Coronæ, to definite magnitudes on the assumption that φ Boötis is constant at 5.1. The first of the above observations of μ Coronæ I have queried, there being an indistinctness in my record, and it being, therefore, *possible* that it does not refer to this star. In all probability it does, however. Further observations of these stars will be communicated again. I got some observations recently, when I found μ Coronæ *less than* φ Boötis.

In connection with star magnitudes, I would like to inquire why it comes about that there is such a wide discrepancy in some cases between the *measured* and *estimated* magnitudes in the "Harvard Photometry." Of course, it will be rank heresy to say it; but I have a fancy that the *estimated* magnitudes are the most correct on the whole. At any rate, they are only expressed to the first place of decimals, and therefore do not attempt an unattainable accuracy.

S. Maitland Baird Gemmill.

Glasgow, Jan. 21.

ARCHIMEDES — TO MR. SADLER — SATURN.

[25275.]—HAVE there ever been any depressions noticed on the floor of Archimedes? On April 22nd, 1885, when the above crater was half full of shadow, four markings were observed in the bright part of same. Three of them were near the bottom on E. wall, and had a very decided appearance, the south-western edge being well defined, and with a very dark shadow. The floor of these depressions was of a dark grey tint, and required splendid definition to see them. These three were all in a line, and seemed to occupy the place of the bottom bright streak, when it starts from E. wall. The fourth of these markings was on the south-east of crater; but while the floor of this one was of the same tint as the others, it neither had any shadow, nor yet such a decided appearance, being much more difficult to hold. These depressions, if they are such, were glimpsed again in May, 1885, when the moon was ten hours older than the observation made in April. Archimedes being then (in May) clear of shadow; but the markings then were not so plain, on account of the sun being higher. These markings must be very shallow, because no shadow has been seen on the floor, and they disappear as the sun rises higher, and the well-known bright streaks make their appearance. I do not say these markings are new, but I have not heard of them being seen before; and, while there has been much said in back volumes about this crater and its bright streaks on the floor, nothing has been said of the above markings. Are they new, or have they been seen before?

Can I ask Mr. Sadler for the position of the new *comites* to ζ Persei, spoken of by him in "Calver's Hints"; I mean the faintest ones? Is their position between 30° and 50° *n.f.*? I see five faint stars in field; but have had no practice in fixing the position;—is this position right? Also there is a faint star in field of ζ Cancri, position about 1° *n.p.*: is this also right?

On Dec. 29 and Jan. 6 there was noticed a broken and knotty belt on Saturn, just above the shadow of crape ring. On the former date it—the broken belt—crossed the ball; but on Jan. 6 it did not cross the ball, but faded away on the *p.* edge. It had the appearance of being a dark belt broken up into little knots, and overlapping a fainter one. Power used 200 on 6½ Calver.

Aleph.

APOLOGY AND THANKS—DISCS FOR SPECULA—MATHEMATICAL OPTICS—PITCH POLISHER—FLATS—DIFFRACTION—BOOMERANG.

[25276.]—As one of the Antipodean correspondents of the "E. M.," I am compelled t
the kindly forbearance of our readers, if replies to my queries are not so promptly acknowledged as they deserve to be.

I have especially to
kind efforts on my b
discs for specula. At
did not think that I c

brown from exposure of some hours, and cannot be restored by O.P. like the subt. of Au + Pb." In the same table the pure gold sublimates are stated to be: 1. Pale yellow (metc.); 2. Purplish violet.

If Mr. B. had read the little "Manual," which he thus misquotes, more carefully, he would have also found the following warning against overheating gold on Al plates, from which he says he experienced an *unexpected* disaster. Article "Gold," page 64: "As the charcoal burns low, care must be taken that the alloy ball (Pt + Au) in a state of white heat does not roll out on the hot aluminium, as in that case the great conductive powers of the latter metal will be overtaxed, and the ball will eat a hole in it; or the Al plate must be rested on a sponge or cloth kept damp with cold water." Mr. B. says, "as my Al plate was getting hot, I placed a wet sponge near the back;" and then insinuates that *he* devised this arrangement in consequence of *his* discovery of the injurious action of white-hot gold on the Al plate.

Mr. B. states somewhere—I cannot now remember in which of his too-gushing communications—that *he* has discovered a method of separating tin from lead by means of his marvellous Herapath blowpipe (which apparently drills holes in the Al plate so repeatedly) upon that unfortunate support. In giving this account, he has entirely ignored the following paragraph, occurring at page 108 of my work "The Blowpipe in Chemistry," which he informs your readers he has carefully studied: "The slightest trace of alloy of lead with tin may be detected in a few minutes on Al plate by keeping the assay ('block tin' for instance) on a C slip, enveloped in a good H.P. The tin will not oxidise as long as it is covered by H.P., whilst all lead is thus rapidly deposited on the vertical plate-surface as a white sublimate, which turns *brown* after P.P."

Lastly, Mr. B. informs your readers that an ordinarily occurring phenomenon, well known to all blowpipe analysts, "may seem perfectly astounding" to them as to himself. "While experimenting last week with my blowpipe, I placed a small pellet of tinman's solder on the support of plumbago on the ledge of Al plate. I then covered it with a very gentle reducing flame, and by gradually turning on the air supply at the regulating screw, I succeeded in coating the assay successively (?) with a shell of pure white stannic oxide," &c. The true cause of this "astounding" phenomenon seems to be given in the remainder of the paragraph above quoted from my work, page 108. "The moment H.P. is removed from the red-hot assay it is covered with a thick crust of tin dioxide, and cools snow-white; this may be reduced to metal by adding a little borax, and covering the mass with a good blue H.P."

It will be very interesting to note what reply Mr. W. J. Grey will make to the extremely pertinent queries of "Would Know," in the "E. M." No. 1,087, page 425. **W. A. Ross.**

COMPOUND LOCOMOTIVES.

[25281.]—I HAVE just received my ENGLISH MECHANIC of Oct. 16, and have read with some amusement "Kappa's" letter (24893) which strongly supports (though unintentionally) what I said about the unfairness with which all new things in connection with locomotive practice seem unconsciously to be treated. I was particularly careful to explain that I did not enter the field as a champion of the Webb compound engines, but that I simply advocated fair play and *correct* statements as to their work. Yet "Kappa" cannot refrain from calling me an "apologist," or from misrepresenting my contention. He observes that "we have to go all the way to New Zealand for an apologist, 11,000 miles being the least distance that will lend enchantment to the view."

I hope "Kappa's" engineering knowledge is superior to his geographical, for if he expects to reach New Zealand in 11,000 miles he would be sadly disappointed, and would find himself in mid-ocean more than a thousand miles short of his destination. However, as Martin Chuzzlewit's American friend remarked: "We will not pursue the subject, lest it should awaken your prejudice!"

"Kappa" works out the tractive force of the compounds in a very eccentric way. He apparently forgets to allow for the lower pressure used in the large cylinder (only 80lb.) and so greatly overrates the tractive force exerted.

I was *not* "in error in saying the compound tried on the North Western had only equivalent to two 17in. cylinders;" but "Kappa" *is* distinctly in error in representing its equivalent would be "18·38in." cylinders. The compounds of the "Experiment" class were expressly built to be equivalent in power to the "Precedent" engines, and to be interchangeable with the latter in the regular work. I adhere, therefore, to my assertion that the "Experiment" compounds represent the same tractive power as engines having cylinders 17 by 24, and four-coupled wheels 6ft. 6in. diameter, whereas the L. and S. W. engine had an extra inch of cylinder diameter.

But "Kappa" further ignores the large difference in adhesion weight. It has long been the particular hobby of the L. and N. W. to work with as *light* engines as possible. The "Precedents" weigh only some 33 tons against the L. and S. W. engines 46 tons, and the disproportion between the adhesion weights is nearly as great. The compounds weigh a little more than the "Precedents," but still have several tons less weight on the driving wheels than the L. and S. W. engines, and the latter (or, at all events, some of them) work with the same pressure, 160lb., that the small compounds use in their high-pressure cylinders. The latter, however, are only 13in., as against their rivals' 18in., and in the one low-pressure cylinder the maximum pressure is 80lb.

I urge that due weight should be given to these points, not only as a matter of fairness; but also having regard to scientific accuracy. Unless in the case of someone who has a direct interest in "running down" the compound engines. I cannot understand why there should be any feeling or prejudice imported into the question. Let the engines stand on their own merits. To seek to damage their reputation by misstatements of their performances is unscientific. I, do not accuse "Kappa" of this. I have no right to do so, for I do not know who he is. He prefers to write anonymously, and has a perfect right to do so. Still, his assumptions are at times barely justifiable. He picks out from my instances of time being gained by the compounds the one in which No. 372, Empress, made up 13½ min. from Holyhead to Crewe. He says that the "up night boat train" was "the one probably referred to," and that is "allowed nearly three hours to run 105 miles with only two stops," so that this "was only a mediocre performance after all; the time was made up because the train was so preposterously slow." He is wrong again. It was *not* the night boat train, but the day express. It was not allowed "three hours," but 2½. The stops were not "two," but five—one being for signals. This makes a slight difference, and gives an average speed of nearly 46 miles an hour, with 12 coaches, in bad weather, without making any allowance for loss of time in starting and slackening six times. The lowest point to which the speed fell off was thirty-five miles an hour at the top of the steep bank in Anglesey, and the maximum speed was 65 miles an hour down another Anglesey bank. I would also point out that No. 323, Britannic, on the Irish mail, maintained an average of 51 miles an hour from Crewe to Chester, and 50 from Chester to Holyhead, against a heavy N.W. gale, with rain and snow; also that No. 305, Trentham, with the up Irish mail, averaged 50 miles an hour from Northampton to Euston, and that No. 306, Knowsley, on the up Scotch express, with thirteen coaches, averaged 47½ miles an hour from Crewe to London, stopping once in each case.

None of these are wonderful achievements; but they at least disprove the rather sweeping assertion that the compounds "cannot keep time." The relative slowness or quickness of the trains is not the point, for these engines have been built for the work of a particular line. Hence it is irrelevant to inquire whether they could run the faster expresses on the G. N. or Midland. When it is proposed to put them to that work it will be time to discuss their capacity to accomplish it. At the same time I must repeat that I do not pretend to predicate of these engines that they are in all respects successful. My opinion on that head may or may not be worth anything; but on the question of fact I am competent to speak very decidedly, and I can assert from my personal knowledge that the compounds, at any rate, do not always lose time as alleged. I do not consider that they run down hill with such freedom or attain so high a speed as the non-compound classes. The "Precedents" are very remarkable for their performances in these respects, as witness their runs each way from Shap Summit, often averaging 60 miles an hour for 30 or 40 miles; and, again, the lengths between Tring and Bletchley one way and Tring and Willesden the other, also on the Northampton loop. I have never seen a compound tried on the 12 o'clock down express to Rugby; but I doubt whether one would run down hill fast enough to keep time with that train, as the "Precedent" Hercules, No. 1,105, does. Three runs with that train and engine gave me the following results:—Willesden to Rugby, 77½ miles—11 coaches, one hour 28 minutes; 10 coaches, one hour 28½ minutes; eight coaches, one hour 27 minutes. The speed and freedom with which the 7ft. 6in. "singles" run with light trains are well known. I have had some splendid runs on the advance portions of divided Scotch expresses in circumstances similar to those described by "Kappa," with No. 61, Phosphorus, and No. 803, Tornado, of this class. I am not prepared to say that the compounds could have run so fast; but could the "singles" give as good results as the compounds on heavier trains?

That the compounds have the great advantages of discarding coupling-rods and double crank-axles, while still retaining two pairs of wheels on which to distribute adhesion weight is indisputable. Whether they can (1) keep time on their trains, and (2) do so at a reduced consumption of coal, also (3) without enhanced cost in repairs, are matters for practical experiment. I have ventured to give an unbiased and independent contribution towards answering the first of these questions.

C. Rous-Marten.

Wellington, N.Z., Dec. 16th, 1885.

WIMSHURST MACHINE COMPOUNDED.

[25282.]—Your readers who take interest in Mr. Wimshurst's "influence" machine will doubtless like to know that about a year ago I completed a compound or multiple form of that machine, and just six months ago I completed another. The first of these is an 8-plate machine, having sixteen sectors on each plate; the diameter of plates being 7½in. The second is a 6-plate machine, having twelve sectors on each plate; the diameter of each plate being 26in. Both of these machines give a very great quantity of electricity. With the small one, owing to the sectors being comparatively near together, I can only get, with jars in circuit, a [illegible] spark; three sparks to every turn of the handle. With the larger machine, and jars in circuit, I can get 4½in. sparks in frequent recurrence. I cannot get a longer spark with this machine, because my Leyden jars will not stand when that length is exceeded. I had a battery consisting of 12 Leyden jars, each jar of a capacity of five quarts. I have had these jars in use for thirty years, but I have now burst five of them with 4½in. sparks: in two cases using a pair of jars when one of each pair was destroyed; and in the other cases using four jars when one of each four was destroyed. In working these machines almost daily, the one for a year and the other for six months, I have always found that on the set of combs all along one side the electricity is manifest in brushes, and on the set of combs along the other side in beads. What I mean is that I do not get partly minus and partly plus on each or either side. The plus is always manifest along the 8 or 6 combs on one side (not always the same side), and the minus along the 8 or 6 combs on the opposite side. The machines are entirely home designed and home made, except that my excellent friend, Mr. James Wimshurst, obliged me by cutting the glass plates for both in his well-known laboratory. I am not by any means satisfied that I have yet arrived at the best proportions of the various parts, and I am now designing a 42in. 8-plate machine in which I hope to improve many details.

Thomas Gray.

Board of Trade, S.W., Jan. 20.

[25283.]—PERSONALLY I have much to thank Mr. Wimshurst for in giving us such a very efficient machine. As a science-teacher, the old cumbersome machine was my greatest bugbear. There was so much rubbing up with a silk handkerchief beforehand, and putting down to warm before the fire, and then an apology to be given, as the effects were not as they should be.

I have, within the last week or so, completed one on his improved pattern with 17in. glass plates, and I confess, as I put the parts together, to a little scepticism as to the working of the machine. I could not, and spite of the theories put forward do not now, imagine the source of the electricity. However, I was agreeably surprised, on putting the machine together roughly, at the ease with which the electricity was obtained.

I was, after all, a little disappointed at the length of spark. Perhaps I had been led to expect too much; but I certainly expected longer than 3½in. or 4in. I had been told that a spark could be obtained, roughly, about 1in. less than half the diameter of the plates. Is that so? I can get a 5in. spark from a 16in. plate machine built on the Winter principle with ease in a very warm room, although the spark from the Winter machine will not bear comparison with that from the Wimshurst.

I noticed, in a similar machine exhibited at the Inventions, that the ends of brass rods forming the combs were covered with little indiarubber caps. Is that better than rounding them? I am thinking of soldering a small brass ball on each end, and also on the tops of the back tubes which support the combs.

I have a small ½in. ball on one conductor and one 1¼in. on the other, and I find that every now and then I have to change them from one comb to the other, especially after a slight rest, or after applying pointed wires, as there is a fine brush discharge from the small ball, accompanied by the usual buzz, but the spark refuses to pass. I change conductors, and all is well. Would that be remedied if the balls were equal? I know difference of size is an advantage; but I like to avoid ha[illegible] to change the cond[illegible] possible. I g[illegible] [illegible]k on our doing it care. [illegible]d the much affected by using a hemispherical cup on one conductor? It seems to me that should be the shape.

In conclusion, and that my experience may benefit others who have asked questions on the subject, I varnished the glass plates in front of an ordinary kitchen fire with shellac varnish, made simply by dissolving shellac in methylated spirit. The sectors were stuck on by the same varnish, putting a double thickness of tinfoil where the brushes touched them, as the foil I used was thin. The glass discs were affixed to the bosses by Prout's elastic glue, which seems to hold very fast indeed, and are separated by a loose washer of tin run on the spindle between them.

Battersea. **G. J. N.**

FUSING POINT OF ALUMINIUM—TO "WOULD KNOW" (?)

[25284.]—MY authority for the fusing point of aluminium is Roscoe's "Chemistry," Vol. II., Part I., page 440. The fusing points of metals are certainly immutable at the same pressure; but they will vary somewhat, though very slightly, with changes of pressure. When metals are melted together to form alloys, the cohesion is less than before, and hence alloys almost invariably fuse at a lower temperature than their component metals.

If "Would Know" really means his *nom-de-plume*, he can easily learn, and if he will carefully study Huxley's "Elementary Physiology" and Balfour Stewart's "Elementary Physics" he will be able to answer the string of extraordinary questions he has mixed together in letter 25249; but the style is very like that of a paradoxist. I have a lively recollection of a correspondent who, some years ago, gravely told us that he never read books because he wanted to enjoy the luxury of thinking for himself; and he *did* think for himself, . . . so do the residents of Earlswood and Colney Hatch. From paradoxists and all their works, Fair Science protect us!

Wm. John Grey, F.C.S., Analytical Chemist.
Newcastle-on-Tyne.

NORTHANTS AND SOUTH HANTS.

[25285.]—Is the former really wrong? Are the counties North and South Ampton? Legal documents are labelled "County of Southampton" when referring to the latter district. I was not aware that I had invented N. Hants as an abbreviation; and, in fact, out of some hundred letters addressed to that part of England I always addressed N. Hants, and they always arrived. But after "Jones, Wales," that is not remarkable. *Unde derivatur* Hampton or Ampton? It is not like North-Humberland, the origin of which is plain. Probably some of your correspondents can reply. Thanks, "M. A.," for kind invite. I have tried once or twice to negotiate an exchange to your county, be its name what it may. **O. J. L.**

STAY BUSKS.

[25286.]—I WILL now endeavour to answer the various questions "X. Y." put to me. He evidently seems interested in the subject. It would never do to introduce the system of lacing in front: the wearer would then have entire control over the lacing, and stays laced much tighter than previously would be the result. The busks in hunting stays are not so short as you think; they are generally of strong bone; this material is used because it is non-yielding, so must be nicely rounded at the top end, and the wearer should be thickly padded there, or should the horse suddenly rear, a bruised chest would be the result. Frequently the thigh portion of the stay is cut out on the side where the leg passes over the pommel; another plan is to have a slit up about 4in. in the same place, with a lacing cord, so that when used as ordinary stays it may be laced up. Both these systems have the disadvantage of the wearer lacing very tight, or the stays will work down, producing much discomfort. I may add, the lacing plan referred to is patented.

Independent busks would be all very well, supposing the cord never broke; supposing it did and the busk slipped down, a most serious injury would probably result. Leather stays have been tried, but are not popular; when heavily steeled they are much hotter to wear than the ordinary make, and in common with all this class of article, retain the perspiration, to the great injury of the wearer. I think if "X. Y." had seen a lady ascending a grand staircase, as I have done, he would not advocate the long unyielding busks. They may be all very well to prevent stooping when sitting on a chair; but a long rigid busk for going upstairs means misery and awkwardness, the wearer —ot being able to suit herself to the centre of vity. Another pernicious practice now largely pted is sleeping in stays. Many young ladies -nd are laced very tightly too. It is in this way: They (the ladies) go see the saleswoman a beautiful ken to confidentially, and they are told to sleep in stays, as she does; but she omits to tell them it is a necessity in her case, as it is with dozen of others who perpetually tight-lace—the fact is, if she removed her stays at night she would, upon doing so, faint away regularly.

I think this fainting is caused by the pressure being removed; the blood flies at once to the head, Anyway, I should be glad of the opinions of others as to the actual cause, as it is becoming common among the lady assistants in the large dressmaking houses. So common did the practice of tight lacing become in one of our large schools, that the lady-principal decided upon compelling all to go without stays for a week, then at an hour's notice appear in full-dress. It was thought the pain this would occasion would put an end to the practice; but it did not, although all admitted a great soreness of the body as the result. "X. Y." seems to say tight lacing is not injurious. I am certain it is; anyone who does it for a year or so, as a rule, is compelled to wear an abdominal belt, showing clearly the pressure on the waist has forced something down out of its proper position. How can it be otherwise when many of the modern stays come, back and front, above the armpits, and extend downwards in front as low as possible? This, with an unyielding busk and steeled so closely as to be rigid in every part, must be so, especially when, it must be remembered, all stays have one fault—that is, draw the body from a rounded oblong into a perfect circle. I cannot see how this can be altered, unless the lacing is done right and left under each arm. This, I am afraid, would be considered too much trouble. For my part, I will say my own daughters are not permitted to wear any of these absurdities; theirs are simply a stiff material, sufficiently so that they shall not appear conspicuous in their dress when mixing with others. As to stays and busks for men, I cannot give "X. Y." any information about them, for I should not consider a man worthy of the name who would wear such things.

A Provincial Staymaker.

Leamington, Jan. 16.

THE MUSICAL INSTRUMENTS FOR HOME.

[25287.]—I AM sorry your correspondent "Country Solicitor" cannot give the information asked for, because although it has all appeared in the ENGLISH MECHANIC years ago, there are doubtless many new readers who cannot procure the back numbers. In the columns of this paper every point in connection with free-reed instruments has been explained and discussed by experts: the information can be found nowhere else in print. I thought that your correspondent, being so satisfied with his Mustel, would be kind enough to describe its parts, and add to the stock of information for the benefit of other readers. I thank him, however, for his advice that I should go to Metzler's and "see one"; but I do not understand how that would benefit other readers. As a matter of fact, a sectional diagram of the orchestral organ, which is an identical copy of Mustel's harmonium, appeared in No. 577—ten years ago! (There are some slight errors in it; the musette being marked 8ft., the celeste 8ft. instead of 16ft., and the baryton 16ft.; but the scale is correct.) If I deal rather shortly, then, with the letter on p. 425, "Country Solicitor" will understand that I am respecting the Editor's space. First, then, in my opinion ("C. S." has given his) the Mustel harmonium, the orchestral organ of Mason and Hamlin, and the Professional and Connoisseur's Harmonium of Hargreaves, are much on the same line as regards one-manual free-reed instruments: they are undoubtedly the leaders, and no expert will find fault with "Country Solicitor" if he chooses the Mustel: it is quite a matter of personal taste. It is unfortunate in replying to my questions that your correspondent should have misunderstood some, and trusted too much to his opinion of my knowledge of these matters. I asked how he kept the two instruments in unison (p. 366). He replies, "by the aid of the piano-tuner." Presumably, then, he keeps a piano-tuner on the establishment. But no matter. Why "C. S." should be surprised because I asked him to say why expression cannot be obtained on the American organ, I do not know; but I begin to understand when I find him stating that the "very principle" of the American organ prevents it. Will he allow me to tell him that there is no difficulty in adding the expression stop to the A.O., or will he refer to back volumes and learn exactly how it is done, or consult the diagrams of A.O. bellows, which have been given more than once? All that is needed is some means of preventing the reservoir collapsing, and the wind current is then direct from the reeds to the so-called feeders. It is very rarely applied to an American organ, because that instrument lends itself readily to any amount of expression without an expression stop.

Passing over the paragraphs in which "Country Solicitor" refers to one or two minor matters—mere details which have really nothing to do wi the excellence of the Mustel harmonium (that due to the artist-workman),—I come to the par graph in which he speaks of the celeste stop bein formed of two rows of vibrators as a "peculiarity and a "superlative excellence," and libels othe manufacturers, who, whatever they may do wit stop-knobs, must have two sets of reeds to get celeste. What Mustel does is to have two sepa rate sets for celeste. In the ordinary instrumen the treble half of the 8ft. row (Flute) is used t obtain the celeste with another half-set o 8ft., otherwise useless, but which in th American organ can be, and is frequently used also as a solo stop in unison with the diapason. The harp eolienne is necessarily formed of two sets, for it is located in the bass portion of the instrument, and is, moreover, of 2ft pitch, so that there is no other set which could be used with it. These, the metaphone, the double touch, the expressive fortes, and the knee levers are all mere incidents of the Mustel harmonium, which owes its reputation to the fact that it is made by an artist-workman, who knows what to do, and can afford to do it. I think also that it needs an artist at the keyboard to bring out its capacities.

By the way, I wonder what "Country Solicitor" would say to the instrument briefly described in No. 568, which has three manuals and pedals and 24½ rows of reeds—that is, 49 "sets"—which had the united skill of Bauer, Laurent, and Tamplin expended on it? The owner of that gave high praise to the Mustel when he said it contained a "something" which rendered it "so wonderful above all others in matters of resource for variety of effects." **Organon.**

[25288.]—I AM much interested in all musical discussions, and particularly in the letter of "A Country Solicitor," who has roused in me a wild longing, to try his "Mustel Organ," which must be something exquisite (and high-priced!). May I be allowed to relate my humbler experiences?

A short time since I invested in a £24 organ by the Smith Co., Holborn-viaduct, choosing that particular form quite by chance, aided by a diligent study of catalogues—not being able to go up to town, I chose amongst numbers,—and I also tried every organ I could get access to. This one has a very elegant and handsome case, with the nattiest little cupboard for music, &c. The tone is pure and sweet, and it has nine stops and two knee swells; and with all due deference to "Country Solicitor," I flatter myself I *can* make it *sing*, and get a variety of expression out of it, and the power of the full organ is quite enough for a small church, and almost too much for my very moderate-sized room.

I should fancy most musicians grow to have an affection almost personal for the instruments they are in the habit of playing upon most. I do; and, moreover, I think a good organ or piano is a much more satisfactory friend than an average human being. What can soothe and comfort you so well in sorrow as music, or rise jubilant in joyous sympathy with your good fortune?

I scarcely know what possessed me to go in for such wild extravagance last summer, for no sooner had I got my organ than the old piano seemed more out of tune than ever, and I had no pleasure in playing upon it, so thought I would sell it and buy another, which I did. In this venture I think I was also successful. Not being able to go to any large town and choose, I had recourse to dealers catalogues and musical journals again. After due consideration, I chose, and sent for one of Mr. Walter Villiers Luck's 26-guinea ones, my purse and the small sum I received for my old piano not allowing of a larger outlay, though I longed to send for the one recommended by Mr. Luck himself, his "Times Model," price 42 guineas. However, I am agreeably surprised at the handsome burr-wood case and rich, sweet tone of the one I did get at such a reasonable price. I had it tuned for the first time yesterday, and the tuner said it was a very well-made piano and remarkably cheap at the price. I was pleased to hear him agree with me, as I never like to place too much faith in my own opinion; for though I am passionately fond of music, I may not be much of a judge in the technical part of musical instruments.

I hope other musicians will give their various experiences of organs and pianos, as the musical readers of your valued journal are numerous, and it may be good for the music trade as well, and I think our courteous Editor would not object to the discussions for that reason.

Laura A. Whitworth.

PLAIN AND ORNAMENTAL TURNING—VARNISH.

[25289.]—I WAS glad to see "M. A.'s" letter, speaking up for plain turning and carving. There is a fascination about the technique of so-called ornamental turning quite comparable to that enjoyed, say, by the chess-player; but there it mostly seems to end; for as a useful or fine art—well, for ornament, at all events, give me a clasp-knife rather than a £100 lathe!

By the bye, I believe North Hants always stood for Northamptonshire till of late years; I know I have often met it in old books, and hailing from Hampshire myself, it used to puzzle me at first.

As to varnish, has "M. A." tried paraffin dissolved in turpentine? It gives a very pleasant surface. Stains are, indeed, a difficulty. But is not carving shallow, and applied so as not to spoil the outline, the best adornment for such things as "Copeaux" describes? I fear I should not like his painted ware, as I certainly do not like the terra-cotta he contrasts it with. Japanese lacquered pots might give hints, and I imagine copal would give as hard a surface as their varnish if used with equal care.

Do "Working Engine Fitter" and "Durston" mean pretty things for plain turning? If so, I might be able to give them a hint or two another day.

It seems to me that lathe lovers, like schoolboy fret sawyers, make a master, nay, an idol, of their tool rather than a good servant. It really is a very useful tool, but not the only one, and for ornamental purposes must be used with moderation, as turned forms become wearisome to the eye when used in excess, and without contrast. Do not amateurs in general take hold of the question by the wrong end, and consider rather what they can possibly do with a pretty tool, rather than look round to see what they or their friends want, and scheme with what tools and materials they can produce the the best result.

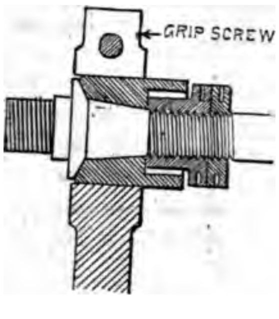
Anonymous.

LATHE MATTERS.

[25290.]—I SEND an appeal to the Whitworth Company which I hope you will kindly insert. A reply from them will throw much light on the screw question.

I was pleased to see our friend "Vulcan" reappearing. I wish, however, that he did not give us credit for so much acuteness, and would be a little more explicit. I am much taken with the traversing mandrel he has given a sketch of on page 428; the sliding bushes were quite a new idea to me. The mandrel is supported through *two* sliding fits, and lies on *two* layers of oil instead of only one, which might cause a little more unsteadiness. I incline to think it would be better to split the casting of the headstock at the top, and so grasp the sliding collars by tightening a screw.

I inclose a sketch of my variation, in which there need be no key, the grip screw grasping the split top of the headstock. There is a traversing mandrel which an amateur might make, and in which you can take up the wear.



In regard to the automatic counter I should like to say I have a most simple affair, which was described on page 67, Vol. II., of *Amateur Mechanics*, now defunct. Anyone can make this: You simply place a suitable change-wheel of large size on the tail-end of mandrel, and then arrange a ratchet and pawl to take the required number of teeth; then screw up the mandrel rather tightly so that the ratchet lever can move it, but the drill or cutter cannot, and then you may work in the dark.

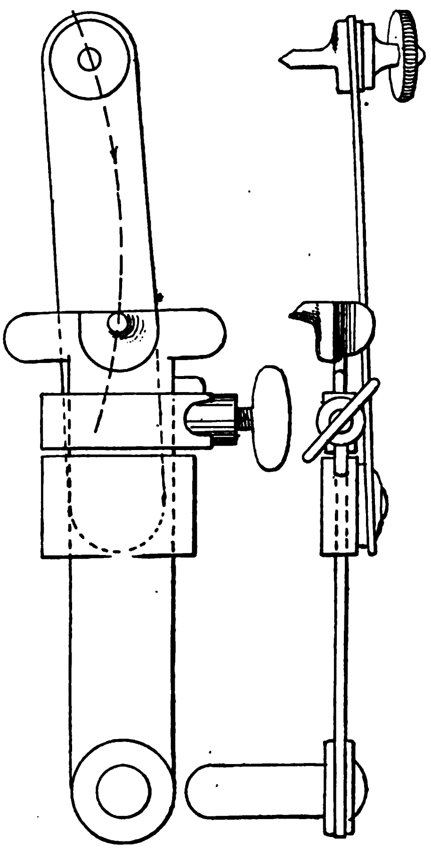
F. A. M.

[25291.]—I WOULD like to call "G. W. D.'s" attention, see page 428, to the fact that any one accustomed to practical work knows by experience that to drill anything truly in the lathe, it is the article itself which must be chucked, so that it, and not the drill, may revolve. I opine that I would have the article chucked and drilled before he could get such a device fixed tolerably true; and were it so, the drill would not bore truly.

A., Liverpool.

A COUNTER FOR DIVISION-PLATE.

[25292.]—TO save the eye the tedium of counting, and reduce the chance of error, I can recommend the following contrivance:—Fig. 1 represents front elevation, Fig. 2 left-side elevation as viewed from dividing plate. The lower point represented between A and B (Fig. 2) is the point for locking the pulley fast, and is riveted to a strong, flat spring which, unlike those usually used, is of uniform width, to allow a sliding sleeve carrying a second and lighter spring with a point attached to slide up and down upon it. It is by adjusting the distance this slide can travel to the number of holes you require to shift at a time that the variable use of the instrument depends. Downwards its travel is limited by the bosses of the two steel points coming in contact upward by an adjustable stop. When about to use, before removing locking-pin clear of the division-plate, advance the travelling point, counting from its lowest position the number of holes you elect to use, then adjust the sliding-stop just in contact with the slide where you determine to limit its upward motion. Each time you shift the plates insert middle finger and thumb between the ears, A B, upon locking spring and the face of division plate, keeping the locking point clear of the plate, while index finger maintains positions of upper point in its hole, and pulley is moved round with left hand until the bosses again come together, and locking point is allowed to drop into the hole presented. It matters not how many holes there may be between the two points at lowest position, for whatever the distance the upper point is in advance at starting it remains uniform, when shifting from one circle to another, as from 96 to 360: the scale of the holes may not exactly suit the distance between the two points when in contact; but by making boss of upper point a little eccentric, loosening milled nut that fastens it to its spring, and turning boss slightly, this may be adjusted. But exact coincidence is not requisite, as any slight loss or excess of motion is pulled up by the conical form of the locking point. It is necessary that upper spring be attached to its slide by a pivot, to allow upper end to traverse a circular arc; note also small steel gib to prevent the end of set screw on stop from damaging edge of locking spring. Locking point may be used singly if desired. Another simple expedient to facilitate counting is countersinking twelve holes equal distant, as every eighth in the 96; thus those commonly used are easily recognised. I think "Vulcan" will see the superiority of above contrivance to the method he mentioned (page 363) of setting a movable pointer the required number of holes ahead, and making a chalk mark at each hole as it leaves the locking point, and is carried by eye, to second fixed pointer.



Acton. **A. Dancaster.**

PLANER WITH UPRIGHT TABLE.

[25293.]—I HAD intended to add a second paper on the matter, giving alternative arrangements both of slot and pin lever, and also of too with one or two other details; but being engag some book work I can find no sufficient ti work out these details. But this method a took my fancy ever since that much-abused first devised and used it, only he went further, and worked it from gearing on the axle. My own object was the greatest p simplification of the apparatus, so that it mi also cheaply made. The table taken out comp the work can be mounted on it when it is la on the bench. £6 is too much. I could made at Colchester for £4, and it is worth al

O. J

AN APPEAL TO THE WHITWORT

[25294.]—WILL Messrs. Whitworth kind form us what is the limit of accuracy attai the leading screw of their slide lathes?

Can the remaining error in pitch, if a expressed in a fraction of an inch? and is measurable amount of drunkenness remainin

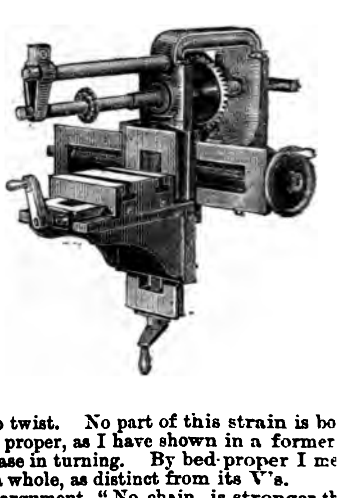
F. A

MILLING ON THE FRONT SLI LATHE.

[25295.]—I AM glad to hear from "F. . that his regard for front slide lathe is not le I, too, am determined, when I can get tin when I have one or two points more satisfa schemed, to commence on a set of patter sink or swim as the case may be.

I think, however, so far as the milling cerned, in the absence of any word from th by a word, for me at least, could settle the I have decided to give up the particular a ment advocated by "F. A. M." for the table. It has no doubt some advantages to mend it. It is always ready, and it has the head to steady end of spindle; but here its vantages begin. The poppet is considera the way. The depth or height of work operated on is very limited. The mandrel well suited for holding such spindles, and th not supported at the other end. Of course, a can be used; but it is hardly so satisfact when spindle is fixed in the internal cone o drel.

Then we have the disadvantages I have a spoken of, the overhang of the table and the which the cut brings on the saddle bearings has to be wholly borne by the V's of bed, wh



tends to twist. No part of this strain is bo the bed proper, as I have shown in a former is the case in turning. By bed-proper I me bed as a whole, as distinct from its V's.

The argument, "No chain is stronger th weakest link," as apparently applied here, d hold in this case, and granted that mandrel weakest link—it does not justify the inser another weak link—in a table badl posed for its purpose. There is another back: to give sufficient stability to the the vertical slide must be nearly d in length, so that when table, or bracket ca table, is at proper height, there will still be between the V's of saddle to keep it steady horizontal V's on top of bracket must also siderably lengthened for the same reason.

For these reasons I have been reluctantly step by step to give up this arrangement that not much reliance can be placed up may of course in an emergency be used fo work; but it should be regarded only as tem till something better can be fitted up. wheel-cutting very well.

Now, with my present knowledge and seems to me the choice is narrowed down 1, A separate milling head, driven from a at right-hand end of lathe with vertic horizontal slides, supported on right- This, perhaps, is the best; [illegible] most expensive, as requir[illegible] ratus.

call them toys for the dilettanti. The argument used in my hearing by the able champion of this school was that 40 years ago the *markings on the diatomaceæ* were discovered on the Continent with a low-angled lens.

It is a very funny thing that both these schools refer to Prof. Abbe's diffraction theory in confirmation of their opinions. To each of these schools let me put the following question: Suppose a lump of common organ-pipe coral were a microscopic object like a diatom, and we had such an object mounted to show a side view, with a low-angled penetration lens you would see markings on the coral; with wide-angled oblique light you would see the longitudinal and transverse striæ; with wide-angled axial cone the pipes and floors. Which is the best? Do away with the axial cone, and you will lose the beautiful inner perforations on the *C. Asteromphalus*, the lace work on the *Isthmia Nervosa*, and the still more minute perforations on the *A. Sturtii*.

Jan. 14. **Edward M. Nelson.**

(*To be continued.*)

LOCOMOTIVES.

[25301.]—Important experiments are being made upon the Carlisle section of the Midland Railway with reference to the adhesion of locomotive wheels. Engine No. 1309, built 1876, has cylinders 17½in. by 26in., and four coupled wheels of 6ft. 6in. diameter. The coupling-rods have been taken off, sand-boxes are placed in the smoke-box, and the sand is applied to the rails and driving-wheels by means of a sand blast worked by compressed air from the main reservoir of the brake. When sand is used in the ordinary way, it is a well-known fact that it is frequently blown away by the wind, and is of no value; but the advantage of the sand-blast is that it insures the sand being carried to the spot where it is required.

The writer has watched the engine start, and also timed the running when riding in trains over severe gradients. There can be no question that a "single" engine will run with less friction, less coal, and less repairs than a coupled one. No engineer would use a coupled engine if he could obtain the required adhesion with a single pair of wheels, and a coupled express engine is always regarded as a necessary evil, which on heavy gradients must be employed to prevent a still greater evil — namely, the slipping of single engines.

There are many trains on the Midland Railway that could be, with great advantage, worked by "single" engines; for instance, the short fast expresses between London, Nottingham, and Bradford. The only possible difficulty would be in ascending the banks at Irchester, Sharnbrook, and Dronfield; but, if the proposed sand-blast were employed, this would be at once overcome. From a scientific point of view the experiments are interesting and valuable; but the practical value will, of course, depend upon whether the saving in coal and repairs effected by the use of a single engine will pay for the cost of the sand blast. At present no data upon this point are available.

Clement E. Stretton, C.E.

40, Saxe Coburg-street, Leicester, Jan. 26.

USEFUL AND SCIENTIFIC NOTES.

◆◆◆

Russian Remedy for Hydrophobia.—The Alisma, or water plantain, is lauded in Russia as a remedy for hydrophobia. The plant flowers during the summer, and should be collected during August. The roots must be dried and grated, then spread on bread and butter, and a good dose taken night and morning. Two or three doses are said to be sufficient to effect a cure.

M. Semmola, a German investigator, has succeeded in producing musical tones from a metal plate by electrifying it intermittently from an induction machine. The plate is supported on an ebonite funnel, and is a millimètre in thickness. The terminals of the induction machine are connected to opposite sides of the plates by wires, and the path of the current is interrupted so that sparks strike across. The plate then begins to sound, and it continues to sound even if a Geissler tube or a lead wire is interposed in the break.—*Engineering.*

In 1870, when the make of gas in Glasgow was 1,295,863,000 cubic feet, and the sale 1,026,324,000 cubic feet, the leakage was 20·8 per cent. During the year ending 1884-5 the make was 2,368,131,000 cubic feet, the sale 2,115,804,000 cubic feet, the percentage of leakage reduced to 10·6. The income from the sale of gas in 1870 was £210,786, when the rate was 4s. 7d. per thousand, and during the last year it was £364,203, at a rate of 3s. 6d. per thousand. In 1870 the candle-power was 28·2, and last year it was 26·3.

REPLIES TO QUERIES.

◆◆◆

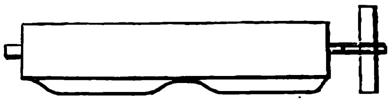
*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[57632.]—**Technical Education.**—"Theorist's" question as to technical education has remained unnoticed too long. His idea would, I suppose, come to about what Mr. Ruskin speaks of as a "liberal education founded on right handicraft." And this surely is very desirable; but difficulties crop up when one considers the means of carrying it out. To begin with. Teachers are scarcely to be found, for it is essential that the handicrafts and physics should be taught in relation to each other, and I am not aware that any series of interdependent exercises, say, in carpentry and mechanics has been so much as begun. The next difficulty that presents itself to my mind is of another order. We want to rear up for the nation not merely super-excellent fitters and machinists, but citizens capable of reasonable human life, and there is a chance that our system might tend to materialise the opening mind. My own solution of the difficulty is to approach the subject mainly from the point of view of architecture—not, of course, the pedantry of the five orders, but the rational, useful arts of building, fitting, and furnishing homes for men and women. Carpentry—we may almost call it the mother of the arts—will come first, but always in conjunction with geometrical or plan drawing, the handmaid of the arts, so that pupils should work from drawings prepared, or at least traced, by themselves; they must learn, too, to work from written instructions, a rare accomplishment, though merely a matter of training. Now for a great difficulty. What are we to make? Well, in Heaven's name, not models—from cathedrals cut in cork to toy engines. What a lumber of them cumbers the earth already! Are they not bound up with that great stumbling-block for designers—whether mechanical or artistic—the impression that proportion is independent of real magnitude? No, we will begin by making boxes. Our first efforts will do for the Parcels Post, perhaps; and presently we shall be able to put some carving on them, and make them pretty with brass hinges and corner pieces; and then we can make all sorts of shelves and small cupboards, and learn to paint or stain and polish them; and as we go along a number of structural principles will be pointed out. We may find by actual experiment on strips of pine the laws of the strength of beams and cantilevers (this is the legitimate use of models to be broken!) and learn the fundamental principle of the triangular frame. And here we shall be carefully shown how wisdom is justified alike in the design of a table with its stiffness dependent on the joints, and of an iron roof-truss with all its joints pivots. And so, as we proceed, we shall see open around us the doors to many sciences; for instance, the preparation of paint and glue will humbly suggest chemistry; and if we have a turn for machines, a real pendulum clock is as easy to make as a model engine, more instructive, and much more satisfactory if achieved. But I must not pursue my fancy too far. My claim, in brief, is that education should regard life as well as livelihood; that without neglecting the claims of literature, children should become familiar with those arts which concern all men, and on which civilisation is founded; gardening (as representing agriculture), cookery, the making of clothes, and the orderly structure of human habitations, *familiar* with them generally, *practised* in chosen branches; and, finally, that they should learn by example and precept how good manners are related to right conduct and beauty to right structure. Thus much for theory. To make such an education generally available needs time and many patient workers. I, for my part, am working with a small group of pupils at that corner of the field which comes easiest to my hand. A twelvemonth hence I may hope to tell you somewhat how my forecast has fitted the facts.—W. A. S. B.

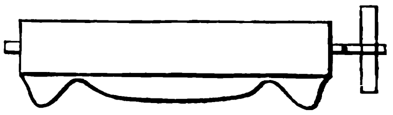
[57974.]—**Cleaning Binocular Prism.**—The prism is usually mounted in a sliding frame, which can be removed from the instrument when required for cleaning. The prism should be carefully dusted with a camel-hair brush kept for the express purpose of removing particles of dust from oculars and objectives. If, after dusting with the brush, the prism should show traces of tarnish when gently breathed upon, a portion of an old well-worn cambric handkerchief should be employed to remove it; it is scarcely necessary for me to say that it should be entirely free from dust, and be kept in a close-fitting box.—H. B.

[58033.]—**Steam Navigation on Canals.**—In reply to "Survivalist," I would point out that the principal objection to the use of steam on canals is not the wave produced by the screw or other propeller, but the displacement wave caused by the passage of a large body, such as a barge. It has been found by trial that if the speed exceeds three miles per hour a rolling wave is set up on each side, which does much damage to the banks. I do not know any canal company to which he could apply; but I suppose any one of them would be willing to consider a scheme for working their traffic more economically and with increased expedition.—S. R.

[58017.]—**Carpet-Beating Machine.**—I saw lately in Cincinnati a carpet-beating machine. The carpet was drawn through over rollers, something like the way cloth is drawn through a loom;



about six inches over it a long wooden drum, round or octagonal, about 18ft. long and 18in. or 2ft. diameter, revolved at a lively speed. Ropes about 1½in. in diameter were nailed to the drum, being secured alternately at the ends and middle, and half-way between the ends and the middle being



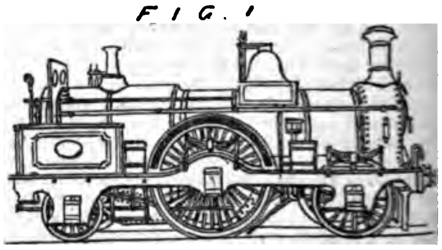
left loose enough to sag about nine inches. The centrifugal force causes the ropes to fly out and strike the carpet, and the bights of rope "breaking joint," so to speak, the whole of the carpet gets well beaten over its whole width.—T. F. S. F.

[58179.]—**Joy's Valve Gear.**—"Nels Poon" asks where he can procure the working drawings of this invention. The answer is of the patentee, Mr. David Joy; but he will find diagrams of this valve motion in back volumes set out with sufficient clearness to enable him to prepare a working drawing from them. I do not understand his allusion to "something more than rule of thumb" in this connection.—T. J.

[58226.]—**Colouring Brass Fishing Reels.**—If "Longing to Know" tries at any bird stuffer he might be able to get the white arsenic (common); it is much handier than the solution he makes up. What is the difference between "bluestone" and "blue copperas." By using the stain with arsenic, there is no need of wasting any time in the operation. Will not some of "Ours" give some recipes for the red bronze, solutions, and stains, and how to make up for the lacquers? It would be useful to many besides—At Last.

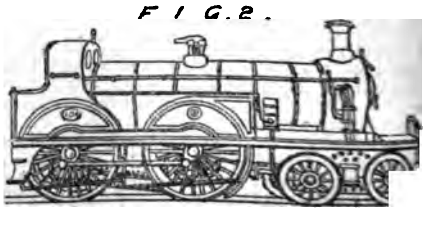
[58251.]—**Old S.E.R. Engines.**—The old mail engines (see Fig. 1) had dimensions: Wheel-base,

F I G. 1



16ft. 10in.; cylinders, 16in. by 22in.; leading wheels, 4ft. 9in.; driving, 7ft. 1in.; trailing 4ft. 0in.; heating surface, 1105·32 square feet. They were mostly built about 1861, and were numbered 2, 27, 43, 72, 81, 82, 83, 85, 116, 197, 198, 199, 200, 201, 202, 203, 204; of which 2, 27, 82, 116, and 198 are broken up, and 83, 85, and 200 have been renewed with the typical boiler, chimney, and Ramsbottom's valves. The latest express engines are as in Fig. 2, and have: driving wheels, 7ft.

F I G. 2.



1in.; bogie wheels, 3ft. 9in.; cylinders, 26in. Numbers run 104, 116, 198, 205, 2 212, 213, 214. There were some very built in 1855, of which I could give some dimensions and sketch if those are the ones referred to in query.—B. FIELD.

[58268.]—**Copper Steam Pipes.**—Thanks to "Belgian" for diagram on page 480; the plan is very much more complicated than ours. The reason why I have known copper steam pipes to be used was that they can be much more easily made to fit accurately at the joints, being so easily bent to the desired form, also because they will give and take the expansion and contraction without disturbing the working parts of the engine; whereas an iron pipe, unless short, will require to have an expansion joint, or something must give way when steam is got well up. On no account use galvanised piping, as this would be to destroy the engine by galvanic action.—A., Liverpool.

[58300.]—**Legal**.—It is necessary to take out administration, which may be done personally or by solicitor. You had better employ a solicitor.—KAPPA.

[58321.]—**Piano Query.**—Pianoforte silking is a trade carried on by itself, most of it being done by those who do nothing else. I never heard of a mechanical method of doing it, and do not think it likely there is one.—ORGANON.

[58324.]—**Patent Circular Saw.**—If this querist cannot get sufficient information from the illustration which appeared on p. 26, No. 1042, I should advise him to see one, or procure the specification of the patent.—S. R.

[58326.]—**Party Walls.**—If the building is in the Metropolis, there is a reply to a query in the *Law Times* of Jan. 23 which will assist the querist in this case. The reply is lengthy, so he had better purchase the paper referred to. Offices, 10, Wellington-street, Strand, W.C.—KAPPA.

[58334.]—**Oil and Soapsuds.**—Is it a fact that the tool won't bite if soap-water is used on oily iron?—P. L.

[58343.]—**Clockwork Lamp.**—Any ordinary clock train which will feed the wire at the required rate will do. Querist should have stated purpose for which it is to be used.—S. R.

[58347.]—**Gas v. Hot-air Engine.**—This is simply a question of taste and price. One of the hot-air engines worked by gas would perhaps suit, or a Bisschop engine. Take the fumes through a pipe in the ordinary way to the nearest outlet. How can any one answer such a question when no details are given?—ESSAR.

[58348.]—**Fish Manure.**—Use dry earth, cinder dust, or spent lime from the gasworks. Any dry waste material will do.—NUN. DOR.

[58349.]—**Telephonic.**—Try No. 24 to 30.—NUN. DOR.

[58351.]—**Medical Coil.**—I think this querist will find the required information in back volumes; but his best plan would be to see one of the street coils: he would learn more than by a page of written instruction.—NUN. DOR.

[58356.]—**Crystal or Washing Soda.**—What does this query mean? The water will keep in solution as much as it can. How would "C. A. M." propose to alter a natural law?—F. C. I.

[58358.]—**Magneto-Electric Machine.**—Nos. 24 to 30 silk-covered will do. If core is ½in., then make the coil ½in. thick all round it.—NUN. DOR.

[58365.]—**Brass Carriage Harness.**—What is it "Groom" wishes—merely something to clean the brasswork quickly, or something to keep it from tarnishing? A brush and crocus powder would perhaps be least trouble where leather adjoins; but rottenstone and oil where there is no risk of injuring anything else. To preserve the polish brass must be lacquered.—NUN. DOR.

[58366.]—**Firewood Splitter.**—I believe there are machines for this purpose; but, as a rule, the wood is split with a chopper, and bundled up in a trough which has a strong band and lever to hold the bundle together until the string is tied round. Tarred hemp is used, and the bundles are thrown into water to swell and tighten them.—S. R.

[58368.]—**Railway Crossings.**—I think this question must be answered in the negative, for I cannot find any railway man who has heard of such a place, let alone seen it. There are some instances, I think, of three lines crossing one another at different levels, but not four.—SEVEN-FOOT SINGLE.

[58369.]—**Ammonium Bichromate.**—Having ked up the reference given, I find that "S. and is not responsible for the paragraph in stion, and consequently withdraw any reflection I may have made on him. Nevertheless, the ent that the ignition of $(NH_4)_2Cr_2O_7$ would netallic Cr but for the presence of the air seems to me to be such utter ren Mr. J. M. Thomson's (not r correspondent's reply) asser- case leaves me still unconvinced. I should be glad if some qualified correspondent will tell us which is correct.—SEARCH.

[58374.]—**Cracked Bell.**—Perhaps you can raise the pitch sufficiently by filing a bit off the rim all round, or flatten it to some suitable note by scraping all round inside the soundbow. You do not say how much pitch is lowered.—ORGANON.

[58375.]—**Boiler Query.**—I don't think you can do more than set the boiler over the furnace, as it has too little diameter to make side-flues profitable. You can leave fire under all night if it is damped down so as to prevent it burning fiercely; but it is rather a small affair for any expensive arrangements.—STOKER BILL.

[58381.]—**Legal.**—The trustee of a settlement is the proper person to keep the settlement deed, and if he chooses to employ any particular solicitor, no one but himself has any right to call on the solicitor to give it up. If the settlement was made in consideration of marriage, which in law is a valuable consideration, the settlement is irrevocable; but if made without reference to marriage, or any other valuable consideration, the settlement is a "voluntary" settlement, and the settlor could sell the property notwithstanding the settlement. A man is not obliged to leave his wife, or anybody else, anything in his will.—KAPPA.

[58396.]—**Legal.**—If a tenant leaves without giving notice he can be sued for the forfeited quarter's rent; but the landlord has no right to distrain for rent not due. An action is the only remedy.—KAPPA.

[58398.]—**Legal.**—Yes; but you must take out administration to your sister's share.—KAPPA.

[58436.]—**Ten Acres (and a Horse).**—If "Ratio" will again read the first part of my solution of this problem, he will see that it is correct, and that it does not matter whether A C is a tangent to the curve A D, or whether it cuts off a segment. I first get an expression for the small segment on the line A B by subtracting the triangle A B C from the sector A C B; then to this I add the expression for the sector A B D, which gives an expression for the upper half of the one-acre space. Even if B D were to be made equal to B C, so that A C were to cut off a considerable segment from A D, the expression would still be mathematically correct.—M.I.C.E., Bath.

[58459.]—**Dumpy Level.**—Many thanks to Mr. Bigg for his answer. I should like a telescope level, if possible; my tripod is one which has been used with a dumpy level. I want a level for use in making cricket grounds, tennis courts, and for draining.—JOHNNY NASH.

[58460.]—**Binocular Microscopes.**—Is not "No Sig." in error when he states that the right half of the image passes uninterruptedly to the eye? I think he will find that the left half of the image passes into the right-hand tube, and the right half is reflected by the prism into the left-hand tube. Will any reader of the "E. M." who has used one of Dr. Wallich's condensers give us the benefit of his experience with it—whether it possesses the advantages claimed for it by the inventor above the ordinary form of achromatic condenser?—H. B.

[58468.]—**Furnace.**—"J. F. C." would esteem it a favour if "T. F. S. T." would give the dimensions of a furnace. The crucible I have is 8in. in diameter and 16in. long. I want to know the diameter inside cupola and thickness of fireclay. I am making a fan 12in. in diameter and 6in. through it. It is in six blades, 5in. by 5in. My gear is capable of driving it at 1,500 revs. per minute. Is it capable of doing the work I require?—J. F. C.

[58473.]—**Legal.**—You can bring an action to recover the rent at any time within six years of its becoming due.—KAPPA.

[58487.]—**Short-Circuit Bells.**—These bells ring by shunting their own coils when the armature is drawn towards the cores, thus never breaking the circuit like the ordinary trembling electric bell, so that any number can be joined in series, and all will ring together perfectly. I should be glad if "C. D. R." can say the best gauge wire to use on them.—L.

[58493.]—**Microscopic Objectives.**—The best way for "F. E. F." to determine the angular aperture of his objectives is by means of Prof. Abbe's apertometer. Messrs. Powell and Lealand's oil-immersion condenser is one of the best forms to use for high-angled powers. Also Wenham's reflex illuminator. In using this as a condenser, it is better to use glycerine to make immersion contact with the lower surface of the slide, and then slightly lower the condenser, when the field will be brightly illuminated. If "F. E. F." wishes to see test objects with the greatest distinctness and brilliancy, he should obtain some slides mounted with Prof. Smith's new 2·4 medium.
They can be obtained from Dr. H. H
Geneva, N.Y. State, U.S.—G. CLIFFORD.

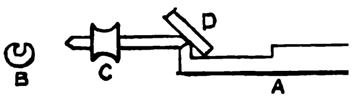
[58534.]—**Metal Moulds for Vulca**
"Os" will smear his moulds with soap or
he will not be troubled with rubber adher
vulcanising. It is only in cases having de
cuts that I have had any trouble in gett
the mould; but considering the time re
make metal moulds, and liability to ac
taking from the same, I do not think it
the trouble. I prefer to use a good q
plaster, leaving plenty of time to set,
varnishing the surface, covering it with
foil, burnishing down if necessary, and
with soap, and I get a smooth surface, as
to tear off the tinfoil when cold.—GYPSU

[58536.]—**Bisection of a Triangl**
Straight Line drawn through a give
Within or Without it.—In answer to "
letter of Jan. 22nd, if a triangle be balan
its centre of gravity, it will also be balan
any straight line passing through the
gravity in whatever direction. And
cannot but bisect the triangle; for if it di
triangle would tip over in the directio
greater part, which is impossible whilst
upon its centre of gravity.—ELAG.

[58537.]—**Bisection of a Triang**
"A H = H h," read "A H = A h." The
tion down lower is faulty; but anyone who
the solution can correct it for himself.—
SAP.

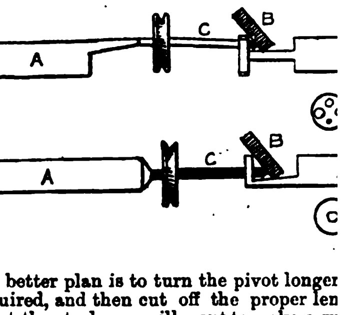
[58560.]—**Iron for Field Magnets.**—
iron v. cast iron for F.M.'s depends in
measure on the actual constructive detai
machine itself. If the armature has a s
of core it would be useless to employ a ver
ful field, as the armature core (Gramme)
conduct a certain number of lines of force.
other hand, the armature may have a very
core; consequently, the power of the fiel
increased to its utmost capacity. Then
seen that in the first place the employme
iron may be permissible; and in the second
wrought iron must be used. In all cases,
iron, when possible, should be used for
cores, as the same current running round
will induce the greatest amount of magnet
wrought iron. You may take these figure
tically correct:—Wrought iron F.M.'s, E.M
volts; malleable cast iron F.M.'s, E.M.F=
cast iron F.M.'s, E.M.F. = 60 volts. As
not able to answer this simple question y
am afraid you will not succeed with the e
machine you say you are making.—W. H.
Coventry.

[58568.]—**Watch Turns.**—"A. W." sh
his runner in the vice, and file out centr
made perfectly flat; then take a broken r
and, without softening it, make a long, sh
to it by rubbing it on the oilstone, turning
at the same time. He should place the
this punch as near as possible to the edge



in vice, and a slight tap with a small ham
make his centre sufficiently near edge to
smallest pivot. The way to point a piece
truly is to file down a steel runner as A;
view of same, C, work to be pointed; D
worn file, held at angle point is requi
drawn backwards and forwards as work
with the bow.—PEGANDREDSTUFF.

[58568.]—**Watch Turns.**—The reason
not get the graver close to the work, is e
cause the piece is not properly pointed, o
in the runner is not near enough to the e



the better plan is to turn the pivot longe
required, and then cut off the proper len
point the steel, you will want to make a r
shape of A¹ or A², according to which y
will suit you best; round the end of th
something like a true point, then allow th

pass through one of the holes in the runner, placing the file as shown at B, work the bow, at the same time filing until a good point is obtained. A, A^1, A^2, the runners; B, the files; C, the steel to be pointed; D, the end view of A^1 A^2.—G. STENING.

[58581.]—**H.P. of Compound Engine.**—There is an error in mine *re* this, owing to the back pressure being taken off before multiplying instead of after. The constant should also be ·0000606 instead of as given. Applying these corrections, calculations would stand as follows:—$·0000606 \times 113 \times 131\frac{1}{4} \times [\frac{95}{8} (1 + 2·079) - 2·5] = 30$ h.p. "W. H. S." has assumed an expansion of 12 times, which causes the difference in our results, but applying above formulas to his assumed case brings out power as about 19 h.p., as given by "W. H. S." All I wish to show is that above formula is simple and correct.—T. C., Bristol.

[58585.]—**Cold Feet.**—Have heard that external application of whisky well rubbed in is as good as anything. A trial can do no harm.—QUÆSITOR.

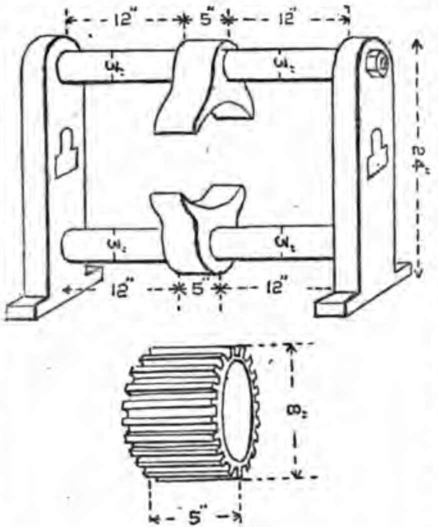
[58585.]—**Cold Feet.**—I should recommend the sufferer to stand up, and then slowly raise himself up on tip-toe, and then lower himself slowly down again. Let him continue this for a dozen or so times, and he will find that the circulation of the blood will soon commence and warm his feet. This practice is rather trying for the calf of the leg.—ONE WHO HAS TRIED.

[58587.]—**Incandescent Lighting.**—If you will refer to my answer to query 58438, you will find a sketch of connections. This is a shunt machine. You will see that the current leaves the left-hand brush, passes through one of the F.M. coils, to the adjustable resistance from there through the other F.M. coil to the right hand brush; two wires lead from the brushes to the terminals of the machine, and from these terminals two wires lead to the lamps. If the sketch showed a series-wound dynamo, the direction the current would take would be as follows: From the left-hand brush through one of the F.M. coils to left-hand terminal; from left-hand terminal, through lamps, back to right-hand terminal; from there through the other F.M. coil, to right-hand brush, thus completing the circuit. If I have not made myself clear, will help you again.—W. H. EAVES, Coventry.

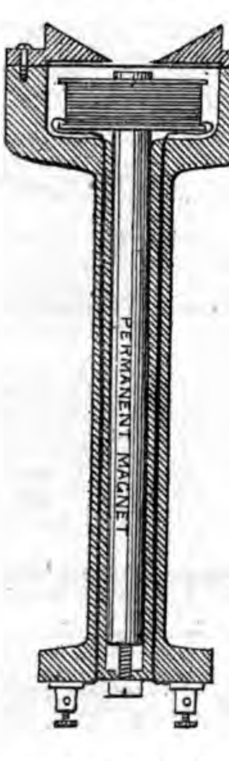
[58589.]—**Piano Action.**—TO. MR. DAVIES.—I think "Apollo" will find that the brass levers he refers to have nothing to do with taking out the action, but are only intended to raise the hammers, so that the check wire at the end of each key may have room to pass when the keys are being removed. The action is probably fastened in the usual way by screws, which pass through the centre and front rails of the key-frame into the key-bottom. To take out the action the hammers should be raised to the strings and secured in that position by the small wooden bolts which are usually fitted for that purpose. The screws which hold the action in its place are nearly always under two consecutive white keys; supposing, therefore, the compass to be six octaves, it will be necessary to take out the keys numbered 7, 8; 24, 25; 43, 44, and so on to the top. In taking out the keys, the hoppers should be pulled forward by the finger until they are free of the lever, otherwise there would be a great strain on the hinges. The "box," or treble action, is generally detached from the lower action, and must be removed first; but before attempting to pull forward the action, be careful to lower the hammers so that they may pass freely under the soundboard. If it is intended to cover the hammers, they should only be trimmed roughly at the back prior to the action being replaced; the action may then be put in and secured to its exact position by a few of the centre screws. The hammers should then be raised to the strings, as before, and marked to their respective notes, as so very little difference in the trimming will cause them to strike the wrong strings. Above all, be careful not to attempt an improvement of the tone by using a thicker felt, but keep as nearly as possible to the quality and thickness of the old material. If new hammer hinges are required, put the action in, as directed for trimming, and pull the hammers to the strings with a screwdriver or blunt chisel pressed on the hinges; the covering slip need not be put on until the glue is well set.—W. H. DAVIES.

[58601.]—**Geometrical.**—"Puzzled" requests geometric proof that equilateral triangle is greater than right-angled isosceles triangle inscribed in the same circle; this may be evident without printed diagram, if "Puzzled" will bear in mind that the inscribed hexagon is greater than inscribed square, and, further, the above-named triangles are equal to half the inscribed hexagon and square respectively.—A. DANCASTER.

[58602.]—**Gramme Dynamo with Pacinotti Armature.**—TO MR. BOTTONE.—Annexed is sketch with dimensions marked in inches of F.M.'s, and armature for a 500-c.p. lighter. The armature should be mounted on a star wheel at each end (gun-metal or brass). The shaft should be 1in. in diameter, good steel. The F.M.'s should be malleable iron. The ring I prefer of Jones's pattern "laminated," but a casting will do very well, provided it is very soft, malleable iron. With 10lb. of No. 16 on the ring, laid on in two strands in each section, the ends being joined by soldering, so that the two strands form but one electrically, of half the resistance, there is no difficulty in winding. There should be 20 sections in the armature, each capable of taking ½lb. of wire. The F.M.'s should be shunt-wound, each cone being wound with 20lb. of No. 18; the whole coupled up in series. I would refer the reader to the "E. M.," No. 1007, for mode of joining wire to commutator, and also to two excellent articles by Mr. W. H. Eaves, Vol. XLI. pp. 261 and 564 of "E. M."—S. BOTTONE.



[58604.]—**Telephones.**—The bobbins are simply pushed on tight on one end of magnet, as sketch, with a little projecting, against which diaphragm vibrates very closely. There is no iron about it (except diaphragm). The direction of winding is not particular. Any kind of terminals will do. Small battery terminals are the handiest.—LES ENFANT.



[58604.]—**Telephones.**—It will not matter which way you wind the bobbins, and a soft iron core is not absolutely necessary, but is an advantage; it should be tapped into the magnet. Don't use the screw adjustment to the magnets, it gives endless trouble; fix the magnet in tight and adjust once for all by putting discs of paper at the top under the diaphragm. Put the terminals at the small end and lead the wires (insulated) down inside the tube. The bobbins are not in circ
battery, but are joined up to the secondary w
the microphone coil.—OS.

[58606.]—**Ball Bearings.**—"Doctor Medi
in his reply to "One axious to Learn," says
ridden a bicycle several months with one bal
in the bearings without any detriment;
does not say whether it is a double ball-be
If so, it merely converts it into a single ball-be
but if it is a single ball-bearing, it shows th
must have touched each other all the way
and in that case the loss of one ball would be
an advantage than otherwise. As "One A
to Learn" said that his bearings originall
tained 13 balls, it must be a single ball-bear
account of the odd number. The reason
leave a slight space between each row is to p
their grating against each other; and the
others keep them apart by means of a perf
brass cage is to prevent their interfering wit
other's motion.—G. TOWNSHEND.

[58608.]—**Legal.**—An illegitimate son is
filius nullius, and therefore cannot possibl
any relatives, except of course his own (legit
children and their descendants. The prop
an illegitimate person dying intestate and a
lor consequently escheats to the Crown, there
no heirs or next-of-kin to take it. I belie
authorities generally deal liberally with
dependent on the intestate if proper repr
tions are made.—KAPPA.

[58621.]—**Locomotive (Model).**—Your
should drive a pair of ¾in. bore by 1½in.
cylinders at that pressure (45lb.) I never f
small tubular boiler with inclosed furnace
well. A spirit lamp with a number of wicks
a copper boiler, having an upright tube or
passing through it, keeps up steam best. I
four-coupled locomotive and tender 16½in
fired in this way, which steams splendidly,
draw a heavy load upon rails.—AMATEUR.

[58621.]—**Loco Model.**—No, size of cylin
about right for the boiler, but you ought t
had more room for water round fire-box.
great trouble with these small models is yo
get draught enough through the tubes to bu
spirit properly, and it is all a question of d
as to whether you can get steam. I have a
larger than yours with ⅜in. tubes, and it is
fect nuisance in this respect. Some time
cut all the tubes out of a small boiler, and
one large one like a Cornish boiler, and it
great improvement. I expect you are tr
with shortness of steam for want of drau
T. C., Bristol.

[58621.]—**Locomotive (Model).**—In re
"Lincumpump's" query, I think ½in. cylind
too small for the boiler described: they sho
⅝in. bore by 1¼in. stroke, and the driving
about 3½in. diameter. I have a model with a
about the same size as the one referred to
the cylinders are ⅝in. bore by 1⅛in. stroke, the
makes plenty of steam at about 20lb. per
inch, and is heated with methylated spirits su
to six ⅜in. wicks in the firebox by a siphon
a tank placed above the footplate; it is nec
to have a small jet of steam to blow
chimney to make sufficient draught t
the flames through the tubes, until the
is started, when the exhaust steam fro
cylinders will make the draught. When you
the spirits in the firebox of a model boiler
loco. type the flames will not pass through tu
½in. diameter unless urged by a blower; bu
cannot be used till steam is being made, so
the boiler depends upon the firebox alone for
ing surface, the door in the latter being left
for the escape of the fumes, much less spirit
burnt than when the blower or blast is at
The supply of spirits can be regulated by the am
of cotton wick in the siphon tubes.—E. L. P.

[58622.]—**Government Architectural
signs.**—The answer to the interrogative (not
argumentative) part of "Architect's" questi
me is, that nobody but the Government ca
pose plans to be paid for by Parliament; bu
liament (which, in this case, is only the H
Commons practically) can refuse to vote m
plans that it does not approve of, and mi
resolution that the Government ought
another plan.—EDM. BECKETT.

[58623.]—**Induction Coil.**—The
seems somewhat thin; but it will be
it was originally sound and of good
should have been taken to fit the
to the tube, also to prevent them
any degree during the process of
paraffin rings or washers should
creased in thickness towards
secondary; but this proportion
tion to the increasing electrical
lutely necessary in coils of mod
in the present instance, massiv
provided, the washers may
if each coating is firm and

out the solder. Make the halves thick enough to chase a fine thread on in the lathe, like the small telescopes have.—T. C., Bristol.

[58643.]—**Black Marble Columns.**—In answering this question, it is rather difficult to understand what is wanted. The size of columns not being given, I cannot say whether the price mentioned for repolishing would be cheap or not. The cheapest and best way in the end will be to have them properly polished; there can be no use in having black marble columns painted, as other and cheaper materials would do just as well. In the first place the paint must be entirely removed: a strong solution of potash and water used hot should do this; but if they have to be scraped, the scraping should be done very carefully to avoid cutting into the surface of the marble. If the columns are simply straight shafts, without beads or other ornament, they may be polished by hand without putting in the lathe. If beaded or otherwise ornamented, they must be polished in the lathe. The first thing to be done will be to find the centre at each end; the centre holes will probably be left in, if not, holes must be drilled; it is usual to have a piece of iron ½in. thick, either square or triangular, let into each end, with hole drilled in centre to fit the lathe; but as they are only required to be polished, and not turned, black marble, with care, should do without these. Having got them to run true in the lathe, carefully examine to see if there are any holes or bits chipped off; if any are found, these must be filled up with stopping, which for black is shellac melted and lampblack stirred in until a good black has been obtained; pour this on a wet slab, and draw out into sticks. To use the stopping, heat the place until just hot enough to melt the stopping when held against it; have ready a hot iron similar to a soldering bit, melting and smooth the stopping, leaving it as near the required shape as possible; this will save labour afterwards. When every small hole has been filled, set the lathe in motion at a quick speed, and with a piece of pumice-stone held in the hand against the column, use water and keep constantly moving from end to end so as to get the same surface all over, not forgetting to go over the beads, &c.; this will grind down the stopping to a proper level. When this is accomplished, wash off with sponge, and carefully examine the surface; all deep scratches must be got out now, as no reasonable amount of labour will remove them afterwards. The great thing is to get it up well, or the polish will be a failure. Be very careful to guard against oil or grease, or you will not be able to polish. The pumice having been applied well and carefully all over, wash off with clean sponge free from grit, then dry the surface, and examine the stopping; if this is found to be all right and all scratches removed, repeat the same process, only using hone instead of pumice-stone. You will find that this brings up the surface still finer; keep on with this until you have got a nice fine surface from end to end. Always examine the work with the surface dry, as water gives a false polish, and wash between each operation. When you are satisfied that the hone has done its work, the polishing proper may be begun. Take a clean piece of cotton cloth, double it up so as to form a pad: on the face of this put fine washed emery: a sufficient quantity should be applied at first, as a second application is bad: hold this with a good amount of pressure against the revolving column, keeping it on the move up and down. Continue this until a slight polish has been obtained, then wash, and use another cloth with tripoli. This will bring up the polish still higher: wash again, and finish with putty-powder. All powders to be used with water, but do not make them very wet. The putty-powder should bring up the polish to a fine jet black as bright as glass. To test when the polish is perfect, wet a small portion, and if the dry and wet part appear the same, the polish will be complete. Wash off, and when dry cover with beeswax dissolved in turpentine: this is to preserve the polish, and should be left on until the columns are fixed, when it may be removed with turpentine.—W. POTTER.

[58646.]—**Platinum Electrodes.**—Fireclay, or perhaps pipeclay, would probably suit this querist. —Os.

[58647.]—**Cemented Floors.**—I suppose you mean that the cement comes up as a grit. You do not mean the dust that gets through the matting. If so, I have had the same complaint, and gave it a coat of the first paint I laid my hands on, and found it a success. The thinner it is in reason the better, provided you don't thin it with turps. I should use linoleum in preference to oilcloth. Remember all floor coverings will rot on a damp floor unless, like matting, it is so open the air can keep it practically dry.—T. C., Bristol.

[58649.]—**Dynamo as a Lathe Motor.**—I cannot recommend a battery and motor for this purpose. It will only lead to disappointment.—S. BOTTONE.

[58651.]—**Intensification.**—If Mr. Park does not like using the mercury intensifier, let him try the formulæ given below, which I take from the Almanac for this year: Sulphate of iron and ammonia, 1oz.; lump sugar, 1oz.; glacial acetic acid, 2oz.; albumen, 1oz.; distilled water, 20oz. Add the albumen last. A few drops of a 20-grain (to the ounce) solution of silver nitrate to be added at the time of using. Be careful to thoroughly free the negative from hypo before using the above. In conclusion, I would advise "Gatton Park" when sending a query to the "E.M." to write it in plain English, and not use symbols, because every photographer is not a chemist. By so doing he will be more likely to receive answers. Let him also procure the Year Book and Almanac for the year if he wishes to get some practical hints on photography—JOHNNY NASH.

[58654.]—**Liquid Silex.**—I think this must be sodium tetrasilicate, the so-called soluble glass. It is not a liquid, but will dissolve in water. Its formula is $Na_2Si_4O_9$.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[58655.]—**Trigonometry.**—In the case where the observed point is 100ft. distant, and only 1ft. below the horizontal line, the angle of depression will obviously be very approximately equal to the angle subtended at the centre of a circle of 100ft. radius by an arc of the circumference 1ft. in length, which may be calculated as follows:—The circumference of a circle 100ft. in radius is 200πft., and since the angles subtended at the centre of any circle are proportional to the arcs on which they stand; therefore $200\pi : 1 :: 360° :$ number of degrees in required angle, which will therefore be $\frac{360}{200\pi} = \frac{180}{\pi} \div 100 = 57{\cdot}2958° \div 100 = 0{\cdot}572958° = 34{\cdot}377'$. If we calculate the angle from a table of natural sines—the sine being in this case $\frac{1}{100}$ or ·01—we shall find the angle to contain 34·378′ nearly; thus by the above method we have found the angle correct to $\frac{1}{1000}$ of a minute. Of course, the accuracy of this method decreases as the angle increases: for angles of 5°, 10°, 15°, 20°, and 30°, the errors will be about 0·013°, 0·101°, 0·355°, 0·855°, and 3·648°.—RATIO.

[58656.]—**The Wimshurst Machine.**—To "J. R."—If you have no better means to test the quality of the glass, try the following very simple one:—Get a piece of paper, say, ½in. square, and attach it to the end of a silk thread; then, in a reasonably warm and dry atmosphere, rub the glass pretty briskly with a silk handkerchief. If the glass is of suitable quality, its surface will become electrified, and will retain the excitement for some minutes; the silk thread and its little paper attached will furnish the means for testing this. The points of the combs should be, perhaps, ½in. from the glasses. The tubes of the neutralising rods fit into the holes of the woodwork, the steel spindle fits into the tubes. Use washers made of vulcanised fibre (not brass) to attach the glasses to the bosses; the washers should not rub against each other: leave the brass bushes sufficiently projecting to prevent the washers from touching.—J. W.

[58657.]—**Induction Coil.**—The secondary wire of this instrument is either broken, or the insulation has broken down. The amount of wire is not disproportionate.—S. BOTTONE.

[58657.]—**Induction Coil.**—The quantity of secondary wire on this coil is no fault. The fault may arise from the secondary being broken. Did you test it for continuity before winding? This should always be done, each layer should also be carefully tested after being wound. Test the secondary as it now stands with battery and galvanometer. If it is found to be continuous the fault is not in the wire, but in defective insulation. Supposing it to be all right in these respects, no spark of much consequence can be got without a condenser.—BOBADIL.

[58657.]—**Induction Coil.**—The dimensions seem fairly good. There is perhaps rather much secondary (I estimate it at about 1,500 yards, taking the outside diameter of coil at 7in., which allows for insulation between the layers); but this should not prevent getting a spark even without a condenser, if otherwise the coil is right. See if the secondary is unbroken by trying if it will conduct a current from the battery. Defective insulation is often the cause of failure.—J. BROWN, Belfast.

[58658.]—**Æsop.**—Original speed of hare is 4 and of tortoise ¼, which is constant $\therefore \frac{1}{4}x =$ distance travelled by tortoise. Distance travelled by hare $= 4\,(1 - \frac{1}{2} + \frac{1}{4} \div \frac{1}{8} - \ldots)$, which always $= 4 \times 2 = 8 \therefore$ tortoise overtook hare in $8 \div \frac{1}{4} = 32$ minutes.—T. C., Bristol.

[58659.]—**Glucose in Leather.**—Extract the glucose from the leather by warming with a little water. The leather might advantageously be shredded. To the solution thus obtained add a few drops of a solution of sulphate of copper, and then caustic potash drop by drop, till the ppt. first formed redissolves. If no glucose, or other reducing agent, be present, the ppt. w
solve. In any case, heat and a ppt.
then red) of cuprous oxide indicates
similar body. A brownish-black p
oxide may be disregarded, as it is on
action of the potash on the coppe
B. B.

[58660.]—**Edison's Chalk-Cylinc**
—TO MR. BOTTONE.—**Mine consiste**
wheel of chalk, looking for all the
small grindstone, mounted on a
platinum wire for an axle. This w
supported on two wooden upright
soaked in melted paraffin). Two bru
thin platinum sheet, press, one on the
the chalk cylinder, the other on the p
itself. The cylinder must be moiste
it work. When wet, if the cylinde
a current is set up from centre to per
—S. BOTTONE.

[58663.]—**Breakage of Loco. S**
Is "slide-rods" correct? If so, mo
are wanted, for at present the cause v
be that they are too weak. Surely
must be meant; though it is eviden
engine if it "slips" with steam shut
is usually understood to mean wheels
round by the steam because the rai
or there is insufficient adhesion.—NU

[58663.]—**Loco. Slide Rods.**—W
wish to know is why the engine (No.
side or coupling rods so often, not w
her slide rods, as by my own fau
appeared last week to the waste of yo
S. PATTEN.

[58666.]—**Incandescent Lightin**
BOTTONE.—If these castings are fr
will find they require the following
wire:—Fields: 2lb. of No. 16 in serie
ture, and 8lb. of No. 20 in shunt wi
Armature: No. 20 about 3½lb. I get
out of the machine with about ¾ H.P.
10's very easily.—S. BOTTONE.

[58666.]—**Incandescent Lightin**
BOTTONE OR MR. EAVES.—Your p
can be used either as series or shunt.
the series system, wind the armature
No. 18 d.c.c., and the F.M.'s with 12
d.c.c., the coils being placed two in ser
in parallel arc. If you wish to wind
as a shunt machine, then use for the
of No. 18 d.c.c., all the coils in series, a
as shunt on brushes. Probable po
machine, 8 to 10 ampères, and from 1
—W. H. EAVES, Coventry.

[58667.]—**Electric Light for P**
candlesticks of a piano would be, perh
convenient place to fix incandescent lam
Swan lamps of 2½ c.p. with holders,
them in parallel arc. A battery to give
light at a stretch is what we all want.
which comes nearest to this is the
nitric acid is used in the porous pots,
must be kept out of doors on account o
but fumes may be avoided by using
nitric acid, the ordinary bichromate solu
quart cells in series will be necessary; l
than four or five hours' light may be
BOBADIL.

[58671.]—**Calorific Intensities.**—
that "Equivolt" means heats of form
will try to hunt them up for him next we
JOHN GREY, F.C.S., Analytical Chem
castle-on-Tyne.

[58671.]—**Heats of Combination (**
Intensities).—If the former is meant,
noteworthy authors are Andrews, Favre
man, Berthelot, and Thomsen. The follo
from the tables of the last mentioned in
mann's "Beiblätter," 1879, Nos. 1 and 5, a
No. 8. They are in calories, for compounds
tion where soluble:—Al_2Cl_6 475560, Na_2Cl_2
$ZnCl_2$ 112840, Cu_2Cl_2 65760, $CuCl_2$ and CaC
62710, $FeCl_2$ and $FeCl_2 4H_2O$ 99950, Fe_2Cl_6
$CaCl_2$ and $CaCl_2 6H_2O$ 187640, MgCl
$MgCl_2 6H_2O$ 186930, Na_2Cl_2 202340, K_2O
Na_2O 155260, CaO 149460, $MgOH_2O$
$ZnOH_2O$ 82680, $FeOH_2O$ 68280, $CuOH_2O$
Cu_2O 40810, CuO 37160, $Al_2O_3xH_2O$
$Fe_2O_3yH_2O$ 191130, K_2S,Aq 113260, N
103970, CaSAq 98330, KSHAq 65100, Na
60450, CaS_2H_2Aq 115360, MgS_2H_2Aq
$ZnSnH_2O$ 46370, $FeSnH_2O$ 23750, Cu_2S
$CaO_2N_2O_4$ 207210, MgO_2SO_2 231230, Ca
248979. See also Watt's "Dictionary of Chem
—J. BROWN, Belfast.

[58675.]—**The Wimshurst Machine**
L. T. GARLAND.—1. The glass discs, after w
ing, should be warmed up to, perhaps,
which may be done by holding them over a
burner, but be sure to keep the glass evenly
or it is liable to crack. For the greatest le
spark, thick brass sectors, with
polished edges, are the best; the difficulty
of their use is that no cement seems to

of each head of the box. The outlet for the current is at the periphery of the box, and the centre of each head has an opening for the inlet. On the centrifugal principle, it will be obvious that with this blower I get a certain pressure of air at the periphery of the box. If I revolve the fan at a moderate speed I get a fair current through the outlet, but not sufficient for my purpose; and, strange as it appears to me, if I increase the speed of the fan, the current is diminished. I have curved the blades of the fan, instead of having them radial, and tried every other modification I can think of, without any good result. I can understand that the fan will not compress the air sufficiently to force a strong current through a small outlet, but I cannot understand why the current is diminished with an increased action.—W. H. H.

[58704.]—**Wheel-Cutting Machine.**—I am desirous of making a machine for cutting the teeth of clock wheels. Could any reader of "E. M." give sketch of a reliable machine? I have the arrangement for cutting in the lathe, but require a separate machine, the dividing plate being horizontal.—BRASS.

[58705.]—**Seamless Lead Joints.**—I have to make several circular lead vessels, the lead being ¼in. thick, and require to be made from sheet lead. Would any of "ours" inform me how the seamless joints are made, as they must not be soldered?—BRASS.

[58706.]—**Stationary Engine.**—A stationary engine is required for pulling a waggon and load up an inclined tramway by means of a steel wire rope. The weight of waggon and load is five tons; horizontal distance, 350 yards; rise, 100 yards; speed, six miles per hour. How is the required horse-power of engine calculated? Present surface of ground where line is to be laid is a hollow curve. How may the deflection of rope be found and the least angle (at any point) at which the front wheels of waggon will not leave the rails?—ANXIOUS.

[58707.]—**Gelatine Moulds for Plaster.**—Should be obliged if any reader could give any information of above—how to make, proportion of ingredients, &c.—GYPSUM.

[58708.]—**Amalgamating Zincs.**—Would some reader of "ours" kindly tell me how I can amalgamate zinc cylinders with mercury, as I have been unsuccessful? The way I used was to dip the zincs for a few minutes in a solution of sulphuric acid, and then tried to cover them with mercury, but ignominiously failed. Ought the zincs to be chemically prepared, and does it matter how long they are left in the H_2SO_4?—GEORGE.

[58709.]—**The Wimshurst Electric Machine.**—I have made one of these machines. Size of plates, 15in. in diam., with 15 sectors of tinfoil on each plate, each sector being 2¼in. by 1in., and about 1½in. apart. I unfortunately got both plates cracked; but I varnished the plates well, and put strips of silk over the cracks. The brushes are made of two pieces of No. 20 copper wire twisted together and pieces of No. 36 copper wire soldered on to the ends of the thick wire. The conductors are made out of ⅜in. brass piping, with bits of No. 36 copper wire soldered on, which bush against the tinfoil. These are supported by two gauge-glasses varnished inside and out with shellac varnish. I only get about 1in. spark without Leyden jars, and when I attach Leyden jars, the outsides together and the insides of each to the conductors, I get no result at all. I should be glad if Mr. Wimshurst would be good enough to put me right.—THOS. SMITH.

[58710.]—**Atoms.**—From time to time I see atoms spoken of in the "E. M." as though they were verities. I have been outside the chemical world, so to speak, for some time, and when I left it I did so with the impression that ultimate atoms were nothing more than a freak of imagination, and that the notion was quickly dying out, being supplanted by such terms as combining quantity or weight, equivalent weight, &c. The frequent occurrence of the word "atom" in the "E. M." has induced me to ask the following questions, and trust some of our chemical readers, who have followed the advance of the science, will oblige me with replies. Has the existence of atoms been proved? If so, by whom, and by what means has this wonderful and interesting feat been performed? What size have they been found to be, and what distance are they apart (from centre to centre) under given conditions? Are they solid or hollow, square or round, flat, or what? Also, how do they bind themselves together to form masses?—INFINITUM.

[58711.]—**Aluminium.**—I am much obliged to Mr. Wm. John Grey, F.C.S., for replying to my query; but as I do not happen to possess a collection of textbooks on chemistry, or even have access to any such collection, it would be rather a difficult matter referring to them for the physical properties of aluminium. The following properties I wish to know for a particular purpose, and if Mr. Grey has any such information to hand, I shall esteem it a favour if he will give it in particular together with the authority. How many kilograms will be required to break an aluminium wire 1mm. in diam.? What are the malleability and ductility of Al in relation to the common useful metals? Can Al be volatilised? If so, at what temperature? Also, at what temperature does it begin to oxidise when heated in atmospheric air?—BROMIUM.

[58712.]—**Guide Mill Rolls.**—I shall kindly thank some of "ours" to instruct me how to groove a pair of rolls properly, that I may roll 1in. square iron down to ¼in. square. A template sketch of the grooves would greatly assist, with particulars as to best size in diam. of rolls, and all information with reference to the above.—BLACKSMITH.

[58713.]—**Burning China.**—Will any reader oblige with information how I can erect a small furnace for firing china after it has been painted by hand on the glaze, to heat it by gas or coal?—SNOWBALL.

[58714.]—**Mathematical.**—I should be much obliged to any reader who may have access to the English Cyclopædia, if he would give me the value of π given there, as I understand by "Limax" under "Quadrature of the Circle" to 607 decimal places. I should also like to know from what expression it was calculated.—RATIO.

[58715.]—**Rust-Preventing Covering for Iron Castings.**—Will someone who knows the best preparation for above oblige by imparting his knowledge? The castings will, in all cases, be ultimately painted. Has paraffin oil been tried? It has been suggested that dipping in paraffin oil and drying in warm air would be a speedy and efficient means to the end desired, which is simply to prevent rust caused by atmospheric moisture.—JOSS.

[58716.]—**Rice-Husking Machine.**—Is there a machine in use for husking rice? Did the Indian Government ever offer a reward for a machine that would husk rice successfully? If so, what amount was the reward? Where would be the best market to sell a rice machine that would husk rice successfully?—W. H. C.

[58717.]—**Limelight.**—Will any of your correspondents kindly inform me whether they have ever tried zirconia as a substitute for lime in the lantern and with what result—whether it gives as good a light, how long it lasts, where it can be procured, and its price, &c.? Also whether there have been any late improvements in artificial limes, and the best formula for their production?—L. S. D.

[58718.]—**Solenoids.**—Would Mr. Bowron kindly give me the particulars how to construct a solenoid? I want them to work a few small toys I intend to make, to be worked by 1-cell bichromate.—STEEPLE JACK.

[58719.]—**Dynamo.**—TO MR. BOTTONE, OR MR. EAVES.—Will you kindly state size and weight of wire for small dynamo? W.I.F.M. 6 by 2⅜ by 1¼, inclusive of boring for armature of W.I. discs, insulated, to light one of Archereau's arc lamps described in page 304 (57596). Also number of revolutions it is required to be driven?—ANXIOUS ONE.

[58720.]—**Backlash.**—How may backlash be prevented in screw gear?—ELDHIN.

[58721.]—**White-Liming.**—A little time ago I white-limed the top of one of the rooms of my house, but soon found, to my dismay, that it had been previously done with whiting, and, as a consequence, it now presents a sad appearance. Is there any remedy other than scraping it all off and re-doing it? Also, how may I know in future whether any wall has been done with whiting or not? How may I avoid such a mess in the future?—ELDHIN.

[58722.]—**Furnace.**—Will "T. F. S. F.," who kindly gave particulars of furnace in Jan. 22, please give us a few further notes on same? Is the outer casing of iron, and will the ordinary fireclay which is supplied at the oilshops do for the lining. I wish to make a movable one. Would a slab of stone do for the base? Any hints as to working it when made will be gratefully received by—LIQUEFACTUM.

[58723.]—**Old Brasses.**—Will some correspondent inform me how to line old brasses belonging to steam thrashing machines? How is the metal held in them, and how do they get the size of bore? Some wear endwise. How am I to fix the metal so as to fill the ends as well as the bore? What class metal is it? How is it made?—MACHINEMAN.

[58724.]—**Boiler Query.**—TO MR. T. C., BRISTOL.—I am making an engine, 2in. bore by 3½in. stroke, to drive my 3½in. centre lathe. Would an external-fired horizontal boiler, 15in. long, 12in. diam., grate 8in. long by 5in. wide, supply steam enough to drive an engine the above size? I intend to make boiler of 3-16in. mild steel, well riveted and stayed, the working pressure not more than 25lb. I am confined for space, hence my reason for asking your advice before making.—SMALL SPACE.

[58725.]—**Circular Milling Cutters.**—I have been a reader of "E. M." for some time, and much interested in plain lathe work, in iron and wood; but have never seen a circular milling cutter. Will someone kindly say at what speed (feet per min.) the acting part or circumference of such cutters will do most work of such a kind as fluting taps, &c., and would not the same cutter be much more efficient if mounted on a lathe mandrel and driven very slow, than it would be if fixed in a cutting frame (such as at page 406) and driven by an overhead at a high speed, as I find if I drive work in a lathe rather fast the edge of the tool is soon gone? Please also give best form or inclination of teeth for a cutter about 1½in. diam., or less. Should the front edge of tool point about straight to the centre? I suppose the work advances against, not in the same direction as, the acting part of the cutter? Is there a small work published, treating of this kind of lathe work chiefly?—H. M. D., Devon.

[58726.]—**Trouve Armature.**—Can any fellow reader inform me if the above improvement on Siemens' armature is patented in this country? Also if it really has the advantages claimed for it, as avoiding dead points during revolution? Also, where can I find a description of Ayrton and Perry's E motor? I have a very large one, which I cannot get to work. The commutator seems wrong, and there is only one terminal to armature wire. I have all back numbers from commencement for reference.—LETTORE ITALIANO.

[58727.]—**Music Plates.**—I should be glad if some kind reader would answer the following questions:—Of what metal are the plates composed? Is the Vieille Montagne zinc suitable, or can I buy the plates prepared? What punches and tools should I require? Can I buy them, or must I get them cut by a letter cutter? What would be the probable cost of a set of punches and tools? To what depth should the plates be punched? Will the depth of ordinary copper-plate work be sufficient? Is there any book or work that I could get any information from? If any kind reader would answer these questions (or part of them), or give me any hints as to the process, I should be very grateful.—IXION.

[58728.]—**Commutator.**—TO MR. EAVES.—Having been a reader of the "E. M." for about five years, I have not yet seen a good article on how to construct a commutator such as is used in the Gramme machine, so, if it will not be asking too much of you, would you be kind enough to give a description of one? How is it made and mounted on the spindle, and how are the brass strips let into the insulating material, which I suppose is vulcanite?—W. H. H.

[58729.]—**Small-power Engine.**—Is there any work treating of the management and adjusting of small-power engines, say, up to 2½ H.P.? I have Reynolds' "Stationary Engine-driving," which only treats of two classes—viz., the beam engine and Robey's semi-portable. I have also "The Safe use of Steam," which only refers to boilers.—CASTON.

[58730.]—**Cylinder Valves.**—Will someone kindly explain the arrangement of separate valve to take exhaust from bottom of cyl. (ordinary slide-valve if the advantage gained is worth the ext small cyl.? Also explain the action of the Rough sketches will be acceptable.—CAST

[58731.]—**Boiler Repairs.**—Having t firebox of loco. boiler, I am anxious to kn to screw patch on with should be cop MELSON.

[58732.]—**Photo. Lens.**—Will some the "E. M." tell me the fault of the follow rectify same:—Some time back I bought B stereoscopic lenses. I have fitted o camera, and I find that without a stop it 4 plate, but does not give sufficient depth purpose. Thinking to remedy this by pu stop, I did so, and found the lens did not but seems to have a circle round the corn the fault with lens, or stops? Before that the stops screw into hood of lens, the maker.—A. CLARK.

[58733.]—**Plante Battery.**—Will friend, "Sigma," kindly answer the respecting the above-named battery? T I am making is composed of six cells, eleven plates, 4½in. by 4in. How many a resistance of 10 ohms each, may I exp this battery? Am I right in assuming of the plates, with the exception of the may be reckoned as effective surface? Du of rest, which must be given in the cour should the battery be left charged, or there any objection to using the charge st for some useful purpose before charging direction, or must the current be sent reverse direction without discharging? connecting pieces in my battery are cut in necessary to cover the connecting pieces so, what kind of cement should be used paraffin do?—IOTA.

[58734.]—**To Mr. Bottone.**—Many of magneto; but as my machine is finish all in one piece, I put a brass ring, insula a spring passes, and connect to brass sketch you connect to one part of shaft say whether this will do? Also how commutator? I see by this week's "E interested in magnetos, and should like give a series of letters on the construction that have appeared on the dynamo.—W. H.

[58735.]—**Leather Scrap.**—If this in a close furnace mixed with quicklime, the nitrogen, what are the best proport —N. H.

[58736.]—**Hot Poles of Field Ma** is the reason that one pole of the field mag gets hotter than the other (evidenced by th off), and that the same pole appears to bar quicker and better? I can see thre now in which this occurs, but can get CHATTAHOOCHEE.

[58737.]—**Glycerine.**—Why does glycer through soft solder so easily, and is ther CHATTAHOOCHEE.

[58738.]—**Water Meters.**—In the Sir Edmund Beckett writes: "Suppose charged by meter, as it will be some day, wonder why it ever was otherwise." W kindly say if he knows of a water meter hold use, which is capable of registering mately accurately, and does he really think be advisable to introduce another cause of vexation into the cistern or waterworks such houses as we can find by the thousand NUN DOR.

[58739.]—**Repousse Work.**—Will some tell me how to make the pitch compo. for the and also give particulars of the iron base cannon ball," as the textbooks say? Must same size as the work, or is the work My brass will be about 2ft. by 9in. How ring, upon which the iron base rests, made?—

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ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 27, and unacknowledged elsewhere :—

W. F. STANLEY.—J. K. Esdaile.—E. M. Richards.—One in a Fix.—R. Tudsbury.—Tyro.—John Brown.—H. Ingham. A. O. K.—Urgent.—Sydney.—J. M. S. C.—Dougall.—N. G. W.—Amateur.—T. J. Murday.—Ajax.—J. H. S.—F. W. Muncey.—S. S.—Arthur Mee.—Philoctetes.—H. Lambert.—Lucius.—S. Constable.—Verge.—Abacus.—Sammy.

ASTRONOMICAL SOCIETIES AND THEIR MANAGEMENT (We regret that it is utterly impossible for us to find room for a number of letters that are to hand this week respecting the Council of the Royal Astronomical Society and the new management of the Liverpool Astronomical Society. We trust it is not derogatory to either society to say that a good many members of both seem to think that their internal management is a matter of paramount importance to the readers of the ENGLISH MECHANIC, many of whom, as a matter of fact, are not interested in astronomy at all. With very much matter pressing week by week on our columns, which we are unable to insert, we must ask the consideration of all, and especially of those who occupy space, and would occupy a great deal more, with matters which are not of general profit.)—J. B., Everton. (No, it is a chemical action; but it is convenient to speak of it as a storage of electricity. If one engine would drive the dynamo, why use two? Can run intermittently, but proper arrangements must be made for cutting connections. Read up back numbers.)—W. L. (All three queries frequently answered. See indices.)—SIGNED CLEANER. (Doubtful if there is anything better than lacquer, as you want it transparent.)—NORTHERN DIVER. (Have you read p. 407, Vol. XL., and p. 189, Vol. XLI.? You will find the details you require in the volumes you mention.)—MIDLOTHIAN. (See p. 275, No. 948; the indices of back volumes, and a little work on the subject published by Lockwood and Co., Stationers' Hall-court, E.C.)—ENQUIRER. (Do not understand you. If the Court of Chancery has advertised for the next-of-kin of anyone, the person to apply to has been mentioned in the advertisement; but you can easily ascertain on application at the Chancery Pay Office, in the New Law Courts, Strand, W.C.)—PAPIER. (By drawing them over or through melted gelatine, we suppose.)—MORGAN J. EVANS. (Certainly there is a sale for them. Advertise the fact that you have them for sale, or communicate direct with known dealers.)—TRAMP. (See the discussion on the subject in the last volume.)—A WOULD-BE ELECTRICIAN. (See any textbook, or recent back numbers. 2. Yes, because the extra tension put upon the strings often throws them out of tune. Always keep a piano up to pitch. See p. 388, No. 718.)—J. C. (Why not ask Messrs. Spon, 125, Strand, and obtain an authoritative answer.)—R. E. (The best time to sow grass-seeds for lawns is April: the quantity about four bushels per acre. The price can be obtained with full directions from the seedsmen.)—H. BOND. (See Hints No. 6. Any questions of the kind should be put through our columns in order that others may benefit by the answers. As a matter of fact, we have no correspondent using that or a similar signature.)—GEORGE. (See recent letters about the Ferrous Oxalate Developer.)—MICRO-FARAD. (There is no recognised qualification of the kind; and no special examination. Your questions are matters of purely personal interest.)—BOREAS. (We do not know of any work of the kind. 2. You might do some good by anointing the parts with vaseline, and giving the cat a dose of castor-oil. Much depends on age.)—A. B. C. (In the "nameboard" in a horizontal line with keys, as shown in sundry diagrams in our columns.)—F. N. (We know nothing of it. The proprietors probably do not care to ask our opinion. You can, however, easily form a good idea by the statement that the battery gives a light of twelve candles for one farthing per hour.)—R. P. (That will do. Use 16 for primary. See back numbers.)—COUNTRY SCHOOLMASTER. (Plenty of recipes for inks in back volumes. Extract of nutgalls with a little sulphate of iron makes the best black ink.)—EDWIN G. CAMP. (Thanks; but what are we to do with it? You should send your hypothesis—or theory, as you term it—to the Royal Astronomical Society.)—NEW SUBSCRIBER. (We are under the impression that Mr. Lee supplies instructions with his model castings.)—LAVANT. (It is the heat rays that affect the radiometer.)—W. H. G. (It entirely depends on the width of the existing reed apertures; but what advantage do you expect to gain? Wallis, of Euston-road, and Dawkins, of Charterhouse-street, sell harmonium reeds.)—E. D. (Procure one of the cheap handbooks. 2. Yes, it does. 3. Doublets are considered best for landscape work.)—AULD REEKIE. (See indices and recent back numbers. 2. How do you propose to wind all the layers in any one direction?)—TOMMY DOD. (Coils can be connected in just the same way as battery cells; but they require very perfect insulation, and should be of the same size.)—A. H. MARSHALL. (Directions for building organs run through many volumes from IX. upwards. The paper organ pipes were fully described in No. 992.) O. P. (Take plenty of open-air exercise. For remedies you must consult a medical man, who can acquaint himself with the peculiarities of your constitution.)—J. B. (The current from one of the medical coils might do some good; but a doctor should be consulted.) GALVANO. (Anything that will make a bit of platinum wire incandescent or send a spark between two points will do.)—W. GODDEN. (Such questions are answered in most textbooks. If you plotted down the relative motions of the earth and planets you would see at once.)—BLACKSMITH. (There are no books on the subject so far as we know.)—AMATEUR PLUMBER. (Equal parts of lead and tin—not "blocked tin." If by "black" you mean "soil," it is made of lampblack, which has been previously made red-hot in a metal pot and allowed to cool, mixed with a little chalk, and water or beer, grinding until no grit is left. This should be as stiff as mortar, and when wanted for use is mixed with a little melted glue, warmed, and applied with a brush.)—CHATTAHOOCHEE. (The ENGLISH MECHANIC lifeboat is at Broughty Ferry, near Dundee. 2. The laws of induction are given in nearly all the textbooks.)—F. J. W. (Query frequently answered. See p. 431, No. 955, and the indices of recent back volumes.)—DEDAR. (See many replies in recent numbers. The data given are not very explicit; but you will want a good many cells.)—REDNOC. (By connecting a bell, as illustrated and described many times. See No. 1049, for instance.)—I. N. COGNITA. (The makers of the instrument will, no doubt, supply you with the information you require. 2. The magnet and the bobbin are much the same as in other telephones. 3. The usual size line wire, and a return is better than earth. 4. The batteries are connected in the usual way. See indices. 5. The Glasgow receiver was illustrated and described in the "E. M."; but the number is out of print. No doubt you can find it in any paper which reported the proceedings of the British Association in 1876.)—AMBITIOUS. (All the numbers are out of print; but Mr. Sladen, of 107, Cobden-street, Leicester, advertises that he can supply any back number.)—BIRD. (Apparently you have misunderstood "O. J. L." Vol. IV. of Holtzapffel's work, not Vol. IV. of the "E. M." 2. What is the reference to the engine named? Where and when was it described?)—BERTRAM SMITH. (Many times. See No. 923, for instance. No doubt several in the Photographic Almanacs.)—WM. ROBSON. (Any of the dyes used for vegetable matters will do. You do not say what colour you want.)—J. K. H. (We do not know. The office is closed. The latest pattern of steel bands were, we believe, covered with indiarubber; but leather cemented on would do.)—ARNOLD T. REED. (By application to the telegraph engineer at the G.P.O. 2. There is no reason why a minor should not take out a patent.)—J. W. E. (Hollow walls make the best building. Settlement is prevented by putting in foundations. You should read the opinions of experts in the *Building News*.)—R. E. Q. (The Wimshurst is the best, by general consent; but the matter has been discussed, as you will find by referring to indices. 2. Don't understand. If the machine does not perform what it is stated to be capable of, it does not "fulfil its guarantee"; but surely you don't want any one to tell you that.)—J. MILLER. (As a "long and steady reader," you will remember that the recipes you require have been given more than once.)—O. P. G. (You could use platinised silver instead of carbon, but you know the cost. 2. Yes. 3. No. Read up your back numbers, which will give you the information you require in connection with your dynamo.)—J. BLAKE. (Better submit your device to some of the makers. It does not appear to have occurred to you that it would be cheaper and more advantageous to have an extra row of reeds instead of your coupler, while it would be next to impossible to adopt it in large instruments. Nevertheless, we believe it is quite an original idea.)—BIRMINGHAM. (Certainly, they are of use; but it is scarcely worth while to go to the expense of one when the meter is only "5 light." Regulate that at the meter-tap. Hundreds of people allow their gas-burners to roar, and then, when the bill comes in, accuse the gas-company of swindling them.)—H. J., R. E. (No; tenths of an inch of water. 2. The difference between the two levels is the measure of the pressure.)—H. A. M. (Many supposed cases of deafness are due to accumulations of wax in the ears. How to make a Self-supporting Ear-trumpet appeared in No. 987. See p. 106, Vol. XXXV.)—STEEPLE JACK. (For wire-covering machines see pp. 14, 65, Vol. XXIX., and the indices of that and previous volumes.)—C. E. F. (The blower named answers well for portable forge, and also for stationary forges; but a portable arrangement is adopted only where necessary.)—VALENTINE. (Zaehnsdorf's "Art of Bookbinding" gives details, and you will be able to judge from a perusal whether "a person" can learn the art from books; so much depends on the person. 2. Welding steel in many back volumes. What kind of steel is it?)—POOR AMATEUR. (Not worth the trouble.)—G. W. W. (Cannot you calculate from the data already given, and from the numerous replies which have appeared recently? It is not a question of what the machine will do, but of what a half-horse engine can make it do, and that is not much.)—J. W. FEETS. (You can, of course, sue him; but we doubt whether you are likely to get a verdict after a lapse of nearly two years.)—THE THEORY OF THE WIMSHURST INFLUENCE MACHINE. (It is impossible for us to find space for the numerous and lengthy communications to hand on this matter, and as most of the correspondents seem to be losing their temper, and as we believe, in the opinion of the majority of our readers, one of Mr. Wimshurst's practical replies is worth a bushel of discussion about the theory of the machine, we must be excused for not continuing the subject.)—JOHN CAREFUL. (Of course he is liable, unless he prefers to be prosecuted.)—W. G. HOWARD, MELIORA. (In type.)

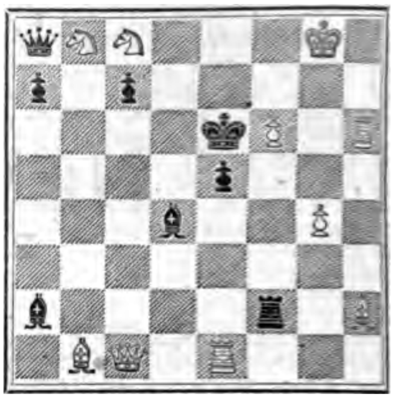
R. BENNETT.—Old Joe.—R. T. Settle.—A. S. Bower, C.E.—T. C., Bristol.—A. W. H., and others have replied to queries already similarly or adequately answered.

CHESS.

ALL Communications for this department [illegible] addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLXXVI.—BY J. PIERCE.

Black.



White. [10 + [illegible]

White to play and mate in two moves.

SOLUTION TO 974.

White.	*Black.*
1. Q-K Kt 5	1. Anything
2. Kt or B mates	

(Six variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 972, by A. W. Fisher (not too [illegible] Isca (a slip of pen; it is 1. Kt-K 4, not Q 4), G. T. [illegible] fellow, A. Sharp; to 973, by G. T. Stringfellow; [illegible] Handescombe Rodd (rather puzzling), E. Howell [illegible] variation wanting), Isca, A. W. Fisher, F. A. [illegible] Palmer, A. W. Orr, Avon, V. S. Pochin, A. Sharp [illegible] Derry, Harold, James Gillan, Constance E. [illegible] T. Bayne (variations not given), Link, E. J. [illegible] Tommy Atkins, W. J. Carpenter, P. I., A. Bolus, [illegible] T. H. Billington, J. S. N. O. (exceeds in beauty [illegible] to 975, by V. S. Pochin, Tommy Atkins, T. H. [illegible] Andrew Bolus, James Gillan.

V. S. P.—Thanks for your suggestion; we will [illegible] to bear it in mind.

T. H. BILLINGTON.—You have failed in [illegible] 1. $\frac{\text{R takes B}}{\text{B takes P}}$ 2. $\frac{\text{Q-Q Kt 2}}{\text{K-Q B 5}}$ 3. B-B sq. is not mate, [illegible] escapes at Q 4.

A. DEAN.—You will have perceived by the [illegible] published in our last that yours was incorrect.

G. H. W. AND H. J. C. A. are thanked for the [illegible]

LINK.—If in 973 1. $\frac{\quad}{\text{B-Q Kt 6}}$ 2. $\frac{\text{Q-Q 2 (ch)}}{\text{K-K 4}}$ 3. P [illegible]

V. S. P.—A capture on the first move is [illegible] a drawback, but if of a Pawn it is of less account. [illegible] Meyer, one of the first problemists, does not object [illegible] indeed of a piece. We do not agree with you, [illegible] to 973. In our view, notwithstanding this drawback, [illegible] a very fine and difficult problem.

J. PALMER.—If in 973 1. $\frac{\quad}{\text{B-B sq}}$ 2. $\frac{\text{Q-Q 2 (ch)}}{\text{K-K 4}}$ [illegible] mates.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, FEBRUARY 5, 1886.

DOMESTIC ELECTRICITY.*

THE large army of amateurs (in this case those unacquainted with the subject) will doubtless be thankful to M. Hospitalier and Mr. Wharton for placing at their disposal a work which describes, in a popular form, the various uses to which electricity can be applied in the household. There are amateurs whose knowledge of electricity and its applications is on a par with that of professionals; but this book is not for them: "it is intended as a book of amusement, combined with instruction, for the amateur who wishes to know something of the working and uses of that subtle something, 'electricity,' which it is prophesied is destined to revolutionise the world." It will be seen from that passage that M. Hospitalier has enlarged ideas of the future of electricity, and it is not surprising that he should assert that "everyone is agreed as to the immense advantages to be obtained from a general distribution of electricity," though he recognises the tolerably obvious fact that it will be "many years before this distribution can become universal." We mention these opinions of the author in order that readers may understand how much weight to attribute to his views when contrasted with those of other writers, who, with less knowledge than the distinguished Frenchman, quite surpass him in their expressed belief as to the future of electricity in its applications to useful purposes. M. Hospitalier plunges at once into his subject by refusing to "gloss over our ignorance by erroneous and often deceptive theories"; electricity is to him a vague term, but he is contented to deal with the results, and having expressed the opinion that it is no more a fluid than the other physical forces into which it may be transformed, he adopts Tyndall's view that it is a "mode of motion," and proceeds to describe the results he obtains with various kinds of apparatus—numerous enough to satisfy the most ardent student. He commences by demonstrating the mutual transformations between electricity, heat, light, and mechanical and chemical energy; he even declines to trouble himself with the exact constitution of his electric generator; all he wishes to show for the moment is the fact that he can, with the assistance of his machine, produce electrical phenomena by the turning of a handle. His Fig. 1 is a small dynamo driven direct from a large wheel turned by a winch or crank handle, which demonstrates the transformation of mechanical energy into electric current. So long as the circuit is open the machine requires little exertion to turn it—just sufficient to overcome the friction of the parts; but when the circuit is closed the operator finds that he is beginning to do real work, and he is compelled to slacken speed—the energy he is applying at the handle is becoming apparent at the terminals of the dynamo in the shape of what is called electric current. That something is there which did not exist before is demonstrated by the motions of the needle of a small compass, which endeavours to put itself at right angles to the current, and thus discloses the principle of the electric telegraph; the calorific effects are shown by connecting-up a small incandescent lamp in the circuit, when the carbon film glows with an intensity varying with the amount of energy with which the handle of the machine is turned. Similarly, a small coil of thin platinum wire can be raised to almost a white heat, or a piece of iron wire be made to glow red, or even to melt, provided the energy applied at the handle of the machine is sufficient. The energy can also be transformed into the chemical shape by means of an accumulator or storage battery; but in this case the electric current is made to act on plates of lead placed in an acid solution, which are so affected that after a time they can themselves give off a current—in this case termed voltaic or galvanic, but practically identical and still a mode of motion, the origin of which was the muscular exertion expended on the handle of the dynamo machine. A thorough appreciation of these facts, that without energy there is no electricity, and that the energy which makes itself apparent as current is always less than the original source in amount, whatever it may be in intensity, prepares the reader for a correct apprehension of what is to follow, which is an explanation of terms used in electricity. M. Hospitalier employs the familiar comparison of the flow of water in a pipe, in which the pressure tending to force the water through represents the potential or electro-motive force of the current. The quantity delivered by the pipe represents the amount of current, and the friction set up by the passage of the water, caused by the smallness, &c., of the pipe, represents the resistance opposed to the electric current in the conductor. It will be easily understood that the flow of water will be greater the higher the pressure and the less the resistance; so it is with the electric current, as stated in Ohm's law: $C = E$ divided by R. A correct appreciation of these "fundamentals" is absolutely necessary if the reader or student would understand the question of domestic electricity; and having thus endeavoured to impart the requisite information, M. Hospitalier proceeds with his work proper by treating in Chapter I. of the methods of producing the electric current. These are, in reality, three only—viz., chemical action, as in primary batteries; heat, as in thermopiles; and mechanical action, as in dynamos. Whatever the distant, or for that matter, the near future, may bring forth, so far as the tyro is concerned, thermopiles are of no use at present to the amateur electrician, while the frictional machines recently brought to a high degree of perfection, do not give the kind of electricity he requires—or rather, do not present electrical energy in the shape in which it can be utilised for domestic purposes. Magneto and dynamo machines require more power than is usually at the amateur's command, though if he has a water wheel, a gas engine, or can put a strap on some factory shafting, they are the cheapest known source of current. For ordinary experimental purposes, chemical action, or the battery, is the most convenient source of electrical energy, and some batteries are cheaper than others because better adapted for the purposes required. Galvanic batteries of different design are probably to be counted by the hundred; but a dozen or a score will include all the best forms, and these are divided into two distinct classes: those called upon intermittently, and those which are required to give a constant current. M. Hospitalier describes some of the better known forms of cell with considerable detail, and in the case of the Leclanché—a most useful cell for many domestic purposes—he gives directions for its preservation, and explains at some length how its possible duration may be calculated. He also supplies examples of the use of the formulæ in working out such questions as the number of cells required to ring so many bells, and then, in Chapter II., explains all the details connected with the installation of electric bells, which is the most simple practical application of domestic electricity. Automatic alarms follow naturally in Chapter III., and Chapter IV. is devoted to domestic telephones. M. Hospitalier considers the telephone a "useful and valuable" adjunct to the othe domestic electric apparatus; but many will prefer to use the mechanical telephone, or even speaking tubes, where the distance is not too great. To show what difference an error of even one letter may make in print, we note that on page 53 Prof. Hughes's microphone is said to consist of a small-pointed carbon pencil held "tightly," instead of lightly; but as several forms of carbon transmitters are described, the reader is not likely to be misled. Electric clocks and the application of electric alarms to ordinary timepieces are described rather briefly in Chapter V., and Chapter VI. treats of electric lighters, apparatus for setting fire to combustible materials, &c. Chapter VII. deals with a subject which apparently interests a great many people — Domestic Electric Lighting. We need scarcely say that we have received many letters which show that the writers have some vague idea that electric lighting can be carried out at a merely nominal expense — something, at any rate, below that of gas; but the public are at last beginning to apprehend the truth, and will appreciate the remarks of M. Hospitalier, when he says "the most serious obstacle to the universal adoption of the electric light (apart from the question of price, which for a small installation is, and must be, very high) is the inherent difficulty of producing the electrical energy. When the distribution of electricity to every house is an accomplished fact, the use of the electric light will become general, even if for an equal light a higher price has to be paid than for gas." All motors are not equally suitable for electric lighting. A steam-engine in a private house is little short of a nuisance, however serviceable it may be at times; a gas-engine is almost infinitely preferable; but the best of all is a water motor, provided the water can be obtained for nothing. M. Hospitalier says that high-speed turbines are the very best motors possible for driving dynamos, and Mr. Wharton, the translator and editor, appends a note, in which he says he can speak from experience of the great advantages of using water power by means of turbines, thus obtaining light from a natural source, costing nothing. Here we find the crux of the electric lighting problem. If the energy requisite can be supplied for nothing—as in the utilisation of a waterfall otherwise running to waste,—electric lighting is a more economical source of illumination than anything else; but if a gas-engine, a hot-air engine, or any other prime mover must be pressed into the service, then electricity cannot compete with gas or oil at present prices, although it has undoubted advantages which many will think are cheaply purchased at the price. On the score of economy, batteries are altogether out of the running, even when they take the form of accumulators charged at some factory where power can be obtained cheaply; but independently of the economic viewpoint, they are always troublesome and often vexatious. Expense and trouble, however, are happily not always effectual deterrents to the enterprise and enthusiasm of amateurs of science; and those who wish to know what can be done in the way of electric lighting in private houses will find it set out with considerable elaborateness in this work. M. Hospitalier speaks highly of Lalande and Chaperon's oxide of copper batteries (which we described in Vol. XXXVII. p. 500), because they may remain set up for months without being touched, and can be called upon to supply at regular or irregular intervals an amount of electrical energy corresponding to the size of the elements used. When it is required to light an electric lamp for a few hours only, the simple bichromate battery is at once the

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* Domestic Electricity for Amateurs. Translated from French of E. HOSPITALIER, with additions, by C. J. WHARTON. London: E. and F. N. Spon.

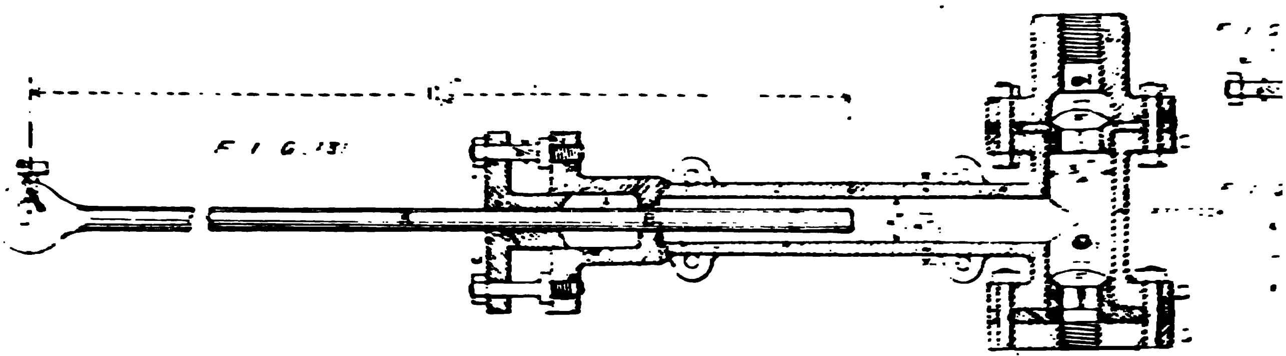


FIG. 137.

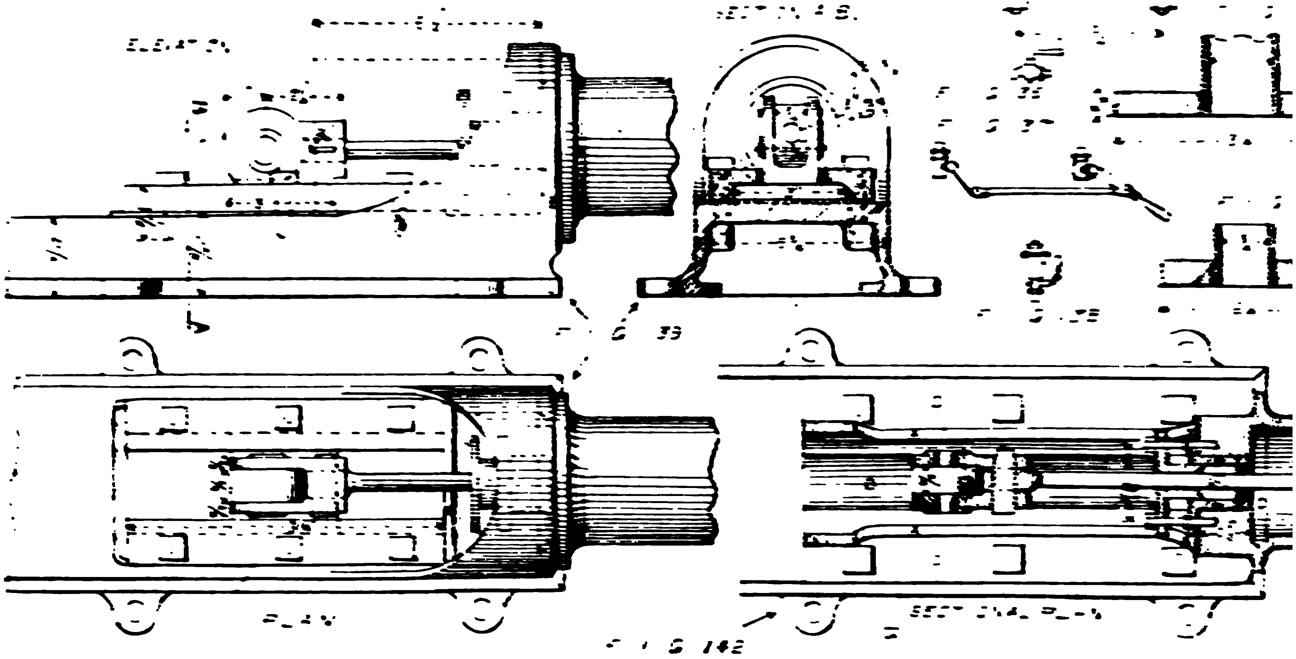
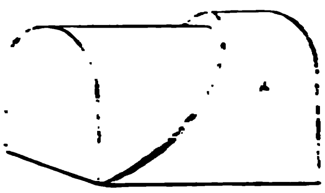
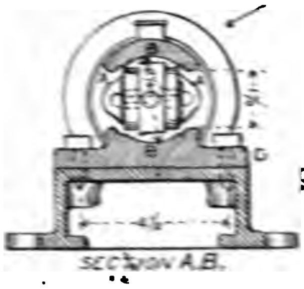


FIG. 139.





SECTION A.B.

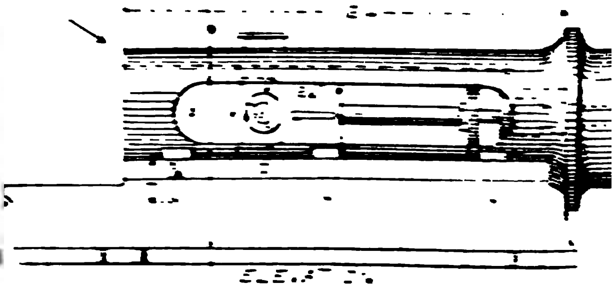
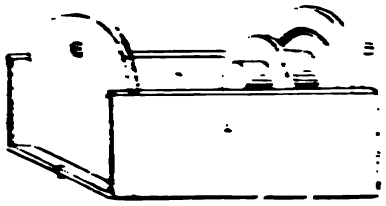
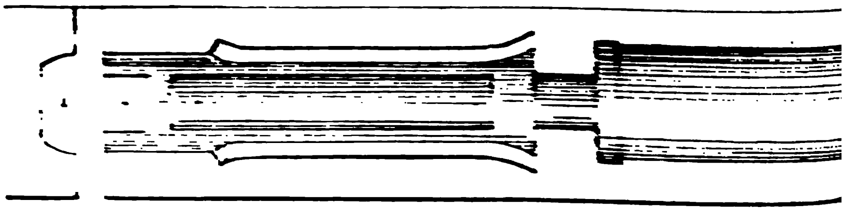


FIG. 142.





cheapest and least troublesome. M. Hospitalier describes many other applications of electricity and some he describes at length; in fact, it may be said that he has something about all of them, even to the electric tricycle of Profs. Ayrton and Perry, which was notable only because it demonstrated the possibility of applying the current as a motive power in such vehicles; for if tricycles are to be driven by other than muscular power they at once lose the greater share of their raison d'être. As serving to show the completeness of this work as a repertory of "Domestic Electricity," we may mention that it contains illustrations and descriptions of such apparatus as Edison's [illegible] graph, an automatic recorder of musical compositions, and Carpentier's repeating melograph, a device which enables a keyboard instrument to repeat automatically any composition which may have been played upon it. We have said enough, we think, to show that this work can be recommended to all who wish to know what can be done with electricity.

ENGINE-MAKING AT HOME.—XII.

Miscellaneous Work.

FIG. 141 shows the pump which is bolted to the side of the cylinder. It is bored to the stuffing-box a, in the neck b, where the plunger works and the flanges c, d are faced. It will be most suitably chucked upon an angle plate. The feet will be filed parallel with the body of the barrel and two [illegible] holes drilled in each [illegible] centres. The valve seatings [illegible] are bored and their flanges faced on both sides. The valves [illegible] are turned to fit the seatings, only having say [illegible] of slack. The bottom flange [illegible] is faced and screwed for the pump and the top one also. Both flanges with their valve seats are clamped to their respective pump flanges, and three holes drilled through all alike for the bolts (Fig. 137). Each valve is prevented from lifting out of their seats [illegible] screwed through the metal [illegible] their heights being adjusted to allow [illegible] the valves equal to one-fourth of their [illegible] At the other end the gland [illegible] is [illegible] turning, and furnished with [illegible] 138). The plunger K is a rod of wrought [illegible] steel, provided with an eye at the [illegible] over the [illegible] spindle (see Fig. 144 at [illegible]). It is kept securely with a set screw.

The pump must be located so that its centre is in line with the centre of [illegible] This will be readily done by [illegible] and plunger into place, [illegible] the plunger to the [illegible] bringing the slipper block [illegible] the end of the guide bars [illegible] of the gland and pump [illegible] ruly, there will be no drop in the body xcept perhaps a little at the far end, and his can be corrected by measurement from he bed-plate facing or by spirit level laid pon the face of the top flange. Clamp in lace, try the plunger backwards and forwards, naking a slight variation in the position of the barrel where the plunger happens to go hard. Then mark the holes off the lugs on the ylinder blocks, and drill and tap two out of the our first of all. Put in their screws, and try he pump again by moving the plunger backwards and forwards to see if it moves easily. f slight adjustment is necessary, it can be ffected in the remaining two holes.

We may consider the engine as fitted up now. But there are connections to be made for the team-pipes—cocks to be screwed in, means of ubrication to be provided, and glands to be packed, before it can be set to work.

For the steam-pipe connections, therefore, we must have two flanges, one shown in Fig. 134, to go on the steam chest facing for the upply pipe. This is faced, and screwed to eceive ¾in. tube, and fastened on with three crews. The other, Fig. 135, is attached to the xhaust branch of the cylinder with three olts, but is screwed to take 1in. pipe.

Two pet-cocks, Fig. 136, are screwed to the ylinder, one into each cover, against the lowest art of the bored portion; put the centres of the ocks, say, at a distance of 1½in. from the centre f the cylinder. These cocks should always be pened during the first few strokes of the iston, to allow of the exit of the water of ondensation. They are best purchased of the nodel makers. Often the cocks are placed in he bottom of the cylinder instead of on the langes, and a single lever and handle opens nd shuts both simultaneously (Fig. 137). A et-cock is screwed into the pump to the centre, hown on the Fig. 131.

The lubrication of the piston is effected hrough an oil cup (Fig. 138) screwed into the op of the cylinder and filled with a mixture of allow and oil. The oil cups in the guide bars re filled with lamp wick and oil, the wick cting as a siphon to convey the oil down the rilled hole in the centre of the cup. The ame remark applies to the bearings for the rank shaft. The strap end of the connecting od should be supplied with a skylight, or plain ubricator, screwed into the strap. For the ther bearing parts, simple pouring of the oil nto the drilled holes will be sufficient.

Glands are rendered steam-tight with spun arn, made greasy and impervious with an pplication of Russian tallow, and wound ghtly around the rods in the stuffing-boxes, d screwed down by the glands. When newly cked, the glands should enter but a little ay into their stuffing-boxes, so that they can screwed deeper as the packing shrinks in lk.

Actually, the steam joints will not be made til the connection pipes are ready: but it ill be convenient to mention them in this ace. Procure some wire gauze and cut out a g-shaped piece for each flange, equal in size its outside diameter, the hole being equal to bore. Smear this thickly with a mixture of l and white lead and boiled oil, insert it tween the flanges, and screw up tightly.

Sometimes the lead mixture alone is used in king joints, without the assistance of the uze; but it is apt to become blown out in e by the pressure of the steam, while the uze forms a skeleton, so to speak, between ose meshes the lead is secure. Also indiaber facings are employed, while frequently ength of fine copper wire is wound around a coil on the face of the flange to assist the d; nothing, however, is superior to the ze first mentioned. There will be nine nts of this character required—one to each inder flange, one to the steam-chest flange, each to the steam and exhaust pipes, and r to the pump flanges on each face of the ve seatings.

shall conclude the series in the following icle, with some notes in reference to the ler and fittings suitable for an engine of character. But before doing so I think ight to adopt some suggestions made by "In-a" (letter 24144, p. 169 Vol. XLI.) respecting design selected for these papers, and to give dry sketches and working dimensions for guides, &c., of those other types which e mentioned in the first article (Vol. XL. p. 532) and the merits of which were discussed in letters 24144 and 24179 of the last volume. I shall make the suggested alterations so clear that no difficulty will be experienced by our amateur friends in modifying the designs accordingly if they so choose.

Fig. 139 shows the usual form of overhanging cylinder whose front flange is bolted to a cover cast with a strengthening hood at the end of the bed. The slide block is also of the form referred to in the letters before mentioned, and commonly employed in this kind of engine. These modifications are all proportioned for the especial engine whose construction we have been discussing in these articles, and excepting in the particulars, which I shall here ennumerate, its details would remain unaltered.

As our aim is to get the centre of the cylinder lower down, we can effect that best by increasing the height of the bed, and so giving the latter additional strength where most needed. Make the bed 2¼in. deep, therefore, or nearly as deep as the blocks for the crank-shaft bearings, which will then stand as simple facings ⅛in. high. Shorten it also at the hinder end to terminate 8in. from the middle point of the original guide bars or 20½in. from the centres of the crank shaft. But the most important alterations, necessitated by this form of construction, are these:—Looking at the end view, there is a hood whose arch is struck to a radius of 2$\frac{9}{16}$in. This must be cored out, and the core print must extend sufficiently far to clear the first spring of the curve, or to the dotted line (elevation). So the print must be 6½in. long, and of the shape of the arch (Fig. 140). This will be screwed to the bed face, and upon it there will be fastened the pattern hood A, best nailed round either in strips or in segments, around whose edge also a beading or fillet may be fastened if desired. The portion, B, lying beyond the print, which receives the flange of the cylinder, is wired on. There are facings provided to receive the slide bars, and the face of the slide block; and recesses (Fig. 139, plan), are shouldered down at the ends of the travel, and a strip runs around these to confine the waste oil. But the print covers over a portion of these, and the core-box is accordingly made like Fig. 141. Two sides, A A, have ends, B B, shouldered in, which ends being cut to the curve of the inner arch of the hood become the guides for the edges of a strickle to be worked or scraped over the sand which is rammed in to form the core. The inner face of one end of the box is made exactly like the front face of the cylinder cover with its recess, and stuffing box and flange, the latter of course being slid loosely over its print. Upon a bottom-board, C, dowelled on, the portion of the facings, &c. covered by the arched print, is fastened precisely as though it were the face of the bed itself, the remaining portion being put upon the pattern which lies beyond the end of the print. The proper making of these parts is mainly a matter of correct dimensioning, so that the facings in the core shall correspond with those upon the pattern, the core face be continuous with the pattern face, and the core match the print in length, width, and curve.

The slide block is made of cast iron, moulding upon its side, and being cored out. The length of its foot or face should not be less than the figures given. The guide bars are usually made of cast iron also; but as the bolt holes will weaken them very much, it will be better to make them of wrought iron, case hardened in this instance. The mode of fitting the slide block with the guide bars, and with the connecting rod (figured on p. 534 Vol. XLI.), is sufficiently clear from the illustration, and I therefore pass to consider the next mode of attachment for an overhanging cylinder (Fig. 142).

In this case the guide is circular in section, and cast in one with the cylinder, so that there is no front cover. A flange is, however, cast around, both to give it a symmetrical appearance and also to afford provision for cleading if desired. The circular guide is not necessarily in one with the cylinder, since it is sometimes cast as a portion of the bed, the cylinder being bolted upon the end as in the last instance. But the advantage of casting these together is that the cylinder, stuffing-box and guide, are bored at one setting.

No difference will be made in the method of constructing the pattern—that is, as regards the jointing of the body, the steam-chest face, the exhaust branch, &c.: but of course the guide and cylinder body will be turned in one length, with a print at each end. The openings, *a*, *a*, at the sides, and the facings, *b*, *b*, for the slide block necessitate the construction of a core box which will include the whole internal portions of the cylinder and guide with their facings, the openings and the prints (Fig. 143). The recess *c* (Fig. 142), at the termination of the piston stroke, is cut out to 3½in. in diameter to save the trouble of turning it out in an awkward position. The rounding of the edges of the side openings is better if prints are put on there; but it is not necessary, nor helpful to the moulder, and the square edge left where the core comes in contact with the mould, can be easily taken off with a chisel and file. But it is advisable to furnish the moulder with some guide to insure the side openings coming parallel with the cylinder foot. If a portion of one of the prints is cut away flat, and a piece corresponding both in size and relative position be put in the box (Fig. 143, *a*); the proper position of the core is guaranteed. The feet, *d*, *d*, for bolting down, will be made fast to the sides of the guide in the pattern.

When boring the casting, the biggest boring bar that can be got through the stuffing box must be used, for if of slight proportions it will wobble, and the two bores will be out of line with each other. To obtain a large hole in this case, the stuffing box is put in as a separate casting (Fig. 142, plan), so that a long bar of 1¼in. diameter can be used. The gland bolts are made to serve the double purpose of screwing the gland down and of fastening the stuffing box casting with its contained neck bush to the main casting itself. A specially long drill must be made, to reach the two holes, and the gland and stuffing box will be passed in from the side of the guide, the lug extensions preventing them from passing in through the front.

The slide blocks, in larger engines, are frequently made with wedge-shaped fittings and bolts; but their adoption is hardly practicable in one of so small size. The hollow space for the connecting rod end is cored out, and in the absence of a slot drilling machine it is best to core out the cottar way together with the hole for the end of the piston-rod, allowing a trifle for boring. The core will be very small, but the making it is quite practicable if the box is made accurately.

The bosses shown in the two sectional views of the bed are inserted to receive the bolts of the guide bars in preference to thickening the bed itself.

DELGER'S IMPROVED CHUCKS.

The improvements in chucks for lathes recently patented by Mr. J. Delger, of Melson-street, Luton, relate to holders for turning eccentric work, and consist in the combination with the revolving mandrel or spindle, or with a removable block or head, secured thereto, of a circularly adjustable boss fitted eccentrically therein, and capable of adjustment by being turned on its longitudinal axis. Within this circularly adjustable boss there is in some cases formed longitudinally a bore disposed eccentrically to the axis of the boss, but in such a position as to be capable of being brought by the circular adjustment of boss, in line with the axis of rotation of the mandrel or spindle. This bore serves to hold the smaller kinds of work to be operated upon, or a drill, or other like tool, or an ordinary lathe centre, or a removable bush in which such articles can be fixed. By suitably adjusting the boss inside the mandrel or the holding block, the work or article carried thereby can either be brought accurately in line with the axis of rotation of the mandrel or when required, into a position more or less eccentric thereto, the amount of eccentricity being ascertained and indicated with the greatest accuracy by the aid of a graduated scale and index. The outer end of the circularly adjustable boss may, if desired, be enlarged to any extent so as to form a circularly adjustable face plate, or the face plate may be made separate and attached to the boss. This face plate will be found useful for carrying the larger kinds of work, which may be chucked or secured thereon in any well-known or suit-

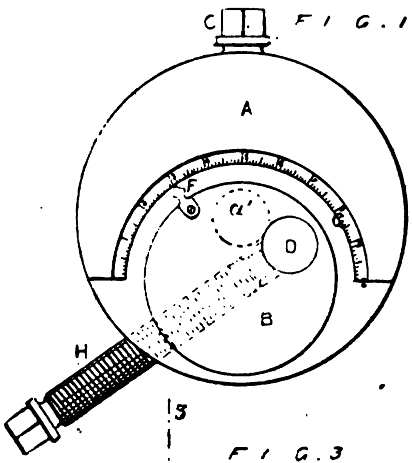


FIG. 1

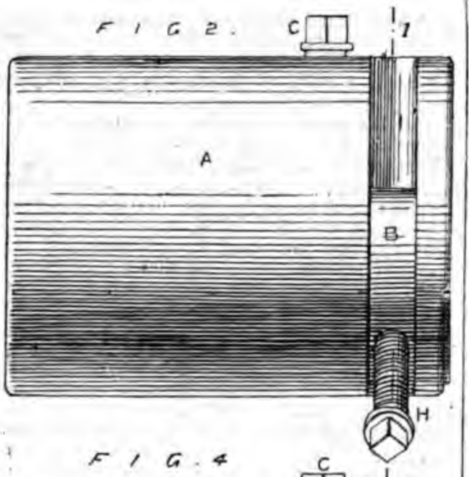


FIG. 2

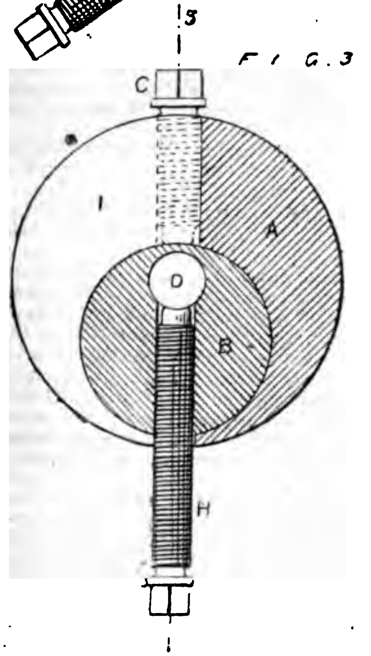


FIG. 3

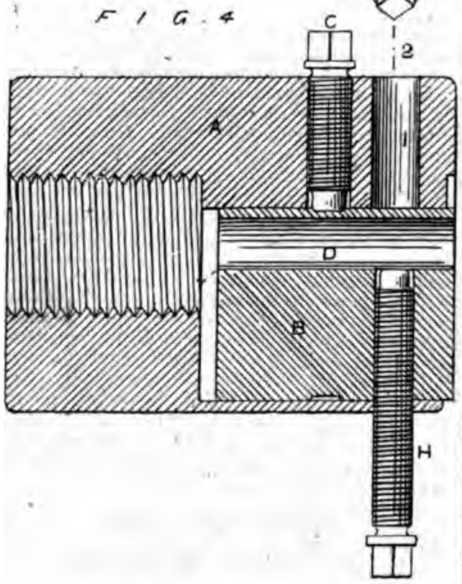


FIG. 4

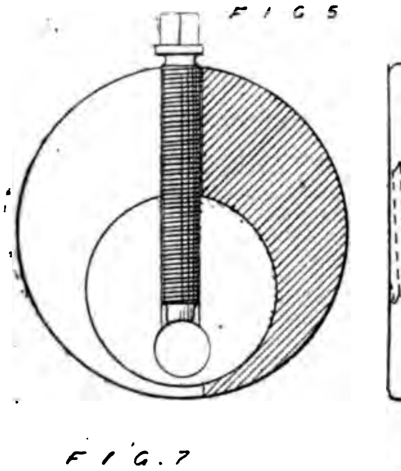


FIG. 5

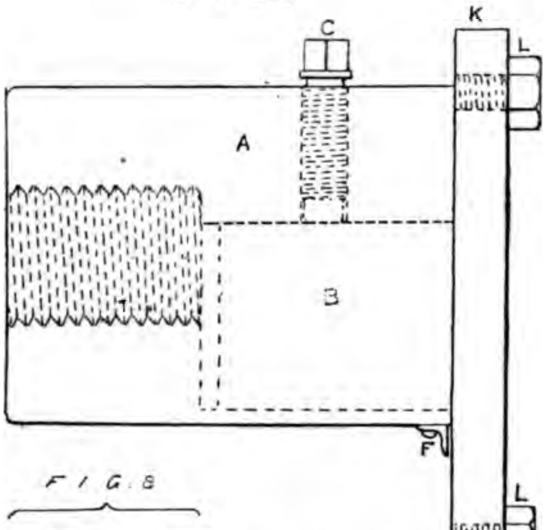


FIG. 6

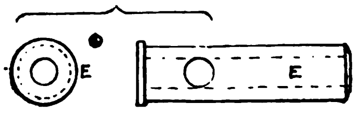


FIG. 7

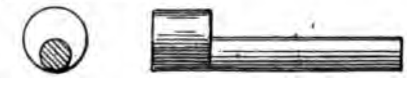


FIG. 8

able manner. Referring to the illustrations Fig. 1 is a detached front end view of one form of the improved chuck complete. Fig. 2 is a corresponding side elevation of the same. Fig. 3 is a transverse section of the improved chuck taken along the line 1—2 in Fig. 2 and showing the bore of the circularly adjustable boss in its concentric position. Fig. 4 is a longitudinal section thereof taken along the line 3—4 in Fig. 3. Fig. 5 is a view similar to Fig. 3 but showing the bore in the adjustable boss adjusted to its extreme limit of eccentricity, and Fig. 6 is a side elevation of the chuck as formed with an enlarged face plate for receiving work of various kinds, to be secured thereto by screws or other well-known contrivances. A is a cylindrical or other shaped block or head forming the main body of the chuck, which block is shown at Fig. 4 as adapted for being screwed to the nose of a lathe mandrel or other rotary spindle, although it may obviously be secured thereto in various other ways, or may even form the end of the mandrel or spindle itself if desired. In a longitudinal bore made eccentrically in the block or removable head there is fitted the circularly adjustable cylindrical boss B, fixed securely therein in its adjusted position by a set screw C, or other well known means. D is the longitudinal bore in the adjustable boss also situate eccentrically therein for the purpose of receiving a bush E (one of which is shown, by way of example only, in front view a elevation detached at Fig. 7), which ser holder for small work, such as the spind eccentrics employed in sewing machines which is illustrated (by way of exampl at Fig. 8, or it may be used as a hold drill or a lathe centre. F is the index in Fig. 1 as secured to the adjustable bo G is a divided or graduated scale on the the block or mandrel A for facilitati setting of the work or article carried boss B either concentrically with the the mandrel or to any given amount of tricity. In order to protect the scale an from injury they are sunk or recessed less in the end of the block. The figu shows the circularly adjustable boss an so arranged that when the index is at the scale the axis of the bore D will c with the axis of revolution of the man illustrated by the dotted circle *d*; circularly adjusting the boss B inside th or mandrel A within a range of a half tion various intermediate degrees of tricity can obviously be obtained. drawing (Fig. 1) the bore D is shown justed to about three tenths of its e range of adjustability. H is a set sc fixing the work or the bush or holder E bore D, a hole being made in the side bush (see Fig. 7) for the entrance of t of the set-screw. I is a slot or groov transversely across the mandrel or block admit of the screw H being brought desired position when circularly adjusti boss B. Figs. 3 and 5 show the screw two extreme positions. If desired the the boss B may be made to project suff beyond the block A to carry the screw which case the slot I will not be requir Fig. 6 K represents an enlarged face shown as formed in one piece with th cularly adjustable boss, and L, L are sc other suitable contrivances for fixi work on. In this arrangement, which found useful when operating upon the kinds of work, the index F may be fitt the block A and the scale formed on the of the face plate, or the scale may be f round the cylindrical surface of the bl and the index be fixed to the back of the plate K, but in all essential particular chuck will be substantially of the same struction.

A PRACTICAL METHOD OF W ING ROCK-SALT SURFACES OPTICAL PURPOSES.*

By JNO. BRASHEAR, Pittsburg, Pa.

TWO years or more since Prof. Langley me to undertake the work of polishi rock salt trains so frequently called into use well-known researches in obscure heat rays. surfaces, under the very best conditions ephemeral in their character, owing to the quescent nature of the material, and in order the best results from them, frequent repoli and refiguring are absolutely necessary. I been informed that the French opticians poli rock salt surfaces upon broadcloth; and, i almost all surfaces I have tested show the have been finished upon some yielding ma as the edges are almost always rounded o would call it, over-corrected. This is fatal t results in any optical surfaces. Mr. George C of Alvan Clark and Sons, polished a pris Prof. Langley which turned out to be beauti polish and in figure. His method was to pitch polisher, with "diamantine" (a fine vari Vienna lime) as the polishing material. A brine was used instead of water, in the ord way. Mr. Clark informed me that the one difficulty he met with was to wipe the pris faces, *after the polishing was completed*, he u arm or palm of the hand, in preference to any else. On a few occasions I have succeeded way, but where success may be had once, may result twenty times, for if any moisture on the surface of the prism or lens, even moment of time, it is ruined.

Happily I have no trouble in this and as my method is easily carried physicist who desires to work with faces, it gives me pleasure polishing a prism I make an about two and one-half or the surface of the prism to be polished. While the pitch is still warm I press upon it any approximately flat surface, such as a piece of ordinary plate glass. The pitch bed is then cooled by a stream of water, and conical holes are then drilled in the pitch with an ordinary counter sink bit, say ¼in. diameter, and at intervals of ¾in. over the entire surface. This is done to relieve the atmospheric pressure in the final work. The upper surface of the pitch is now very slightly warmed and a true plane surface (usually a glass one, prepared by grinding and polishing three surfaces in the ordinary way) previously wetted, is pressed upon it until the pitch surface becomes an approximately true plane itself. Fortunately, moderately hard pitch retains its figure quite persistently through short periods and small changes of temperature, and it always pays to spend a little time in the preparation of the pitch bed.

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* From the *Proceeding* the Advancement of [illegible] Meeting, August, 188[illegible]

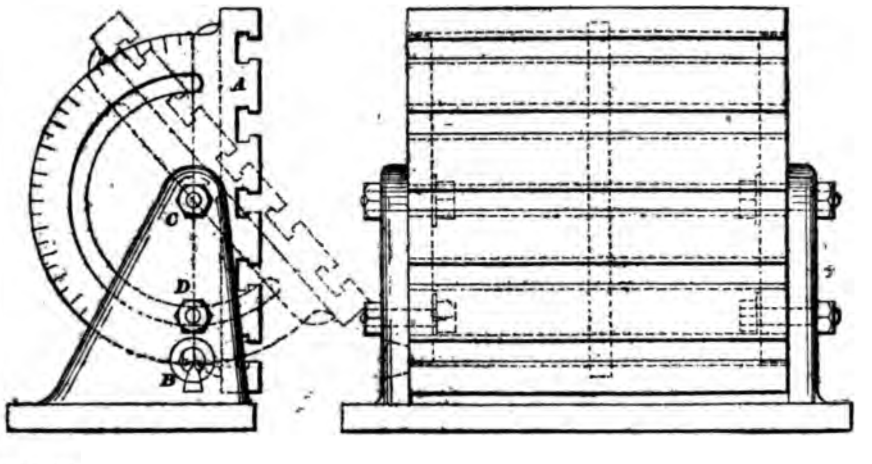
The polisher being now ready, a very small quantity of rouge and water is taken upon a fine sponge and equally distributed over its surface. The previously ground and fined salt surface (this work is done the same as in glass working) is now placed upon the polisher and motion instantly set up in diametral strokes. I usually walk around the polisher while working a surface. It is well to note that motion must be constant, for a moment's rest is fatal to good results, for the reason that the surface is quickly eaten away, and irregularly so, owing to the holes that are in the pitch bed. Now comes the most important part of this method. After a few minutes' work the moisture will begin to evaporate quite rapidly. No new application of water is to be made, but a careful watch must be kept upon the pitch bed, and as the last vestige of moisture disappears the prism is to be slipped off the polisher in a perfectly horizontal direction, and if the work has been well done a clean, bright and dry surface is the result. The surface is now tested by the well-known method of interference from a perfect glass test plate.

If an error of concavity presents itself the process of polishing is gone over again, using short diametral strokes. If the error is one of convexity, the polishing strokes are to be made along the chords, extending over the edge of the polisher. The essential feature of this method is the fact that the surface is wiped dry in the final strokes, that getting rid of the one great difficulty of pitch polishing, a method undoubtedly far superior to that of polishing on broadcloth. If in the final strokes the surface is not quite cleaned I usually breathe upon the pitch bed, and thus by condensation place enough moisture upon it to give a few more strokes, finishing just the same as before. In ten minutes I have polished prisms of rock salt in this manner that have not only shown the D line double, but Prof. Langley has informed me that his assistant, Mr. Keeler (J. E.), has seen the nickel line clearly between the D lines. This speaks for the superiority of the surfaces over those polished on broadcloth.

In polishing prisms I prefer to work them on top of the polisher, as they can be easily held, but as it is difficult to hold lenses or planes in this way without injuring the surfaces, I usually support them in a block of soft wood, turned so as to touch only at their edges, and work the polisher over them. Though it takes considerable practice to succeed at first, the results are so good that it well repays the few hours' work it requires to master the few difficulties it presents.

A CONVENIENT ANGLE PLATE.*

It is often desirable to chuck work at different angles, and at a given angle by degrees, for drilling, planing, or milling. The drawing I send herewith will give a clear idea of a device I made for that purpose after being annoyed when chucking work, by blocking it, and getting the angle by the use of the bevel protractor, which both consumed time, and in many cases was not a permanent chucking (owing to the blocking) until the job was finished. To overcome this difficulty I made an angle plate as shown, and it is a great satisfaction to use it. You can see at a glance what angle it is set at, by the graduated arc, and the angle can be quickly changed from one to another. It is often desirable to drill holes into a piece of work at different angles, or to drill holes on the opposite sides of a casting in which the holes must be parallel with each other, or two holes to be drilled at right angles to each other, or any angles, which can be quickly done. I speak of such castings as are not surfaced on all sides. A casting that is squared up can have this condition of the holes brought about without this plate. The plate, as [illegible]y be seen, will swing from 90° to 0, and from 0 to on the opposite side. It [illegible] desirable to [illegible]e or mill two or thre[illegible] [illegible]k, which [illegible]



angle plate has been accurately made. To accomplish this the plate must be centred at C, and have a hole bored the size required for the bolt, opposite holes on a line with each other, then insert a mandrel with good centres and face off the ends or arc pieces true and parallel with each other on a lathe, then put it on a pair of true planer-centres and plane the top off. Thus we have a true plate. Then plane the inside of the standards of base plate, square with bottom; bore the holes for the bolt on which it swings at right angles to this surface, and on a line with each, and the plate is true. The arc can easily be graduated on the universal milling machine. A hole, B, exposes the graduation, and a pointer is inserted therein. Bolt D is loosened on both ends, as well as bolt C, in order to swing the plate. When the four bolts are again tightened, there is no danger whatever from slipping. An addition can be made to this plate, of great advantage for use in milling, by putting an extra plate on the bottom, to form a swivel bottom, in order to set the plate at an angle to the travel of the platen of the miller when end milling work is to be done. This base can also be graduated, and thus any angle be obtained.

BLUE HEAT ON STEEL.

At a recent meeting of the Institution of Civil Engineers, Mr. C. E. Stromeyer, A.M.I.C.E., read a paper calling attention to the injurious effects produced by working mild steel at what is known as a blue heat, and in view of certain extraordinary failures, both in boiler and ship plates when worked into place, the subject is receiving the attention it deserves. The author of the paper commenced by stating that, in spite of the many excellent qualities possessed by mild steel, and in spite of its extended use for shipbuilding and for marine boilers, many engineers considered it a treacherous material. They were able to adduce numerous instances in which steel-plates and bars had failed in an unaccountable manner. In nearly all such cases a cursory examination brought out the fact that the plates in question had been subjected to bending or hammering while hot, and there could be little doubt that, while they were being worked, these plates were at a blue heat, or, as smiths and boiler-makers termed it, a black heat. It should, by this time, be well known that such treatment was the most injurious to which steel could possibly be subjected, and therefore such failures could not be properly regarded as unaccountable. Iron possessed the same peculiarity, but being less ductile than steel, similar failures were not so glaring. The author then mentioned cases in which plates, both of iron and of steel, had failed without this treatment, although the quality of the material was good, according to the usual tests. Three hundred and thirty experiments had been made in connection with the subject of the paper, and consisted mainly of bending and of tension tests. The results were contained in tables and in diagrams.

It appeared that the limit of both iron and steel was raised by repeated tension-testing. In some cases the limit rose above the original breaking-stress, although the ultimate breaking-stress was only slightly affected. The total elongation was reduced by previous mechanical operations, while the contraction varied considerably. A test-piece which had been shortened when cold showed a reduction of the elastic limit, but another piece which had been shortened when hot showed an increase. By the expression "blue heat" the author includes all those temperatures which produce discolourations (ranging from light straw to blue) of [illegible] steel or of iron. He showed [illegible] been bent cold, either once or [illegible] as many subsequent [illegible]ees. But if the same [illegible] blue-hot it lost a great deal of its ductility. Out of twelve samples, in which two preliminary hot bends were made, nine broke with a single blow of a hammer, and the other three only stood one or two subsequent bends. Thin Lowmoor iron did not break quite so easily, but supported about one-half the original number of bends.

The experiments all pointed unmistakably to the great danger incurred if iron or steel were worked at a blue heat. The difference between good iron and mild steel seemed to be that, while iron broke more readily than steel in being bent, iron suffered more permanent injury than steel by cold working, but that if it had successfully withstood bending when hot, there was little probability of its flying to pieces when cold, like mild steel.

It was a common practice amongst boiler-makers to "take the chill out of a plate" if it required a little setting, or to set a flanged-plate before it was cold. This was nothing else than working it blue-hot, and should not be allowed. All hammering or bending of iron and steel should be avoided, unless they are either cold or red-hot. Where this is impossible, and where the plate or bar has not broken while blue-hot, it should be subsequently annealed. It is satisfactory to learn that, since the introduction of mild steel, a practice has been gaining ground amongst boiler-makers which will have the effect of guarding against such failures, and should be encouraged. It consists in the cessation of work as soon as a plate, which has been red-hot, becomes so cool that the mark produced by rubbing a hammer-handle or other piece of wood over it will not glow. A plate not hot enough to produce this effect, yet too hot to be touched by hand, is most probably blue-hot, and should under no circumstances be hammered or bent. The theory that local heating of a plate sets up strains which sometimes cause failure does not appear to be supported by the experiments. But it is doubtful whether the proposal to locally reheat a plate, worked when hot, in order to anneal this part should be carried out. Several test-pieces were made red-hot, or blue-hot, and then were slowly cooled, by holding one of their edges in cold water. As might have been expected, the medium-hard steel lost much of its ductility. The other steels and the iron were not greatly affected.

The author concluded by suggesting that the question should be further investigated, and that steel manufacturers should endeavour to ascertain whether every quality of steel was made permanently brittle by being worked at a blue heat, or whether this was independent of the various impurities contained in it; and also whether prolonged exposure to a blue heat could produce the same effect.

EMULSION MAKING FOR AMATEURS.*

This being the season when amateur photographers are perforce debarred from outdoor work, I have thought that a few remarks on the above subject would not be unacceptable. I therefore subjoin a brief account of a method of proceeding, which will, I believe, be found to result in all respects satisfactorily. The formula which I have found to prove most useful, though only slightly modified from others published, is as follows. For 10oz. emulsion take

Potassium bromide	50gr.
Ammonium bromide	110gr.
Nelson's No. 1 gelatine	20gr.
Water	7oz.

Place a jar containing this in a vessel of cold water, and raise the water to boiling point, when

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* By THOS. EARP, in the *British Journal of Photography*.

immediately remove the jar. Have ready weighed out

Silver nitrate...............	200gr. in crystals
Potassium iodide	6gr.

dissolved in half a drachm of water. In the dark room add the nitrate of silver to the bromised gelatine, and proceed to beat up vigorously for about five minutes with a horn or silver fork, then pour in the solution of iodide, and again beat up for some time. Now proceed to acidify with hydrochloric acid, and test with litmus paper till there is an acid reaction, the paper turning clearly red. No definite quantity of the acid can be prescribed, as I have found that in some cases I have been obliged to add as much as eight drops of strong acid to get rid of alkalinity, while in others one or two drops effected the purpose. I am convinced that a large proportion of failures in emulsion making arise at this point, as I have never failed in making a clean working emulsion giving clear shadows after attending carefully to this matter. Next replace the now sensitised emulsion, in its jar, in the vessel of boiling water, there to remain boiling for one hour, or longer if greater sensitiveness be required. In the meanwhile weigh out.

Nelson's No. 1 gelatine............	60 grains
Heinrich's gelatine	120 ,,

and, in a second jar, soak this for about three-quarters of an hour in cold water, as much as the jar will hold; then reverse the jar, with a piece of muslin over the top, and drain thoroughly. When the emulsion has boiled for the specified time, remove it from the boiling water, and replace it by the jar containing the soaked gelatine. Plunge the jar of emulsion into cold water, and keep it there until the gelatine in the second jar is thoroughly liquefied. The vessel of boiling water having been removed from the fire before the jar of gelatine was placed in it, the temperature of both will now be found to be just suitable for mixing. This must of course be done in the dark room, pouring the emulsion into the gelatine so as to leave behind any coarse precipitate which may have been formed. The process of thorough mixing for some minutes must now be repeated, and the emulsion finished by adding about a drachm of strong ammonia, with constant stirring, when it may be put aside to cool and ripen for a few days. The washing and remelting may be done, as most convenient, by any usual method. I may mention that in some cases complete precipitation of the gelatino-bromide has taken place when cooling, in the vessel of cold water, after boiling; but as this is not of uniform occurrence, I depend upon the method of washing the finished emulsion. The vessels I employ are ordinary two-pound jars, such as are used for Moir's marmalade. When boiling, I close them with a bung in which a groove has been cut, and cover with a tin cap—such as the lid of a canister—to exclude any ray of light, as I do not boil in the dark room. For storing, nothing is better than a stone ink bottle—of course, thoroughly cleansed—and in this the emulsion is remelted for coating, over an ordinary fire, as in boiling. The idea of employing the two bromides occurred to me on account of having observed that with potassium I got clear shadows, with, possibly, too little detail in them, while the reverse was apt to be the case when ammonium had been employed, and I think the mixture will be found an improvement.

Etching Metallic Surfaces.—Mr. A. Piper, of Coleman-street, Wolverhampton, has recently patented improvements in etching metallic surfaces, by which the effect is produced by one simple process instead of three expensive ones, as heretofore. The article under treatment is coated or plated by the ordinary mode of electro-plating with gold, silver, nickel, brass, copper, &c., upon the surface of which deposit the required design is painted with an acid-resisting substance, and those parts not required to be ornamented are protected with the same substance. The article is then immersed in an acid, which eats away the coating or plating from the unprotected parts, at the same time producing a frosted or dead surface upon the naked metal upon those parts. The chloride deposited by the acid is removed by simply dipping in aquafortis. The acid-resisting substance is then removed by washing in a spirit or in oil, which leaves the design standing in relief, and of the colour of the metal with which it was coated or plated, upon a frosted or dead ground of the colour of the base metal. Thus, if the article be copper plated with silver, the design would be white upon a dead copper ground. Or the effect may be reversed—that is, the design be sunk, and of the colour of the base metal—by protecting the bulk of the article with the acid-resisting substance, and leaving the design exposed to the action of the acid, and proceeding as before. Thus, if the article be copper plated with silver, the *design* would be a dead copper colour upon a white *ground.*

SCIENTIFIC SOCIETIES.

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ROYAL MICROSCOPICAL SOCIETY.

THE fourth meeting of the session was held on the 13th ult., at King's College, Strand, W.C., the president, Dr. Dallinger, F.R.S., in the chair.

Mr. Crisp called attention to a series of 40 very thin sections of European woods, each cut in three different ways, which had been sent for exhibition by Mr. M. Wilmersdorffer.

Mr. E. M. Nelson exhibited a 1in. aplanatic lens by Zeiss (after Stenheil), which was made upon a somewhat new formula—a kind of achromatic Coddington, its great merit being the very large and flat field which it gave at a focal distance of about an inch.

Mr. Michael said he had been afforded an opportunity of examining this lens, and it struck him that the large size of the field would be found to be of very great advantage. This, together with its long focus and excellent definition, made the lens a very useful addition to the existing means of casual investigation.

Mr. Crisp exhibited some of Dr. Zenger's double-sided slides for mounting objects so that both sides could be examined if required. The slides had an aperture pierced through the centre, so that two thin glass covers could be put on with the object between them.

Messrs. Coxeter and Nehmer exhibited their new silico-carbon battery and incandescence lamp for the microscope. The battery has in each of the four cells two large silico-carbons, with platinum clamp connections, and one zinc rod with screw terminal. It is charged with chloride of ammonium. No chemical action takes place except when it is actually in use; and once charged, it will need no further attention, but will be always ready when required. There is a shunt on the lid to connect the cells consecutively, and thus illuminate the object with the varied requirements of high and low power. The current passes through a rheostat before it reaches the incandescence lamp, the electrical resistance can be afterwards lessened or taken out of the circuit by moving a sliding bottom, and thus the battery is economised. The lamp-holder is jointed, and can be moved into any position, either above or below the stage, or to any part of it, and the position of the light is not altered by any movement of the microscope. The light can be turned "on and off" at the lamp when desired. The lamp is claimed to be "the only one with practically no heat; it gives a delightfully soft and steady light, capable of great variation in intensity, and far less tiring to the eyes than ordinary reflected light."

Mr. C. Beck exhibited a form of the "Star" microscope, which had been specially fitted to suit the requirements of petrological investigation; also a battery and incandescence lamp for the microscope.

Mr. Crisp exhibited Prof. Martin's stroboscopic apparatus for determining by the vibrations of a lever on the armature of an electro-magnet the rate of ciliary vibration in cells, rotifers, infusoria, &c. The lever carried a small diaphragm of paper at the end, by which means the rays from the illuminator were periodically cut off and admitted to the microscope.

Mr. Deby's note on the discovery of *Amphipleura Lindheimerii* in Spain was read.

Don Alfredo Truan y Luard has discovered in the North of Spain, abundantly, as he states, *Amphipleura Lindheimerii*, a species hitherto known only from South America. In a footnote the author states that Herr Möller, of Wedel, has asked him for a number of these diatoms to be mounted by him as test objects. "Now, *A. Lindheimerii* is larger, and has very much coarser striæ, easy of resolution, yet non-specialists would have trouble to distinguish it from the commoner European species. I do not suspect for one minute that Herr Möller himself would knowingly offer for sale test slides of the coarser diatom under the name of *A. pellucida*; but others might be found not quite so scrupulous. Special slides, it is well known, are often kept of *A. pellucida*, of *P. angulatum*, of *F. saxonica*, of *Surirella gemma*, and others, for the best exhibition of high-power objectives; and these pet 'coarse' slides are in general not willingly parted with by their fortunate owners. My advice is: Make sure in future that the *A. pellucida* you resolve with ease is not a *Lindheimerii* of Don Truan y Luard." This last diatom is figured in "Grunow, 1862," Pl. XI., Fig. 11, and was distributed by Prof. H. L. Smith in his "Species Typicæ," No. 17. A careful examinetion of either of these will prevent any confounding of the two species.

Mr. A. W. Bennett gave a résumé of his paper "On the Fresh-water Algæ of the English Lake District," illustrated by coloured diagrams and drawings on the blackboard.

The President said that the paper afforded an excellent illustration of the kind of work which was within the reach of all present, and whi could be carried out with the instruments whi they possessed, and it showed how it was possibl to utilise a holiday by doing good work and at th same time adding to the pleasure derivable fr it. It had often seemed to him that work of th kind was apt to become periodic. They did certai work, and then there seemed to be years of pass in which very little more was done in the sa direction; and in the case of the Desmids the was still a large field open to those who were willi to devote themselves to the study. The literatu of the subject was not so great as might have bee expected, and it was quite within the power o anyone who would try, to add a great deal to the knowledge of these organisms. He felt sure th the Fellows of the Society were much obliged Mr. Bennett, not only for his paper, but also the very concise way in which he had presented them the results which it embodied.

Mr. G. F. Dowdeswell's paper "On the Appe ances that some Micro-Organisms present und Different Conditions as Exemplified in the Micro of Chicken Cholera" was read.

The President said that they were greatly debted to the author for this valuable contribu to a subject of such admitted importance. entirely agreed with the observations it contai as to the deceptiveness which many of the proces of staining and preparation produced. No do they had their special value, and it would be qu true to say that a great deal was to be learn the employment of such means when they were garded as processes auxiliary to the object of inquiry, and were used as means to an end. B to regard such methods as producing results whi they could afterwards rely upon was, he thou only to place confidence in that which further perience would be unlikely to sustain. The dry of the object and the staining it in most cases entirely changed it that too much stress could be laid upon the protest now made, for he ha found that some of the organisms which he ha examined in the living state had altered so during the process of treatment by reagents tha it would have been impossible to identify them a the same. It was only in proportion as they worked with the living, or at least unaltered specimens that they would be able to reach conclu sions likely to advance their knowledge of wha was true concerning them. He was glad to fi his own experiences so entirely confirmed by observer who had made these more recent obser tions.

Dr. Maddox called attention to the death of D John C. Draper, of New York, who had for ma years devoted himself largely to the study of blo corpuscles and to photographing them.

Mr. J. W. Stephenson's paper "On 'Cent Light in Resolution" was read, the object of paper being to call attention to the misunders ing that had arisen by the alleged resolutio *Amphipleura* by central light—that is, with the real aperture.

Mr. E. M. Nelson thought the paper touch upon a very important matter with regard to questions of central and oblique light. Wh Prof. Abbe's theory came out it was said t every microscopist should have an apparatus examine the diffraction spectra, on which alone power of resolution depended. This appeare him to be manifestly wrong, because it was q certain that the best resolution of *P. formosa* obtained when the whole field of the micros was full of light and no diffraction spectra w visible. This theoretically reduced the pow resolution; but, as a fact, the resolution itself enormously increased. He was about to rea paper bearing upon the subject at another dealing with an object which was immensely minute than most of the so-called tests. T could be seen only with central illumination he thought the ability to resolve this was of value than the resolution of lines. What he ferred to was a small spicule extending across of the spaces between the lines on the dia Taking the distance between two adjoining str tions to be the 1/24,000in., and the intersp being about equal to 1/48,000in., and estimating small marking at even ⅓ of the interspaces would give it a diameter of the 1/144,000in. was a thing that could not any how be reso under the oblique light system; but could onl seen when the objective was full of light.

Mr. Crisp said that Mr. Nelson was such a known expert in such mateers that it perhaps presumptuous for him to point out he had mixed up two entirely different ques —visibility and resolution—which perhaps counted for the misunderstanding to which paper was directed. In the same way the d have seen 1/1,000,000in. was supposed disproved the limit of resolution depen wave-length. It was, however, only a visibility, whereas the diffracti aspect of it, referred last case put by Mr the resolution not bei light, it was oblique light, and nothing else, that resolved the object. As to the notion that the better the diffraction spectra were seen the better they could see an object, he (Mr. Crisp) now heard it for the first time, and he did not understand where Mr. Nelson could have found such a statement. Again, no theory that he was aware of suggested that there was such a "reduction of the power of resolution" as Mr. Nelson had referred to. No such reduction, in fact, took place.

Dr. Matthews said he was one of those who had been stumbling over this question, and it had seemed to him that resolution and visibility meant very much the same thing. Most photographers would bear out the statement that a picture taken at mid-day was never so effective as one taken when the sun's rays fell upon the objects at a greater angle, and when the contrasts of shadows enabled the eye to perceive the details in a more effectual manner. Just in this way it seemed to him that when a thing was said to be "resolved," it meant that its component parts seemed to be more visible.

Mr. Crisp said the difference between visibility and resolution would be understood from the fact that though they might be able to see a line with a dry objective which measured the 1/1,000,000in., yet they could not separate two or more of such lines. He further said, in reference to a question from Mr. C. Beck, that there could be no manner of doubt as to the difference made by Prof. Abbe between resolution and visibility, and read the following quotation from Prof. Abbe's original paper. "Such objects *can* be seen, *however minute they may be*—this is merely a question of contrast in the distribution of light, of good definition in the objective, and of sensibility of the retina. In point of fact, neither Prof. Helmholtz nor the author has ever spoken (as, however, has so often been supposed) of a limit of 'visibility'—only of the limit of visible 'separation.'"

Mr. Nelson drew a diagram upon the board showing the appearance under the microscope of the spicule to which he had previously referred, and which he said he saw perfectly with an immersion objective of 1·43 N.A. and a dry achromatic condenser. "How was it possible," he asked, "that a thing like this, with a diameter of 1/144,000in. only, could be seen"?

Mr. Crisp said that that was simply a repetition of the difficulty with which they had started. The spicule was merely a question of visibility, and not of resolution, and it could be seen with almost any aperture. All that was here required was sufficient power and definition in the objective, as well as appropriate illumination. A series of such objects, however, could not be seen except with large aperture.

Notice was given that the next meeting would be made special, for the purpose of enabling Dr. Dallinger to be elected president for a third year.

The list of nominations for council and officers for the ensuing year was read.

Messrs. Curties and Hembry were elected auditors of the treasurer's accounts.

The anniversary meeting will be held on Wednesday next, at 8 p.m., at the Society's rooms, King's College, Strand, when the president (Dr. Dallinger, F.R.S.) will deliver an address dealing with the results he has obtained during the last four years principally in the employment of the greatly improved microscope object-glasses made on the homogeneous-immersion principle. The special research which Dr. Dallinger has been engaged upon, and to which his address will be devoted, is the elucidation of the origin, development, division, and ultimate function of the nucleus, as found in what may be assumed to be its simplest condition in the more striking of the septic organisms, and his microscopical observations have been chiefly made on the living organism. The object-glasses employed by Dr. Dallinger are high powers of most recent construction, in which the apertures have been carried to the highest point hitherto attained, and were made expressly for his investigations by Messrs. Powell and Lealand.

Toxic Action Proportional to Atomic Weight.—The salts of the rare metal rubidium act as heart poisons like those of potassium and lithium; and Richet, who has examined the action of these substances on both warm- and cold-blooded animals, finds that these metals are poisonous in almost exactly the inverse ratio of their atomic weights (lithium 7, potassium 39, rubidium 85), so that the minimum lethal dose of rubidium is about a twelfth of that of lithium, that of potassium being intermediate between these. It appears, therefore, that the toxic action is really a chemical one, the chlorides of the metals acting by displacing, molecule for molecule, the chloride of sodium in the tissues.

OLD-BEARIN[illegible] [illegible] discovered in [illegible] commune of [illegible] d the [illegible] ng district of [illegible]

SCIENTIFIC NEWS.

THE Dun Echt Circular No. 110 continues the ephemerides of comets Fabry and Brooks, as calculated by Dr. H. Oppenheim for Berlin midnight. Brooks's comet is, as we hinted last week, now of little interest to the observer; but Fabry's is steadily increasing in brightness, and by the end of the month may become an attractive object. It is still within the square of Pegasus, but towards the end of the month will be found on a line joining Beta Pegasi and Alpha Andromedæ. The ephemeris for Berlin midnight is as follows for the dates given, which will be sufficient guide as to the rate of motion:—

	R.A.			N. Dec.	
Feb. 7.	23h.	23m.	28s.	24°	40·4′
9.	23	23	5	25	8·5
11.	23	22	43	25	31·0
13.	23	22	24	25	55·7

Barnard's comet will, according to Prof. Krüger, arrive at perihelion on May 3, at a distance of ·48 in terms of the earth's mean distance, so that about April we shall have two comets more or less conspicuous objects in the sky. Barnard's comet is at present in Aries, and in the third week of the month will be a few degrees south of Alpha Arietis.

A brilliant meteor was observed from a place near Barnstaple on the 27th ult., and is described as having a "tail of a smoky consistency, rather of the shape of an elongated fan," which altered its position from the horizontal to the vertical as the body fell. The meteor is stated to have been a pale emerald green, with a yellow flame apparently playing all over it.

The Sheffield Technical School, erected at a cost of £11,000, in connection with Firth College, was opened last Monday, when Sir F. Bramwell stated that the City and Guilds Institute wished to see a technical school in each large town, where general science could be taught, but attention could be specially directed to the particular industry or industries of the neighbourhood. Sir Henry Roscoe, M.P., said that the prosperity of the State and the skill of the artisnn were closely connected, and he expressed the hope that the Education Commission would endeavour to introduce into elementary schools more practical teaching, such as freehand and mechanical drawing, lessons in natural science, and manual exercises in the use of tools, which would be especially useful to young men sent out to new lands. Technical schools, however, he reminded his audience, are not to teach a trade, but to teach artisans the principles of the trades they practise.

Lord Rosebery has endowed a new lectureship in Edinburgh University. The course, which will extend over five years, will consist of thirty lectures on the philosophy of natural history. The lectureship has been offered to, and accepted by, Mr. G. J. Romanes, M.A., LL.D., F.R.S.

At a recent meeting of the Royal Society, Dr. Downes read a paper on the "Action of Sunlight on Micro-organisms," in which he called attention to the fact that the observations made by himself and Mr. T. Blunt, described in papers contributed to the Society during 1877-79, had been corroborated by other investigators. Dr. Downes now asserts that the hyperoxidation of protoplasm by sunlight is a general law, from the action of which living organisms are shielded by protective developments of cell wall, colouring matter, &c. In previous communications Dr. Downes had shown that sunlight was fatal to saprophytes, and that in the presence of free oxygen the molecule of oxalic acid might, under the influence of light, be entirely resolved into water and carbonic acid. The alterative ferment of cane sugar, a representative of the diastases, is also oxidised by sunlight.

At the meeting of the Physical Society on the 23rd ult. a "Note on some Organic Substances of High Refractive Power," by Mr. H. G. Madan, was read. The ketone is a thick yellow oil, boiling at a temperature near the boiling-point of mercury. Apparently a very stable, neutral, and harmless substance, like Canada balsam, it does not seem to be capable of hardening, hence is not by itself adapted for a cement. Its refr[illegible] index for the D line is 1·666, higher than that of carbonic sulphide, while its dispersive power is approximately the same. The author has made the bromide of the ketone, but it seems liable to decompose, with formation of hydrobromic acid, which acts upon the spar. Mr. Madan also exhibited a specimen of metacinnamene, a highly refracting glass-like solid, obtained by the action of light or heat upon cinnamene. It possesses a refractive index of 1·593 for the D line, and would make a valuable cement if it showed a firm adhesiveness for glass.

The Cardiff Naturalists' Society held the 18th annual general conversazione on the 21st ult., and after the transaction of routine business, an unusually interesting collection of antiquities, curiosities, and scientific apparatus was inspected. Mr. Casella exhibited a collection of meteorological instruments, and Messrs. Watson and Sons, of High Holborn, had a fine display of microscopes and objects, and at intervals during the evening gave "demonstrations" with their new lantern microscope. The programme and catalogue of exhibits made by members show that science meets with due attention in Cardiff.

A second course of eight free lectures to artisans and others connected with the building trades is announced to be given on Wednesday evenings, at 8 o'clock, at the Carpenters' Hall, London-wall, on "Matters Connected with Building." The first of the course will be given on Feb. 17th by Mr. T. Blashill, F.R.I.B.A., when the subject will be "Timber: its Growth, Seasoning, and Preparation for Use."

At a meeting of the Royal Medical and Chirurgical Society Mr. H. Lee read a paper, in which he endeavoured to show that the rays of light which pass through the pupil and impinge on the tapetum lucidum are reflected again in a concentrated form as from a concave mirror. He concludes that animals having the tapetum (a shining layer existing in the choroid coat of the eye in some animals) see better in the dim twilight than others. In the horse and ruminants it is called a tapetum fibrosum, and in carnivora and seals the tapetum cellulosum. It is well developed in the horse, but is found in deep-sea fish only. Birds have no tapetum, nor have bats, mice, and rats, and Mr. Jessop suggested, therefore, that the use of the tapetum was to increase the stimulation of the retina in animals whose retinæ are not so sensitive as those which do not possess a tapetum.

At a recent meeting of the Society of German Mechanical Engineers at Berlin, Privy Councillor Stamke, chief technical adviser of the Minister of Prussian railways, stated that it was quite useless to discuss vacuum brakes, as there was no longer any question that automatic compressed air brakes would alone be used over the whole Continent.

The 150th anniversary of the birth of James Watt was observed by the Technical Society of Winterthur, Switzerland, and was celebrated by the Association of Foremen Engineers of Glasgow and the West of Scotland on the 23rd ult. In the course of his remarks the president of the latter made an opportune reference to the genius and ability displayed by William Murdock, who as the founder and inventor of gas-lighting, the designer of the first locomotive, and of the first oscillating and slide-valve engines, deserves a larger share of public recognition than he has yet received. Murdock received but scant recognition from Boulton and Watt until he sent in his resignation, and then the firm discovered that he was worth £1,000 a year as manager of their works.

The Rev. T. E. Espin, B.A., F.R.A.S., has been re-elected Special Observer to the Liverpool Astronomical Society; also the Society of Science, Letters, and Art, of London, have conferred upon him the honorary title of F.S.Sc. for his valuable work in astronomy.

ALLOYS of cobalt and copper have many useful applications. The alloy with 5 per cent. of cobalt is particularly useful. It is as inoxidisable and malleable as copper, as tenacious and ductile as iron, and is suitable for rivets and fire-boxes.

AN international exhibition, similar to that held at Antwerp last year, is planned by the city of Geneva for 1887.

LETTERS TO THE EDITOR.

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[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

◆◆◆

DOUBLE STARS—STAR DISCS—μ GEMINORUM—B. I. 16 LEPORIS—GORE'S NOVA IN ORION—STARS NEAR ζ PERSEI AND ζ CANCRI—OBSERVATIONS OF SATURN'S SATELLITES.

[25302.]—THE following are the position angles and distances of the stars referred to by Mr. Gaudibert (letter 25155, p. 359).

No. 8. (O Σ 464) 58·6° : 0·64. Dc. 1869·9.
„ 9. (O Σ 510) 174·2 : 0·20. Eng. 1883·3.
11. (71 Tauri) 70° : Peirce 1868·1.

The case of 71 Tauri is an interesting one. On Feb. 16th, 1868, Mr. C. S. Peirce, at Harvard, first noted it as double, "much closer than 80 Tauri," which was then about 0·75; and a few days later the star was looked at by Mr. Searle, who could see no indication of duplicity. I asked Mr. Tarrant (whose eye for close pairs is of extraordinary fineness, though, perhaps, not equal to the almost miraculous vision of Mr. Gaudibert in this respect) to examine it some little time ago with some other pairs with his 10in. reflector, and he thought that it was certainly double, the direction being about 240°, agreeing with that given by Mr. Gaudibert. He had no knowledge of any previous observations. This star will be occulted on the morning of Feb. 13th, but under unfavourable conditions in this latitude. I regret the misprint in Mr. Gaudibert's letter of Σ 138 for Σ 183, as I had asked a friend to examine the stars near, though none of them agreed with Mr. Gaudibert's description, with a large aperture. With the correction he notes his star is evidently Arg. (+ 28°) 335, which follows Σ 183 3min. 45·6sec., and is 5·6′ north of it. I cannot find it in any well-known double-star catalogue; but have not time to search very carefully at present. The position-angle of Σ 186 (P. I. 209) is nowhere near 100° now. Hall gave 0·5° : 0·31″ : 1879·9; but the angle has changed considerably since then.

The following is Mr. Stone's correction referred to by "Orderic Vital," letter 25159:—"Erratum in the Astronomer Royal's 'Undulatory Theory,' Macmillan and Co., 1866. On page 80, line 4, *for* 'Let this angular diameter in seconds be *s* ["The angular diameter of any ring as viewed from the centre of the object-glass $= \frac{r}{b} = \frac{\lambda n}{2 \pi e}$. Let this angular diameter in seconds be s, then $n = \frac{2 \pi e s}{\lambda}$ sin. 1″"] *read* 'Let this angular *semi-diameter* in seconds be *s*.' Mr. Knott's 'calculated diameter of extreme discs,' *Monthly Notices*, Vol. XXVII. No. 5, page 191, require to be each multiplied by 2. It will then be seen that the observed diameters of the discs are *very* much smaller than the diameters of the first black rings, a result to be expected from the rapid degradation of the light as we proceed from the centre. See *Monthly Notices*, Vol. XXVI. No. 2, page 45. The measures of discs must however from this cause be most uncertain." (*Monthly Notices*, XXVII. p. 303). "Orderic Vital" should read M. Ch. André's doctorial thesis, "Etude de la diffraction dans les instruments d'optique"; it is published by Gauthier-Villars.

In this connection I may remark that I should imagine that the star discs given by, say, M. Jansen's 19½in. mirror of only 5ft. 3in. focal length, and Schröter's of the same aperture and 26ft. focus, would be somewhat different in character. We know, moreover, that an object-glass like the Washington 26in. will not define the discs of red or yellow stars so well as it does those of blue or white ones, and the measures of the discs would be subject to uncertainty for this reason also.

The star noticed by Mr. Goodacre (letter 25217, p. 402), near μ Geminorum, is not in Smyth's diagram, the only place one would be likely to find it in, as it is too far from μ to be called a companion; indeed, Smyth's star would not have been noted by anyone but him. Burnham gives the magnitudes of Smyth's *comes* 11·5 Σ, and therefore it would probably vanish when near the ring of Saturn. Whether it was occulted or not I cannot say, but Mr. Woodside's place of μ (letter 25138, page 360) on January 9th seems rather a singular one.

Mr. Espin, in writing on B. I. 16 (letter 25218, page 402), has apparently overlooked a letter by Mr. Bone in the ENGLISH MECHANIC for July 29th, 1881, and one of my own in the number for August 19th of the same year. In addition to the observations given there, I notice that it was called 7 mag. by Taylor at Madras, on three nights between 1830 and 1843, but I cannot give the dates; Piazzi called it 6 mag. in his first, and 7 mag. in his second catalogue; Santini, 7 mag. (two observations), between 1856 and 1858 (and I suspect 5½ mag. also, for his No. 494, which has exactly the same declination as 495 (P. V. 7), but the R.A. of which is 21·7 sec. less, does not exist); Radcliffe's observations, 7 mag., 1842·071, 1854·110; Greenwich seven-year catalogue, 7 mag., 1865·7 mean date, 3 nights; D'Arrest, 6·5 mag. between November, 1874, and March, 1875; it is also in the "Uran. Argentina."

The dates of Bradley's observations are 1753, October 14, and 1754, January 16; Lord Wrottesley's name should be expunged from Mr. Espin's list, as Morton was his observer, and the date of the observation was January, 1856. It is thus in no less than eight meridian catalogues, as might be expected from its being one of Bradley's stars, and the error in its place is the more remarkable. Stone gives: Vh. 5m. 46·83sec.—11° 59′ 59·47″, 1880. It has apparently a very slight proper motion.

I looked up Mr. Gore's *Nova* with the 3·2in. Sheepshanks refractor on the night of January 4th. I thought it about 6·8 mag.; but the night was not good. The colour was fine, and the small star Mr. Espin mentions was readily seen. Herr Engelhardt gives for this: 10·5 mag., 105·7° : 53·05″.

I am afraid I could hardly explain to "Aleph" (letter 25275, page 446) which the stars I meant near ζ Persei were without a diagram, and I could scarcely ask the Editor to engrave one for that purpose. If, however, he will communicate with me (preserving his *nom de plume* if he desires), I will send him a diagram of the object. I know of no star near enough to the triple ζ Cancri to be called a faint companion; but there are, of course, many faint stars in the field.

The observations of the satellites of Saturn, about which "W. L." inquires (query 58620, page 414), have been made at various observations, including those of Geneva, Toulouse, Washington, Bermerside, and Greenwich. He will find some of the Washington in the *Monthly Notices* for May, 1884, and July 1885; the Bermerside for 1884 are in the number for January, 1885. The rest are scattered up and down various publications, and the complete results at Washington are not yet published.

H. Sadler.

32, Manor-street, Clapham, Jan. 30.

Σ 848—THE MEROPE NEBULA—THE NOVA ANDROMEDÆ.

[25303.]—THE star Σ 848, the place of which for Epoch 1875 is as follows in the Earl of Crawford's edition of the "Mensuræ Micrometricæ":—R.A., 6h. 1·4m.: Dec. + 13° 59′; was measured by Struve as a quadruple star; magnitudes, 7·3, 8·0, 8·2, 9; positions, about 108°, 120°, 183°; distances, 2·35″, 28·59″, 43·05″. It is situated in Sir W. Herschel's Cluster VIII. 24 in Orion. In all the editions of Mr. Webb's "Celestial Objects," only the close pair is mentioned. My original edition of the "Mens. Micrometricæ" formerly belonged to Mr. Dawes, and there is a pencil note, in his handwriting, with a diagram on the margin. The note is as follows:—"There is a *fifth* star of about 11th mag. in the north-preceding quadrant, distant perhaps 15″, which Struve has not noticed. I found it 1848, March 21.—W. R. D." By the date, this must have been with his 6⅓in. Merz, at Camden Lodge, Cranbrook. It is, of course, very obvious with my 8in. objective. It is surprising that Struve should not just have mentioned this small *comes*, as it is much closer than the two companions he has measured, though the magnitude is less than his limit for measurement. This star is Sir W. Herschel's I. 57, and South's 506, "called by S. Nova."

In regard to the subject of the Nebula in the Pleiades, lately mooted in your columns, I have seen it many times the last few years with my Cooke 8in. objective and a fine Kelner ocular of a power of 42 and a field 55′ in diameter. I am sorry to differ from the distinguished observers who deny its existence, but am quite confident that I see the Nebula, as it is represented in Tempel's beautiful map, *Monthly Notices*, Vol. XL. p. 622. I have more than once seen the following edge south of Merope, sharply defined, as noticed by a Florida correspondent in the *Observatory* for March last, p. 94, "a curve lying within a curve of similar shape, formed of small stars," as is well shown in Tempel's chart. The Florida correspondent also states: "This object is to me one of the steadiest and easiest objects amongst nebulæ." I do not, however, endorse this statement. The great desideratum for the exhibition of the nebula is as low a power and as wide a field as possible, in order to secure contrast.

In your article in the number for January 1 of this year, on "The Progress of Astronomy in 1885," it is stated that the Nova in Andromeda "is now invisible." Is it invisible to all the large telescopes of the present day? I examined the star on Dec. 15 last with a brilliant moon almost on the same meridian, and made the entry in my note-book "readily seen, powers 350, 445." Bad weather and indisposition precluded further examination till Jan. 6, when I wrote, "tried the nova with all powers up to 880, utterly failed to see it—had not even a momentary impression." I hope the possessors of large apertures may be induced to detail their experience in these pages, as it would be most interesting.

George Hunt.

Hopefield, West Dulwich, Jan. 29.

SATURN.

[25304.]—PERHAPS the following observations upon Saturn may be acceptable in the present dearth of opportunities. They were made with a superb 6½ Calver mirror and a power of 215 on the night of Jan. 18. Air was very steady. I classify results as advised by Mr. Franks. The outer ring. This was much less bright than ring B, and had a distinct line at about one-third its breadth in both ansæ. Cassini's division was seen clear all round, just clearing the S. pole of the planet. Ring B was very bright on outer border, and appeared to diminish in brightness towards inner edge, not gradually, but by steps, which at times gave me the impression of fine lines or divisions. Is there any suspicion of further divisions in this ring? Ring C was very well seen. A very evident separation exists between B and C, and was easily seen. The inner edge was sharply defined in both ansæ, and the ball of planet visible through ring where ring passed in front. The colour of this ring was faint purple, and unless I am much mistaken, a division exists in it in the centre, but this is too faint for any aperture. The shadow of the ball upon the rings was black and sharp, but appears to curve convexly on ring B and concavely on ring C. One broad belt is on the equatorial part of the ball, and in moments of best definition two fine hair-like lines were visible in centre about one-third across the planet, and a lighter patch on the south border. This patch was the brightest part of the whole system. On the south polar portion several faint belts were perceptible, the polar bluish tint being very perceptible, and in strong contrast to the brown of the temperate region. The satellites visible were six in number—Titan and Iapetus, of course; Rhea, almost at east elongation; Dione almost at west; Enceladus had not reached east elongation, and was south of following end of ring. Tethys was south, preceding, and was very faint indeed, being many degrees fainter than Enceladus. I had much difficulty in picking up Tethys; none with Enceladus. I reduced aperture to 3in. and found Cassini's division still visible without difficulty. I regret I cannot send a sketch, Saturn presented a never-to-be-forgotten sight.

I have recently examined the following stars and shall be glad if Mr. Sadler can confirm my observations. The positions and distances and magnitudes are only estimated:

56 Aurigæ	a 12th mag.	at 0·8″	50°.
Σ 698	13th „	„ 6″	150°.
Σ 572	10th „	„ 1″	75°.
20 Gemini	15th „	„ 4″	115°.
Σ 1106 equal stars in contact			180°.
118 Tauri	a 12th mag.	at 0·5″	160°.

I wish to express my personal thanks to Mr. Sadler for the lists of close stars he has supplied from time to time for Mr. Gaudibert's examination. I have examined most of them with the most gratifying success. As an instance, Σ 2505 was at once seen elongated in same direction as by Mr. G. The limit of 4·56″ divided by the aperture is certainly far surpassed by Mr. G.'s mirror, as I completely divide half-second pairs when air is steady, and obtain neat discs with 120 which do not perceptibly enlarge with higher powers.

Allow me to congratulate you and my fellow readers on "Prismatique's" masterly and crushing rejoinder upon the star-disc question. I am pleased to see it has silenced his ignorant opponent, whom allow me to express the wish we may hear no more.

Edward Clark.

NOVA ANDROMEDÆ — θ ORIO SATURN'S SATELLITES.

[25305.]—IN the *Monthly N*
1885, there are given the [illegible]
Nova in Andromeda at
together with a chart
The two stars there
at 11·0 and 11·4 mag
be much obliged to

your readers who are well posted as to star magnitudes, to say if these two stars are really so faint. In my observations upon the Nova, I find that these two stars were also used by me in my comparisons, but I had estimated them at 10·2 and 10·5 respectively, or nearly a magnitude brighter, β being assumed as 10·5, and α being estimated as ·3 brighter. Of course I feel some hesitancy about raising such a question; but as I ask it for use in any future estimates, I hope some of your readers will enlighten me. For if they are really about 11th magnitude, my eyesight must be somewhat better than I thought it was. On the night of Sept. 23rd, with the moon full and very bright, both of them were pretty easily seen with power 60 on my 4in. Cooke, and α easily with power 25. The star γ on the chart I estimated at about 12th magnitude. It was first noticed about the beginning of October, while looking around for fainter comparison stars, but was rather too faint to use at the time. Still, with power 120 it was often visible thereafter, and on a good night I had no difficulty in seeing it. If this star is really 13th magnitude, I do not know why there should be so much difficulty in my seeing the 5th star in the Trapezium, and yet upon several occasions lately I have turned my glass upon Orion when on the meridian, but could not be positive of seeing it. Even after referring to the diagrams showing its position, still I could not satisfy myself that it was seen. Inasmuch as I have seen both stars of the Debilissima with the same glass, and that without much trouble (even when the telescope was mounted in the city), I cannot understand why there should be so much difficulty with the Trapezium star when the telescope is now mounted in the country, three miles from the smoke and haze of the city, unless the star is certainly variable. My glass shows five of the satellites of Saturn easily; in fact on the night of January 13, with the moon just past 1st quarter, Rhea was very easy, and Dione was certainly seen, a diagram being made at the time, and the satellites identified afterwards by means of the *Nautical Almanac*. On January 17 at 10 hours, with the moon nearly full, and only about 10' distant, with power 200, Rhea was seen steadily without any trouble. While watching Saturn on the night of January 15 at 10 hours (Rhea being easily seen), another point was shortly afterwards suspected with power 200, almost due following, and about a magnitude or more fainter. Putting on power 300, and feeling pretty sure that something was there, I followed it up till Saturn was just passing out of field, when it was seen steadily for a few seconds. It was apparently slightly more distant from the planet than Rhea. No satellite is in that position, so I suppose it was some fixed star. My diagram makes it about on the same parallel with Rhea, very slightly north. **W. H. Numsen.**

Baltimore, U.S., Jan. 22.

THE MUSICAL INSTRUMENTS FOR HOME.

[25306.]—"COUNTRY SOLICITOR" having lately favoured the readers of "Ours" with a brief description of the famous Mustel instrument, perhaps I may be allowed to express my opinion on some points in connection with the subject.

I quite agree with all that "Country Solicitor" has said in favour of the Mustel reed organ. I have had the pleasure of listening to the charming effects produced from the Mustel organ under the manipulation of an excellent performer; but I cannot agree with "Country Solicitor" in his opinion that the American organ lacks expression.

Take a good American organ, such as those manufactured by Mason and Hamlin, Clough and Warren, or Carpenter, and other excellent makers. Let the instrument be played on by a skilled manipulator, and under these conditions I hesitate not to say that true expression can and will be obtained even from the American organ.

There is another reed organ which richly deserves a word of praise. I refer to Mason and Hamlin's orchestral reed organ. This instrument is made on the pressure system, and contains some admirable solo stops, due to the excellent voicing of the reeds, combined with every skill bestowed in the manufacture of the instrument. Although reed organs, constructed on the pressure system, are much to be admired, yet such instruments seem to lack (to a great extent) the pipe-like quality of tone found in good American organs constructed on the exhaust principle. If the latter instruments lack expression, it is totally the fault of the person who plays on them, and not the fault of the instrument. Few peopl [illegible] of the [illegible]mount of expressio[illegible] [illegible]rican organ. [illegible]

certain method of admitting the air to one of the sets of reeds. A great many professional musicians object to the common (rather too common) method of having one set slightly out of tune with another set. A celeste of this latter description sounds distressing if used in "full organ." With the plan adopted by Messrs. Mason and Hamlin, the air can be admitted to all the reeds contained in the instrument without any objectionable effect.

Now, as we have a most interesting subject in discussion, I should like to make a suggestion that one of "our" experts would (before this subject falls out of our columns) describe the method of voicing the reeds, and also explain the other methods by which the various characteristic qualities of tone are obtained. I have no doubt that the subject, if properly treated, will demand the attention of the majority, if not all, of the musical readers of "Ours."

This proposition I am unable to carry out myself, for, as regards reed voicing, I do not pretend to be an "expert" at the art. I wish I was; I should not then be necessitated on some occasions to want other people's assistance.

I am aware of the articles on voicing (referred to by Mr. N. E. Child, p. 408) that have very far back appeared in the ENGLISH MECHANIC, and it is certain that very little practical information has, since that time, appeared in "our" columns. If some kindly-disposed expert would begin the subject, and explain the art of voicing, in its various forms, in producing the variety of tone effects found in the best and larger class of reed organs, I am quite certain that the subject would meet the approval of every reader who is at all interested in musical matters. **G. Fryer.**

[25307.]—I HAVE always been under the impression that the expression stop was not applied to the American organ because that instrument was so much more capable of expression without it than the harmonium. There is no reason whatever why the American organ should not have an expression stop. It would only be necessary to connect the feeders with the wind-chest by means of a separate channel, and to make the expression stop close a valve over the channel leading to the reservoir, and the thing is done. The percussion in the Mustel organ acts, I presume, upon only one set of reeds, and, if so, I fail to see how it can affect the whole, or any, of the other stops drawn in conjunction with it. The "lip touch" sounds suspiciously like the percussion reeds speaking perceptibly before the others—a circumstance difficult to reconcile with the extreme sensitiveness of the reeds generally, as described by "Country Solicitor." It would be interesting to learn whether the percussion acts upon a set of reeds of "first" or of "second" touch, and if the latter, whether the "lip touch" is as apparent when a stop of "first touch" is used with it as when one of "second touch" is drawn. Also whether an accompaniment played by "first touch" is as perfectly in tune with the melody as when the keys are fully depressed. The metaphone is apparently a "swell within a swell," and in saying that it renders the tone of the Mustel similar to that of an "American organ, and to a church organ heard at a distance," our friend logically admits a similarity between those two instruments which would seem to prove that the American organ is no unworthy representative of its prototype, the pipe organ. After all, he admits that the much-vaunted metaphone of the Mustel only renders it similar to the American organ, to which he would have us believe it is so immensely superior.

As regards the knee pedals, why is it (*k*)needful to button them up in order to produce one of their effects? Would it not be an improvement to "fork" each pedal, and place the knee in the fork? The central position could then be—say, medium; to the left, soft; to the right, loud; and all trouble of buttoning and unbuttoning (which takes time) would be avoided.

The pneumatic swells are undoubtedly good. The expression stop, when carelessly used, is most destructive to light and finely-voiced reeds; but by the use of the expression swells a given effect can probably be got with about half the usual pressure of wind. I should like to ask here whether Mustel's reeds are entirely at the mercy of the "expressionist," or whether there is any limit to the wind pressure that can be applied to them. The effect of a celeste formed by two rows of reeds, one sharper and one flatter than the normal pitch, is cheaply purchased at the price of one set of reeds extra, as it admits the proper amount of "out of tuneness" to produce the celeste effect, but reduces that otherwise undesirable quality by one half when u[illegible] [illegible]h other stops. I scarcely dare go so far as [illegible] the effects of the baryton and [illegible] "[illegible]icky"; but I think that [illegible] a great deal to do with [illegible]lled" from the stops [illegible] a given [illegible] [illegible]tain usually [illegible] it with these two stops you go an octave further afield, and are apt to be impressed accordingly. Tastes differ, and therefore perhaps my test would not be a fair one. But I should like to hear the opinion of someone who hears the tones of the baryton without seeing from which part of the keyboard they are produced. **Ajax.**

MICROSCOPICAL—CENTRAL v. OBLIQUE LIGHT.

[25308.]—MR. NELSON has fallen into a strange mistake. He replies to a paper read at the Royal Microscopical Society, and describes its object as being "to show that as the resolution was effected by the illuminating beam along the edge of the axial cone, the central portion was useless, harmful, and as such ought to be stopped out." Also, that its object was to "discountenance the use of central illumination." In fact, the paper not only had no such object, but from beginning to end contains not a word or a hint on what Mr. Nelson declares to have been its object! We are all pleased to see his signature on microscopical subjects, and my object in writing is not to deter him from continuing to slaughter his foes, but only to point out that in this case the foe is a purely imaginary one, developed from his own inner consciousness, and having no existence in connection with the paper whose object he has so strangely misunderstood.

One Who Knows.

CENTRING GLASS FOR MICROSCOPE.

[25309.]—I HAVE among my microscope appliances a "centring glass" about 2in. long in its tube, and which fits over the top of the eyepiece for certain uses in centring the stage and other parts of the microscope. The tube contains two lenses and a minute central eyehole. I am not sure whether this appliance was invented by Andrew Ross or Mr. Wenham, and I cannot find any description of its structure or uses in any work that I have on microscopy. Would Mr. Wenham oblige us with a sectional drawing, showing the path of the rays of light through the microscope and centring glass, and give us some instructions for its use? The appliance is little known; but is, I fancy, a very useful one for critical manipulators in microscopy. **F.R.M.S., jun.**

OPTICAL MATTERS.

[25310.]—THE number of the "E. M." for Jan. 22 contains one of those curious communications which appear at, happily, rare intervals. Some of your readers will doubtless have collections of curiosities in literature, and to any such it would be worth while spending twopence in an extra copy for the sake of cutting out and preserving letter 25257.

"Pen-y-Van" has, he tells us, "made the reflector my special study from my youth up until now—far past middle age." Surely the opinions of such a one ought to be weighty, and I am, therefore, rather anxious to hear what such artists as Messrs. With, Calver, Brashear, and others have to say to them. We are told that "silver on glass will never give good definition under a very high power," because—(1st) The glass surface cannot be rigorously tested unless it is silvered; (2nd) That this silvering is sufficiently uneven to "mar the definition even were the glass perfect"; (3rd) That even if the glass surface and silvering are perfect, polishing the silver film is "utterly destructive of very fine definition."

These are practical points upon which I am sure some of our artists will have something to say.

With reference to optical glass, I should just like to mention that I have very recently received one of Feil's price-lists. They have a series of crown glasses ranging from 2·45 to 2·80 in density; and a long series of flints ranging from 3·00 to 5·500 in density, and from 1·5417 to 1·824 indices of refraction. Perhaps I may be permitted to give the address of Feil's agent, Mr. R. Schroeder, 1, Smith-terrace, Althorpe-road, Upper Tooting, London, S.W. **Orderic Vital.**

COLLIERY WARNINGS.

[25311.]—In last week's issue of the ENGLISH MECHANIC a person who writes under the name of "Tish" attempts to prove that the Colliery Warnings which I gave in these columns in July last, were a complete failure. Unfortunately for him, and at the same time fortunately for me, he falls into a singular error at the commencement of his letter, and utterly fails to prove anything except his own ignorance of the matter he writes about. He begins by quoting my letter as follows: "A change of atmospheric pressure, combined with disturbances of the magnetic currents (earth currents) and seismic perturbations may be expected to occur during the ensuing six months," and then goes on to compare the dates I named as dangerous to miners, with the position of depressions as shown in the daily weather charts. This is where "Tish" comes to grief. There is not one single word or sentence in my letter to lead anyone to suppose that I expected areas of depression on the dates given. How "Tish" makes it out otherwise I am at a complete loss to understand. I simply stated that on these dates a *change* of atmospheric pressure (see my letter 2448 of July 10th) would occur. I did not say that a "deep depression," or a "high anticyclone" would exist over the British Islands during these periods, but simply used the word "change" in its usual sense, and meant by it that an increasing or decreasing atmospheric pressure would take place, combined with magnetic and seismic disturbances, which would give rise to outrushes or accumulations of gas in mines, and thus render those dates dangerous to miners.

"Tish" appears to be under the impression that colliery explosions and outrushes of gas can only take place during the existence of a low-pressure area over our islands, and takes it for granted that I am of the same opinion as himself. My belief is that the only time when the pressure of the atmosphere affects the gases within the earth's crust, is when a sudden or great change of pressure takes place, and not when either a high or low-pressure system has become dominant. Should a disturbance of the magnetic or seismic forces also occur in conjunction with a sudden change of atmospheric pressure, then the period is rendered exceptionally dangerous. Such dates will be found marked with an asterisk in my letter of July 10th.

The only fair test to which my warnings can be put, is for some official connected with a large mine in which gas is found, to give an accurate daily record of the condition of the mine with regard to the quantity of gas observed in the workings. This would at once show whether or not the warnings were of any use. I sincerely trust that such observations will be forthcoming, and I shall be glad if they are sent to the Editor of the ENGLISH MECHANIC, or to me for publication as a test for my warnings. **T. J. Murday.**

Felton, Northumberland, Jan. 26th.

CONSUMPTION OF COAL BY LOCOMOTIVES.

[25312.]—THE following is the Crewe Coal Sheet for October, 1885, for the top and the bottom engines in each link, and the average of the whole link.

Engines, No.	Miles run.	Coal lb. per mile.	Cost per 100 miles. £	s.	d.	
113	2858	34·8	1	4	4	Big compounds Crewe to London only.
509	2394	38·1	1	6	0	
	Average	35·1	1	5	1	No. 1 link.
803	4947	30·2	1	3	1	Crewe to London, small compounds.
306	2362	34·1	1	4	6	
	Average	32·1	1	3	7	No. 2 link.
789	5270	30·6	1	2	10	Big Jumbo's, Crewe, Carlisle, and London.
1187	7332	43·2	1	6	9	
	Average	36·9	1	4	9	No. 3 link.
333	4756	27·0	1	2	5	Small comp., Crewe to Holyhead.
1116	5210	32·3	1	4	1	
	Average	29·9	1	3	1	No. 5 link.
1104	3997	28·2	1	2	7	Small comp., Crewe to Holyhead.
1115	3396	33·2	1	1	7	
	Average	30·8	1	3	6	No. 6 link.
231	5750	24·8	1	1	1	Yorkshire. Link No. 7. Ramsbottom's four-wheel coupld
1215	3285	35·6	1	4	0	
	Average	31·6	1	3	4	

I will offer a few remarks on the above sheet. The average miles run by the two big compounds is only 2,626 miles, whilst the large Jumbo, No. 1187 ran 7,332 miles. The greater mileage of the latter is owing to the big compounds failing and being under repairs in the shed. I may also point out that these big compounds are very crafty, for they manage to run the light trains and then, of course accidentally, fail when their heavy work is coming on, so that they show better in the sheet than they deserve. Then the Jumbo's have to run the heavy trains in their place.

On comparing the cost per 100 miles, it appears to me that the compounds which use the best Welsh coal are only charged the same price as those that use the cheap inferior coals are, when it is well known that it not only costs more, but it comes farther and the cost of carriage is greater. Outsiders have very little idea of the way they are being misled by the compound brake, and I wish to give them the facts so that they can think the matter out for themselves. The lightest big compound used 31·8lb. of coal per mile, and £1 4s. 4d. per 100 miles. The lightest big Jumbo used 30·6lb. of coal per mile, and cost £1 2s. 10d.; and it ran twice the number of miles with worse coals. It was 4·2lb. of coal less, and 1s. 6d. per 100 miles less in expense. Ramsbottom's four-wheel coupled engine, which runs the worst road in Yorkshire, is 24·8lb. of coal per mile, and £1 1s. 1d. per 100 miles in cost. That is 10lb. of coal less per mile, and 3s. 3d. less in cost than the lightest big compound. Besides, the Ramsbottom engines do not get justice done to them; they are not kept in proper repair, and they use more coal in consequence of being out of repair. Then the very pick of the enginemen and firemen are selected for the compound, and the cast-offs are put on the Ramsbottoms. At some stations they fine them 10s. for putting a jimmy in the exhaust pipe, but there are few or any compounds run without one. Why fine them at Longsight and permit them to do it at Crewe?

The compounds have every advantage in their favour—the best men, best coal, and best attendance; a set of men in the shed to examine them before they are allowed to go out, and a set of men to assist at the large station, because the engineman and fireman cannot get them ready in the time allowed. They have all this without the cost appearing against them. Trickery, misrepresentation, humbug. Well may Mr. Seaton say that they are "monsters of iniquity." He would say worse if he knew all.

I just want to say one word for my Yorkshire brothers. They have suffered very much lately because they have to run often tender first; and by some incomprehensible means, the tenders that were made for Yorkshire roads with weather-boards on, as they go in for repairs, are put to engines that have no tender-first to run, and tenders without weather-boards are being sent into Yorkshire in their place. This is the old game of putting square pegs into round holes, and round pegs into square holes. I have noticed that a number of the men have been off ill in consequence of the above arrangement. I hope this will be remedied.

Meliora.

COMPOUND LOCOMOTIVES.

[25313.]—ALLOW me to inform Mr. Rous-Marten that in Sept., 1885, I believe it was, "Aurania," No. 363, ran the 12 o'clock express from Euston, and arrived at Rugby 8 minutes before time, doing the journey from London, 82½ miles, in 1 hour 35 minutes. On the 10 a.m. Scotch express the large compounds have been doing some good work lately between London and Rugby. On Jan. 30th, 1886, one of them brought it into Rugby five minutes before time, ten coaches on, 1 hour and 45 minutes. When they first came out I remember Knowsley, No. 306, left Rugby with 12.45 p.m. up to London, sixteen on, and made five minutes up between there and London. They do some good work and they do some bad, and so do other engines besides the compounds. Some drivers do better with them than others. One driver cannot keep time with a compound, and yet another man with the same engine will. Is it because some of them are afraid to run, or is it because they do not understand the engines properly? In my humble opinion the compounds are a very good engine, but, like everything else, they will stand improving. For instance, if the steam could be discharged from the high-pressure cylinders to the chimney in case of emergency, it would save time in starting, as the driver would not have to set the train backwards to get rid of the steam in the low-pressure cylinder as that gets choked up. **Ghilleasbuig McTomae.**

[25314.]—MR. ROUS-MARTEN'S championship of the L. and N. W. compounds affords acceptable relief from the storms of adverse criticism to which they and their performances are everywhere subjected. A compound *is* occasionally put on the 12.0 down to Rugby and Manchester, and *can* run down hill fast enough to keep time, at all events, with a light train. On Jan. 14th, rails dry, 365 America, small compound, with six coaches on, kept time to Willesden, left punctually, and ran to Rugby in 1 hour 28 minutes, or three minutes under time. (The run was continued by 1194 Miranda, "Precedent," which took the train to Stoke ticket platform, 62½ miles, in 1 hour 19 minutes, or three minutes under time, in spite of being stopped by signal at Barlaston.)

As a supplement to Mr. Rous-Marten's records of the performances of the "Precedent" Hercules with this train, the run on Dec. 22nd, Willesden to Rugby was done in 1 hour 27 minutes by 862 Balmoral with eight on, the train leaving one minute late, and standing at Rugby platform with three minutes in hand. As an instance of how the two lines most noted for punctuality maintain their prestige, I may give the following terminal times of up trains on Jan. 14, a good day for running:—

Euston: 12.10 Morning Manchester arrived 12.5; 12.30 Birmingham Express arrived 12.28. King's Cross: 1.0 Leeds Dining Car arrived 12.57; 1.17 Cambridge Express arrived 1.16.

The 12.10 and the 1.0 were both nine coaches, the others lighter. **L. N. W.**

RAILWAY SIGNALLING.

[25315.]—THE eighth clause in the requirements for railway safety issued by the Amalgamated Society of Railway Servants directs attention to the importance at all junctions of putting an actual lock upon the signal arm itself, as well as upon the levers in the signal box. The ordinary interlocking frame prevents wrong signals being lowered by the man in charge, so long as the connections, rods, and wires are in proper order, but if (as was the case at Earl's Court recently) a rod should fail, the system is rendered useless. To avoid this danger, Mr. Davis, of the Great Eastern Railway, invented, and Messrs. Saxby and Farmer manufactured, an efficient apparatus, which appears to satisfactorily insure the impossibility of two conflicting signals being off at one time. To prevent this, the action of lowering one signal is made to actuate an extension of the rod to the other conflicting signal. This "lock rod," as it is called, works a mechanical hooked bell-crank which directly locks the arm itself, which must always be "on" when the conflicting signal is lowered, as the same action which lowers the one locks the other. Having described the method of locking, let it be supposed a fracture has occurred in the rod working a branch home signal at a junction, and that the signal has been lowered to or stands "off," and remains in that position after the signalman has returned the lever in his box to the normal position, as the balancing of the arm is altogether insufficient to overcome the friction of the rollers in the long length of rod or wire. The action of returning the lever of the branch signal to "danger" would, of course, unlock the levers in the locking frame in the box, but should the signalman, without knowing of the failure of the rod, attempt to lower the main line signal, he would be unable to do so, as the actual locking on the main arm would prevent its being taken "off." It will be found, by taking any example, that whichever rod breaks, no two opposing signals can be standing off at one time, and it has the further advantage of immediately acquainting the signalman that something is wrong with the apparatus.

The method can be carried out with signals of any type, whether worked by rod or wire, and is stated to be comparatively inexpensive in its application. It can be applied, however complicated the station or junction may be, and is certainly the only direct mechanical lock between conflicting signal arms. The locking device of one arm may be made to act upon and control the locking device of one or several other arms directly between the signals themselves, without the intervention of the movement of the levers, or the locking device of any signal arm may be connected back to the levers in the locking frame, so as to lock or unlock any levers as may be required.

From the accident at Earl's Court it would appear that if so simple and effective a method of preventing accidents can be applied for a comparatively small cost, railway companies should give this matter their earnest consideration. Signal connections will always be liable to failure, for whatever care is taken in their manufacture absolute security cannot be guaranteed by any tests of the material, so that a method by which these failures are rendered harmless is of the greatest importance, both to the public and the servants.

Clement E. Stretton, C.E.

Head Offices, A.S.R.S., 306, City-road, London, E.C., January 23.

BRAKES.

[25316.]—I RETURN many thanks to Mr. C. E. Stretton and "Upton Park" for their answers. I do not know whether "Webb's Air-brake" is in use on the L. and N. W. Railway; but I think it is only being tried experimentally. I hope also in time that air-pressure brakes will displace vacuum-brakes. On getting out of the train from Surbiton one morning at Waterloo, I saw two coaches of the L. and N. W. One strange thing that I noticed was that each of them were fitted with both the automatic-vacuum and Webb's air-brake. This vacuum I presume is Webb's. The driver of the 9.3 train from Surbiton on the L. and S.W. Railway tells me that you cannot take the Smith's automatic-vacuum brake off the carriages except by means of a wire. This brake is largely used on the L. and S.W. I am well acquainted with — by which it is put on—viz., a vacuum is maintained in the pipes, air is admitted which destroys the vacuum and thus applies the brakes. What I want to know is how the brake is taken off?

of your numerous readers give me a sketch and description of how the brake is taken off? In the tables of the great brake trials at Newark, in Mr. Michael Reynolds's "Continuous Railway Brakes," it mentions that an L.B. and S.C.R. engine is fitted with the "Westinghouse vacuum" only experimentally. I should be glad if any of your numerous readers would give me a thorough description of this brake. Is it automatic or non-automatic?

Triple Valve.

GRINDING AND POLISHING GLASS SPECULA.

[25317.]—I THINK in this letter it will be well to take up the subject of the shape of specula, at least, to a small extent, for this is really a large subject, and if I were to make known all the data that I have relative to this subject, I should surprise all interested in it; the fact is it is a subject little understood, nor could it be before the shadow and zonal tests were used, and now where they were not used conjointly, no confidence can be placed on any description of any speculum, and any who are trying to make specula without their united aid are only working in the dark, and, therefore at guesswork. "Pen-y-van's" letter (25257) is an instance of this. I have had such evidence of this, even up to the present time, that I feel I am doing all astronomers who have to use the telescope, and all who attempt to make them, the greatest kindness in calling attention to this subject at this present time. There will come a time, I hope, when all who attempt to make specula will first become thoroughly master of the shadow and zonal tests, and can thus guarantee the shape of the speculum as answering to the requirements of these tests, and will not be afraid of their specula being tested by them. When this time comes then there will be no longer any necessity for my insisting on the importance of working specula to their requirements. I should advise all purchasers to insist on their specula being able to come very near to the requirements of the zonal test especially; for, if a speculum will stand the zonal test, it will stand the shadow. I can well liken it to the fine adjustment of the microscope as compared with the coarse adjustment: it is what gives the final touch to the definition.

In dealing with the shape of the speculum, an answer in part, at least, will be given to "Jeckay's" letter (25112) as to "what is a perfect adjustment under use of a whole aperture, is perfect for a side aperture." He is quite right, if we suppose a perfect parabola to be the shape of the speculum; for, by supposition, the parabola reflects parallel rays to the same point or focus, whether they come from the centre, the outside, or the intermediate zone; therefore the focus of the centre is the focus of all other parts of the speculum. As to "Jeckay's" thought that the hyperbolic figure is the one that is needed to correct the "damage to definition caused by the flat stopping out the central rays." I do not understand how stopping out the central rays can alter the foci of any of the other zones, and if they meet at one point or focus, the eyepiece would have to be at that point, whether the whole or part of the surface were exposed. I should like to know what makes "Jeckay" think that the hyperbolic or over-corrected figure is better than the parabolic figure for the Newtonian reflector.

So far we have only the theoretical side of the question; but we must remember that the actual telescope is only an approximation to perfection, or what theory requires, and, in answering the practical questions "Jeckay" puts, I feel I am treading on delicate ground. I do not feel it part of my duty to publicly criticise the work of living telescope makers; they are all doing their best, I have no doubt, as far as they think what is the best, and they have been steadily improving for the last twenty or thirty years; this I know from a careful testing of specula of all ages and makers. But I am not going to give in public a description of the work of any living maker without his consent, or under very exceptional circumstances—comparisons among the living are invidious; I do not think it would be fair to the trade, since they are doing their best; but they must advance, or others will for them, and step into their position. But I should rather be happy to help any in the trade, as well as amateurs, to improve either in their mode of working or testing, and the trade has no need to feel aggrieved or insulted at this offer from me; for I can tell them that I am one of themselves, in a proper way, too. For I have been apprenticed, and served my time, in London, as a mathematical instrument maker (not drawing instruments), including astronomical, philosophical, and optical instruments, and that I, at the same time, i.e., while apprenticed, paid a consideration to a working optician to teach me his art in the evenings after I came from my master's shop, and to allow me to go to his shop at any time to see him work at all the branches. And, further, that I likewise paid one of the late Andrew Ross's ¼in. object-glass makers for the microscope to call at my lodgings, in Southwark Bridge-road, as he returned from his work in the evening (for he lived on that side of the Thames) to teach me how to make the lenses for the microscope object-glasses. I obtained the tools under his direction, and in these various ways I got a practical knowledge of every branch of the trade. My master was the same as Mr. Swift, the microscope maker, of 81, Tottenham Court-road, learned his business from. I served my time between the years 1855 and 1859, and now, when I go to London, I like to visit the workshop of a friend who served his time under the same master as I did, and thus I see the advance that the trade is making, and I take an interest in still comparing the mode of doing things with what they were thirty years ago when I learned the trade with very great pleasure, so I can say I am in the trade truly, though I have never followed it as a trade, but as an amateur, merely as pastime or hobby. I was apprenticed for the pleasure of knowing how things were done in connection with the instruments used in astronomy and optics, and I certainly do not now regret having spent four years at such a trade, and yet I am an amateur. It is perhaps worth mentioning that "Prismatique" was learning the optical department at one of the first, if not the first, practical opticians in London, at the same time as I was learning as an apprentice the "framing," as making the mechanical part of the instruments is called, and the optical as overtime, and that he had often to bring the optical work to our shop, though I never knew this till we appeared together in the columns of the ENGLISH MECHANIC, when private correspondence brought it all out, to our mutual surprise. I feel it necessary to mention the above personal matters at this juncture, for two or three reasons, among the number because I am continually receiving letters that show that many think I will make them specula and telescopes at a little less price than they can get them from the trade, and that I intend to go into the trade, and that my letters on "Grinding and Polishing Glass Specula," are a kind of preparatory advertisement and blowing of my own trumpet to attract trade shortly. Now I hope all such will learn from the above that I have no such intention, and that, if I had, I should have been in operation long before; and, further, I hope all in the trade will not fear me as a future rival; but, if I can help them rather, I shall be happy to do so for the love of it. I feel constrained, further, to make the above personal revelations because I believe the making of specula is capable of more improvements, and that I should like the trade to go on to them by adopting them as they are introduced, and not stand out against them because the suggestion comes from those they think are only amateurs. What we want is the makers to come abreast of the latest improvements, then the users of the telescope will get the benefit; for very few who wish to get a good telescope can spare the time to master the art of making a parabolic speculum, or master the shadow and zonal test. I have, perhaps, said enough on this point just now; but my only inducement in writing is that observers may with certainty be able to get a good instrument.

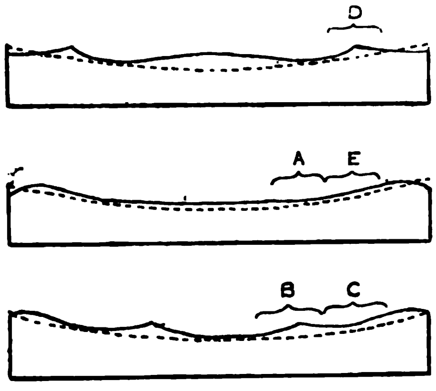
With this digression, and [illegible]t it is not a digression, I will proceed to [illegible] what will be an answer in part to "Jeckay's" practical questions. He says: "It is commonly asserted that mirrors are all undercorrected; but are they so?" I am sorry to tell it is too true, and that, even in ordering, some will request that the makers leave the figure a little under-corrected. Makers have to meet the requirements of their customers, though they may know that the full amount of correction would be better. The idea that under-correction is best arose, no doubt, from the fact that the old makers had not full control over the figure in polishing, and that they had to depend on the fine-grinding on the rigid metal tool for the truth of the foundation spherical figure, as they thought; though even then they never got a perfectly spherical figure to begin the polishing with. Now, in polishing, they had to follow this figure, keeping as near to it as possible, for truth's sake, only deepening the centre a little at the last, with fear and trembling, lest they should lose the truth of the figure. In this case of imperfect control, of course, the carrying the correction to its full extent may produce worse defects in untruth of figure than a little under-correction; and so in the then imperfect mode of polishing, and figuring, and testing, it perhaps was better to not push the correction to its full extent; but we ought to have such control over the polishing as to keep a regular figure, whether we carry the correction nearly to or beyond the required amount, and for any length of time we may require to get the exact amount of correction. If we (I speak as one of the trade now) have carried the correction too far, we ought to be able to bring it back without any fear of losing the regularity of the figure, and if we happen to carry it too far back, we ought to be able to carry it back again and again, if required, till we get the exact amount of correction, or what is near enough to make no practical difference, without ever losing the regularity of figure or control; this can be done. I have worked at a speculum for nine months, in my experiments, without regrinding or ever losing the control of the figure, and I have polished and tested, on an average, ten or twelve times a week, having to make fresh polishers many times. I have, of course, had it all manner of shapes. Now anyone else can have the same complete control who will study the laws and directions I have given. Now, what I advise intending purchasers is that they request that their specula have the proper amount of correction, no more, and no less, with proof also; the trade ought to supply it; keep the trade up to it. This is not recommending too much, for we amateurs can do it (I write as an amateur now).

In the last paragraph of "Jeckay's" letter, he would like to know "the appearance of the out and in focus of a large star with whole aperture." He adds, "I believe it forms the readiest and best test the amateur can possess. Now all this depends much on the figure of the speculum. "The figure!" I fancy I hear "Jeekay" say, "why if it be exactly corrected, the figure is the true parabola; if a little under-corrected, which has been thought of old to be the safer, then the figure is a true ellipse approaching the parabola, and will not all true ellipses approaching the parabola, give the same out and in focus image, and, therefore, the amateur can judge of the perfection of his speculum by its approach to the required appearances." Well, I answer, if all specula that approach the parabola were true ellipses, it would be so; but are they true ellipses or parabolas is the question, and how are we to find it out? This is what I mean by their figure. The appearance of the in and out focus will not give us the figure. To illustrate what I mean I give the figures of three 12in. specula; each is under-corrected, and they were considered good ones in their time. I think all will easily conceive that the in and out focus appearance would vary for each one, and therefore no reliance could be placed upon their indications; of course, if they were regular curves, it would be different.

These specula were made when a little under-correction was considered best; but it will be seen that the curves are not regular. The dotted lines represent the true parabolic curve, the plain lines the actual curve of the specula. Now the curve, as a whole, may be called an ellipse approaching the parabola; of course, in the figure the variation from the true curve, as shown by the plain line, is enormously exaggerated, but the true idea of the shape is given. Now these specula gave what was considered tolerable definition; but the in-and-out focus appearance would give no idea of the actual figure of the surfaces. Now suppose the three possessors of such specula were to give a description of the in-and-out focus appearance to "Jeekay," how confusing it would be, and most likely his speculum would be different to either, and he would have confusion worse confounded by such a test. I tried this and similar modes of testing for about twenty years, and could not be certain, much less satisfied. I gave it up in disgust, and determined to master the shadow and zonal test, which I had tried some fifteen year before and failed to master; but I was driven to it again in desperation, and mastered it, when it revealed to me such a state of affairs as to the figure or shape of specula already in existence that I never expected to find, such a complete working in the dark by all those who did not use the shadow and zonal test together, that I felt it would be the greatest kindness to amateurs and the trade to give such a description of testing by their conjoint means that would enable any one to master it with a tenth part of the trouble I had to do so, and further, that it would raise the standard of perfection of the reflector, and makers would ultimately have to come up to it, and thus astronomers would have at their disposal a better class of instruments, and thus astronomy would be advanced.

I was convinced that no other test would give certain results. I mastered it, and now others can do the same from my descriptions, and attain the same certainty at once, and without waiting to look at a star. Mr. Linscott's letter on the same page as "Jeekay's" witnesses to the ease and certainty of the shadow and zonal tests. I know it will be said that few amateurs have a testing apparatus or know how to use it if they had. I answer: Therefore the necessity of the general use by those who make for the trade of these tests conjointly, for the purchaser has to a great extent to depend on the assertions of the seller of specula as to their proper correction. What is necessary is a more complete use of the zonal test in conjunction with the shadow test by all makers: till then no certainty can be attained. With the adoption of the zonal test the standard of excellence would be raised and astronomy benefited. Now that all who have not a testing apparatus may be without excuse for buying an imperfectly figured speculum, I have offered before, and am still willing to test, free of charge, any specula sent to me for that purpose. Of course, I expect carriage both ways to be paid.

Before I leave this subject I may further explain that, suppose the possessor of the second speculum were to try a 2in. or 3in. zonal aperture, or side aperture, at A, the definition would be pretty good; but if the possessor of the third speculum tried the same zonal aperture, or side aperture, on his—viz., at B, the definition would not be anything near so good; but if he tried a zonal aperture, or side aperture, at C, there would be a great improvement of definition. He tells the possessor of the first speculum of this improvement, and he tries the corresponding part of his speculum at D, and he finds the definition is bad. What confusion to attempt to compare these three specula in this way! The fact is they are not alike in figure, and yet the definition of all three specula with full aperture



would be about the same; how perplexing to any one who did not understand all this. Now the shadow and zonal test would reveal the cause at once. These things used to puzzle me for nearly 20 years, till I adopted the above tests, when all became plain and easy. I may explain that the three specula drawn above were the work of men who had spent years at speculum figuring, and were considered as near perfection as each could be got by its maker. There are few old specula that are exactly corrected, and of regular figure; it was, I believe, a pure matter of accident to get it.

I would here explain that there is a latitude allowable within whose limits the figure is practically perfect—i.e., that no difference of definition could be observed on the best nights, either on a star or a planet. I may perhaps here state what I consider from experience to be the limit within which I should consider a speculum practically perfect. To illustrate it practically, I will take a case. Suppose a speculum whose outside zone when tested at centre of curvature ought to be $\frac{8}{100}$in. longer than the centre zone or part covered by the flat. Now if the outside zone was only $\frac{6}{100}$in. longer than the centre, or as much as $\frac{10}{100}$in. longer, there would be no perceptible difference of definition from perfect correction—viz., $\frac{8}{100}$in.; in other words, ¼ the required correction above or below the exact correction is allowable without any detriment to the definition, only provided the curve is regular from edge to centre. Makers ought to be able to get this near with certainty, for it practically allows a latitude of ½ the whole amount of the required correction. Many specula have done good work that are ¼ under corrected, and other that are ¼ over-corrected, thus taking in a latitude of ½ the proper correction; but I do not say no difference could be seen between the definition of such and others that were exactly right on a very fine night.

I believe, when perfect certainty is attained in the working of specula, the whole of their manufacture will be in the hands of the trade, the same as steam engine-making. Who thinks of making his own patterns and getting tools to make his own steam-engine? All know that it is cheaper and better to go to a regular engine manufacturer, because there is no uncertainty in the make; the principle of division of labour comes in then.

H. A. Wassell.

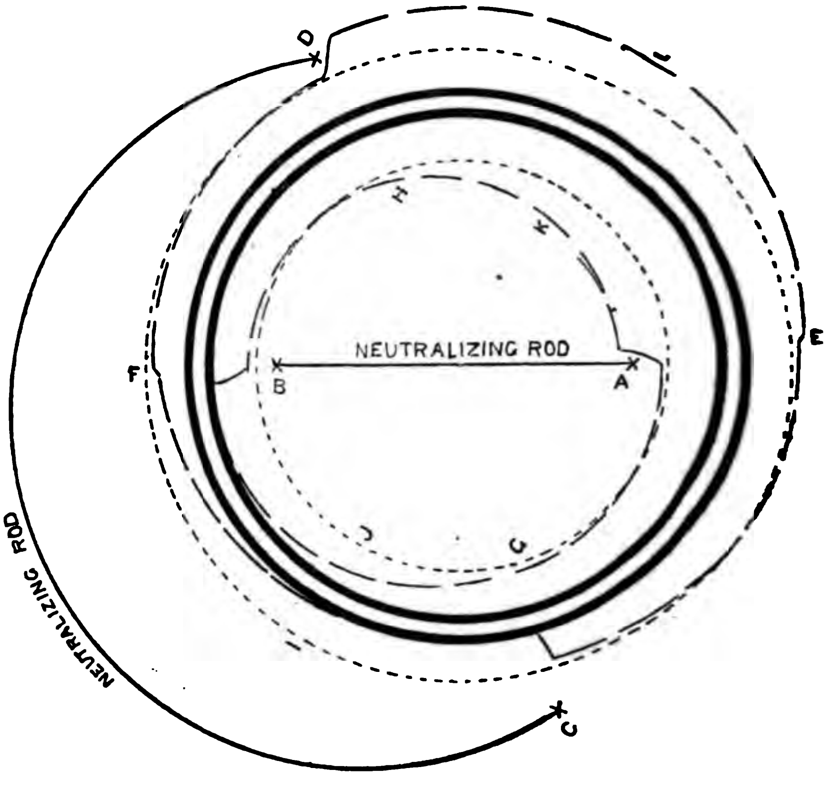
Addenbrook-villa, Love-lane, Stourbridge.

THE WIMSHURST INFLUENCE MACHINE.

[25318.]—Many of your readers are taking interest in the theory of the working of this machine, and it is possible that with the number of independent minds at work, we may obtain some real advance in this branch of thought.

Will you be good enough to allow me to graphically illustrate one of the prominent features—viz., the "surface density" at the various parts of the external surfaces of the cylinders or discs? For the purpose of the illustration it is, perhaps, better to select the cylindrical form.

Let the thick black rings represent the two cylinders in section, the smaller circle to revolve in the same direction as the hands of a watch; the larger circle to revolve in the opposite direction.



A, B, C, and D will represent the four metal brushes at the extremities of the two neutralising rods.

Now, for the purposes of the illustration, we may assume that the finely-dotted circles represent the normal coatings or condition of the electricity when the cylinders are at rest; while the outline, shown with dashes, represents the "surface density" of the electricity when the cylinders are in motion.

It will be noticed by looking at the diagram that the electrical condition on the vertical line passing through the axis of the machine is nearly normal; while at the points E, F, G, and H the excitement is rapidly acquired; and at the points I, J, K, L the maximum limit of electrification is reached. From these points to the four metal brushes, the electricity produced by the continued travel of the glass escapes in sparks, or electrical vapour.

It will be noticed that the glasses are not rendered quite neutral by contact with the brushes but that a slight [illegible] or — charge escapes the brush, and is carried onward by the plates into the spaces between the brushes A and C and B and D respectively. We might, perhaps, with advantage, call these the "equalising spaces"; while we might term the spaces between B and C—and A and D the "exciting spaces.

Examining the diagram in the light of the few preceding remarks, we shall notice that in each of the spaces which we have termed the "exciting spaces," the sum of the densities at any two points opposite to one another on the excited surfaces of the two cylinders between the brushes B and C, or A and D, will be equal to the sum of the densities at any two similar points in the same spaces; in other words, the boundary lines of the electrical charges in each of these spaces are parallel to one another, as may be seen from the diagram.

To determine what is the electrical condition of the spaces between the glasses is a more difficult problem, and I shall be glad to learn if any success has attended the labours of your readers in that direction.

One last thought I should like to put before some of your readers. Whatever may be the originality, or the brilliancy of our ideas, or however strongly we may feel that the views put before us by others are wrong, let us not degrade science by mingling mere personal invective and unseemly wrangling with our instructive discussion on points which perhaps more than any other need to be approached in a calm and thoughtful manner.

James Wimshurst.

[25319.]—"G. J. N.," in his letter of this week, asks three questions, which I have pleasure in answering. They stand thus: 1st. Can a spark 5in. in length be obtained from 16in. plates? Answer: 6in. length spark can be obtained with 16in. plates; but to get this the machine must be in good condition, and the Leyden jars must be large.

2nd. Is the indiarubber cap at the ends of the combs better than a rounded end to the wire? Answer: The little cap, which is made of vulcanite, is very much better than the rounded end.

3rd. I have unequal-sized balls to the terminals and sometimes get a fine brush discharge, the spark refusing to pass. Would that be remedied if the balls were equal-sized? Answer: If the balls were equal in size, you would not get the fine brush discharge. but at same time you would not obtain the greatest length of spark. The balls should be of unequal size, and be well polished: the larger ball must then be in metallic connection with the comb which has the electrical brush on its points.

J. W.

[25320.]—"G. J. N." ought certainly to get a longer spark for a 17in. machine. An 8in. which I have just completed out of the most homely and cheapest materials gives a 3in. and 3½in. spark from small Leyden jars (I will send particulars shortly); and a 12in. machine gives a 4½in. spark. Perhaps you do not arrange the neutralising brushes for high tension—that is, if you have started the machine, turn the rods so that they make a small angle with each other, and nearly a right angle with the conductors. The brushes must have metallic contact with the sectors. In case the sectors have been varnished all over, glass-paper the centres of them all round the plate, so as to insure contact. By attending to this point I made a machine, which once worked only very indifferently, to perform well.

T. D.

HARD STEEL MANDREL BEARINGS.

[25321.]—I am glad that my second notice of this subject has induced one or two correspondents to refer to it. Can Mr. Shakespear inform us what is the usual width of bearings and diameter of mandrel neck in the 5in. German lathes with split steel parallel bearings, to which he refers in letter 25229?

In reply to "A. Liverpool" (letter 25206), I must remark that my observations were not intended to apply to lathes in which one end of the mandrel is supported by a tail-pin. For such I should by all means recommend a cone-fitting either of brass or steel. Many, however, prefer the mandrel to go right through, and be supported by double bearings; the tail end is then free, and may be

for various purposes. Now, the poin

arrive at is this: Assuming that

an essential part of the design, ar

or cylindrical? If the latter.

that a split steel pair are

fitting than a plain steel

"single advantage" that

an arrangement is that

which the parallel

must either be good

chattering, mandrel,

beauty," is not exact

backstay, a hand-vice was held in the slide-rest, and the rod end gripped, thereby adjusting it so as to line with the lathe-bed, both vertically and transversely; the milling cutter held in the drilling-frame or slide-rest was then adjusted and set to work to cut through the iron support to a sufficient depth into the steel rod, which was drawn through by the main slide-rest, and the other rods finished in the same way without further trouble. Also, if the edges of parallel strips require to be grooved or to be finished with V or other formed edges, they may be fitted into a groove in a piece of hard wood, held by the fixed backstay, and be finished in the same way; and the jaws of strips of metal are best drilled with this arrangement, with one or more rows of equidistant holes, of course screwing down a strip of metal over the plate to keep it close to the wood support. If the length of the holes required exceeds the range of the slide-rest, leave the drill in the last hole, open the grip or hand-vice and shift the rest back, grip the work again, and proceed as before.

As to fly and milling cutters and their frames, I note that mitre gear is used merely for the purpose of getting the driving gut to work in any position into which the frame may be inclined. I consider this plan very objectionable for the high speed and clean-cutting action required. This kind of gear is, of course, suited for taking heavy cuts by *reducing* the speed by a wheel and pinion of 4 or 5 to 1, as for fluting a tap; but for a fly-cutter I prefer driving by a pulley direct from the spindle. I never find the least difficulty about angular position of the cutter frame, because I seldom attach the guide pulleys to this frame; for these I have a separate standard from the lathe-bed, adjustable in all directions, which enables the gut from the guide pulleys to pass on to the pulley on the cutter spindle in every way.

Finally, a word about overheads. As I have before stated, I much prefer the "old-fashioned" balanced arm arrangement to any other, because it is so universal in the direction that it can be placed. There is but one length of gut to look after; it can be turned away either to back or front, so as to come properly over pulleys below; and if the cutter spindle is set at a considerable incline from the horizontal, the overhead bar can be tilted, and the end pulleys shifted so that the gut can drive the cutter spindle direct, without the intervention of any intermediate pulleys below; and the balance-weight at the outer end of the lever is most handy for regulating the tension of the gut according to the work, and by means of a drill spindle made by Evans I sometimes have to drill a series of holes less than $\frac{1}{30}$in. diameter, requiring very little tension in the driving gut.

F. H. Wenham.

TECHNICAL EDUCATION.

[25326.]—I HAVE before me the calendar of the Manchester Technical School, and this school, I think, fills the requirements and desires of your correspondents. On the outer cover of the calendar is printed the following:—"Departments.—*Day*: Manual Training School, Engineering, Chemistry and Metallurgy, Bleaching, Dyeing and Printing, Art Drawing and Design, Languages. *Night*: Engineering and Builders' Work, Mathematical, Chemical and Physical Science, Technology and Staple Industries, Art Drawing and Design, Modelling and Carving, Languages and Commercial Knowledge. In the list of subjects taught are the following, in addition to those mentioned on the cover: Dressmaking, English composition and correspondence, Arithmetic, Geography, History, Shorthand, Bookkeeping, Geometry, Machine Construction, Applied Mechanics, Theoretical Mechanics, Sound, Light, Heat, Magnetism and Electricity, Chemistry (theoretical and applied), Geology, Physiology and Botany, Biology, Metallurgy, Physiography, Agriculture, Designing, Telegraphy, Metal Plate Work, Plumbing, Carriage Building, Printing, Carpentry and Joinery, Brickwork and Masonry, Pattern Making, Surveying, and Modelling.

Those who are interested in a good work may very well expend twopence on the syllabus of this school, which they will obtain from Mr. J. H. Reynolds, the secretary (I may safely say without praise, the able secretary). In this school one master is not expected to teach everything, from cock-fighting to the precession of the equinoxes; a large number of teachers are employed (over forty), and the classes are divided, so that each teacher has no more pupils than he can thoroughly control. A syllabus is all very well, and a number of names with and without handles looks very imposing; but "the proof of the pudding is in the eating," and I think I am justified in saying from practical experience with pupils of the school, that the whole scheme is handled in a thoroughly practical and common-sense way, and that boys are taught to use both their hands and their heads. I believe the school to be a pattern for what all schools *ought* to be, and that the scholars take as an *amusement* what, differently handled, would be *very hard work*.

The idea of a perfect training does not need to be worked out, it is to be seen at this school as an accomplished fact, and this at an exceedingly small cost, the fees for the day school being only two guineas per term. If your correspondents want to learn how to do it let them go and see: the secretary and all concerned have sufficient common sense to be proud of their work, and to be open to criticism, and they are not too old to learn, if anything is to be learnt.

A good idea as to the practical common sense of the affair may be formed from the fact that the school interval in the middle of the day is one hour only, and the boys are provided with a good substantial dinner for sixpence, if they choose to stay for dinner.

Thomas Fletcher.

WHY DID FAHRENHEIT CALL HIS BOILING POINT "212 DEGREES."

[25327.]—I AM sorry to see our best authorities neglect this question. Even Atkinson ("Ganot," Ed. 1883, p. 259, Art. 303) keeps up the old fallacy that Fahrenheit's data were the boiling heat of water and the cold of equal parts of snow and ammonium muriate, then supposed to be the "absolute zero."

This is "darkening counsel," with a vengeance!

My dear old friend, John William Draper, used to teach all his classes in the university (as far back, at least, as my "freshman" days, of 1866, and how much farther back I know not), that it was a serious omission in authors not to explain the real facts, which are obvious enough too, when you look at it. Dr. Draper explained to us that Fahrenheit's upper datum was not the boiling point of water, but the melting point of ice; the lower datum being the supposed "absolute zero," obtained as stated above. He divided this space into 32 equal parts, for the very good reason that this allowed him to easily get the length of one degree, by the elementary process of continuous bi-section with a pair of dividers, thus: $\frac{32}{2} = 16$; $\frac{16}{2} = 8 = 4 = 2 = 1$, &c. The length of one degree being thus obtained, he continued the graduation upwards, and the boiling point of water falls at 212, at 30in. pressure. Voila tout! Simple enough, too, when you know it.

Roi ne Puis, Souza je Suis.

Brooklyn, U.S., January 15th.

COMPRESSIBILITY OF WATER AND BOILER EXPLOSIONS.

[25328.]—I AM afraid that M. Rabache (25261, p. 427) and I look at a subject from such different points of view, that we can scarcely quite agree in our results. He debates my statement that there is a difference in the bursting of a boiler by hydraulic pressure and by compressed air or steam (p. 318), and says that "whenever a bursting is produced by mere pressure, either of water, air, or steam, the effect is exactly the same." But then the gist of my statement is that while in the hydraulic stress we have this "mere pressure," in the case of elastic substances, such as air and steam, we have superadded to this a store of energy which comes into play when the vessel begins to give way. This applies only to the case of pressure applied by steam from another boiler, or generated from a limited supply of water wholly vaporised in the boiler itself. I say that here, besides the mere rending of the iron, we *may* have some further mechanical result: we *should* have it if the metal is brittle, as cast iron, which the stored energy of air and steam would scatter in fragments, while hydraulic pressure would simply burst the vessel.

The same principle applies, but in much higher degree, when the boiler contains, besides steam, a large quantity of water heated to the steam temperature. I say that this water, while it has nothing to do with the actual boiler explosion (except in some doubtful cases where it has been supposed to assume the spheroidal state), has all to do with the damage caused by the explosion. M. Rabache says I am wrong, and asks, "What is stored energy if not mere pressure"? Well, here we are at the beginning of the definitions of science. Mere pressure is not energy at all; it is a force or an evidence of a force; but its capacity for work depends wholly on the stored energy of which that pressure is the evidence. A ton weight lying on the ground exerts a pressure, but has no stored energy, and can do no work. That requires pressure exerted through a space and upon a mass. A pressure which ceases to exist the moment it produces motion, has no store of energy, and such is the hydraulic pressure, whose store of energy is limited to the elasticities of the water and the containing vessel. A boiler charged with water stores the energy from the heat applied to it. If that boiler has little or no water in it, its bursting will do only a little injury; if it is charged with water, it may do enormous injury, yet the *mere pressure*, as shown by the gauge, should be the same in both cases.

Therefore, M. Rabache's proof "That 'Sigma's' opinion is erroneous" is itself erroneous. He supposes his boiler burst by *steam supplied from another boiler*. Of course, there would be simple rupture, followed by blow off of steam from the charged boiler, which can only escape through the supply-pipe. But I may add that I should not care to be present at that test: there would be considerable risk of bursting both boilers by the commotion set up in the active boiler. No doubt many readers have known this to occur when steam has been suddenly turned on from a boiler. I have known it to happen several times.

English scientists are not so ignorant as M. Rabache supposes. They know fully the causes of boiler explosions, and they know perfectly how to prevent them. The cause is invariably a weak place in the iron, and the mode of prevention is regular inspection by a careful and qualified man. They are not so foolish as to admit either that "heat is a composed or combined fluid which can be decomposed into its constituent elements just like water." They also know, as an absolute fact, explosions are *not* due, as M. Rabache states, to a decomposition of the water into its gases and their recombination. That exploded notion has been thoroughly tested: a merely practical man seeking to explain what he does not understand might adopt that fallacy; but a scientific man would know that the conditions are not such as to permit the decomposition; and, in the next place, that if the gases were actually forced into the boiler, the conditions would not permit their recombination and explosion.

As to heat, and the old idea which M. Rabache puts forth, that it is the neutral form of mixed E^{+} and E^{-}, that is, the two (supposed) electricities, we are not likely to go back to the babyhood of science. We know something about heat nowadays; among other things we know that we can convert it into, not electricity (as that theory would involve, but which we cannot do), but into mechanical work, which is absolutely inconsistent with the theory that heat has any actual existence as a fluid, single or combined.

Sigma.

"JOURNAL" OF THE ROYAL MICROSCOPICAL SOCIETY.

[25329.]—"A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY," forsaking his celestial occupation to deal with worldly matters, wants to "know the cause of the unprecedented and seemingly inexcusable delay" in the issue of the index for the volume just completed. Our respected friend "F.R.A.S." has, if he will forgive my saying so, too much followed the modern evil practice of condemning first and inquiring afterwards. The editor of the *J.R.M.S.* may have been lying within an inch of his life for the last month, which would excuse his not completing the index. "F.R.A.S." does not know, and has never inquired, whether this is not so, and yet he speaks of the delay as "inexcusable." Or, again, the editor may have been a victim of the abominable state of our lunacy laws, and, as Mrs. Weldon has forsaken the Courts, may not be able to "get out." This also would excuse the delay, but "F.R.A.S." has never inquired. Or, again, the editor may have——but why multiply suggestions? "F.R.A.S." has made no inquiry at all, and therefore cannot answer any other suggestions that I may make. The short moral is: Don't call things inexcusable until you have inquired whether there is any excuse.

One Who Knows.

Lacquer Work of the Burmans.—The Burmese lacquer work is not unlike that of China and Japan, but is made exclusively of small bamboo strips. These latter are woven into circular boxes of all sizes, from betel-pouches to house-trunks. The first step in the lacquering is to smear the box with a mud containing (or not, according to quality) a proportion of the black varnish called *thittsee*, obtained from Melanorrhœa *usitatissima*. Next follow sun-drying and polishing in a lathe with soft sandstone and water. A coat of the varnish, mixed with bone-ash, is then applied, and rubbed down; another coat, containing less bone-ash, and another rubbing down, succeed; then a final coat of varnish is polished, giving the box a smooth, brilliant, black surface. The pattern is put on in black and red. First, black lines are run round the box by a kind of style or point, fixed in a bit of wood or bamboo, so as to leave a slight projection, the point being charged with black varnish; on rotating the box in the lathe in contact with this style, the necessary black lines are produced in relief. This being completed, the box is entirely covered with a coating of a red paint made from vermilion ground up in a vegetable oil (*shantsee*), so thick as to conceal all the black lines. This dry, a rubbing down with rice-husks and water in the lathe removes the red colour from the prominent black lines. Any additional colours are successively applied, and the pattern developed by a steel style, pointed at one end and flattened at the other. The market value of the finished box depends on its elasticity and the fineness of the pattern.

—e.g., diagram No. 2, say it contains 39·5lb. average pressure; then—

$$\frac{201 \times 39{\cdot}5 \times 125 \times 3{\cdot}5}{33{,}000} = 105 \text{ H.P.},$$

and not 45½. I have carefully scaled the diagrams with the following results: Diagram No. 1 shows 43·3lb. average steam pressure as from C to B. Ditto shows 4·85lb. average back pressure as from A to C; hence—

$$\frac{201 \times 43{\cdot}3 \times 68 \times 3{\cdot}5}{33{,}000} = 62{\cdot}7 \text{ H.P.}$$

and—

$$\frac{201 \times 4{\cdot}85 \times 68 \times 3{\cdot}5}{33{,}000} = 7 \text{ H.P.}$$

caused by the back pressure. Diagram No. 2 shows 34·2lb. average steam pressure as from C to B. Ditto shows 26·6lb. average back pressure, as from A to C; then—

$$\frac{201 \times 34{\cdot}2 \times 125 \times 3{\cdot}5}{33{,}000} = 91 \text{ H.P.}$$

and—

$$\frac{201 \times 26{\cdot}6 \times 125 \times 3{\cdot}5}{33{,}000} = 70 \text{ H.P.}$$

caused by the back pressure. No comment has been made on the back pressure, but surely it must be taken into account, as it is resistance against the engine.—SYDNEY.

[58563.]—**Wimshurst Influence Machine.**—If "An Amateur" will well rub down with emery cloth both surfaces of his 17in. ebonite discs, and then give them a good coat of shellac varnish, he will find them work far superior to glass ones, and he need not fear decomposition. We have ebonite machines, which have been treated in a similar manner, now working as well as when first put together years ago.—R. TUDSBURY AND SONS, Edwinstowe, Newark, Notts.

[58568.]—**Watch Turns.**—Would "Pegandredstuff" kindly say how I can turn down the pivots of an eight-day regulator clock, in an ordinary 4in. lathe? Can I get a runner made to fit headstock similar to the one he gives a drawing of?—NOMEN.

[58569.]—**Spring Gun.**—J. Denmeade has, I think, hardly considered what he asks. No bow would shoot an arrow 40 yards if aimed perfectly point blank, and held only "3ft. above the ground." The resistance of the air to a lawn tennis ball would be many times greater than that encountered by the arrow; nothing short of an explosive would give the initial velocity necessary, if the barrel is to be "horizontal." Let him try the range of a pistol fired accurately under those conditions. Of course, if he allows the muzzle to be elevated the thing becomes easy.—W. J. B.

[58585.]—**Cold Feet.**—I am also troubled in that way, and after 25 years' experience of the following plan, venture to mention it—not as a remedy—that is the part of the physician—but as a mechanical palliative. Provide a bag of carpet or other thick woollen. The bottom 12in. square, one-third of the top to be 18in. high, two-thirds to be 3ft. 6in. from the base, so that when the feet of a person seated are placed in the bag, the short part fits up close under the knees, the long part forms a flap, which is to cover the knees and thighs, well up to the waist, where it may be, by a tape-loop, hitched to a button. This bag is to be lined throughout with sheepskin with the wool inwards—a good strong fleece of a short-woolled sheep, taken in the spring of the year. The bag is then placed at my writing-desk. Next provide socks of thick lambswool, quite large and loose; any elasticity, of course, tends to hinder the circulation in the small vessels. Place a pair of these on the fender to get warm and dry, then, presuming the feet are cold, take off your socks and examine them—the feet. You will find them pale, cold, and damp—three abnormal conditions. This sight gives an intelligent idea of what ought to be done, namely, to make them rosy red, warm, and dry; and to keep them so, I need hardly add, toast them till red, put on dry socks, and into bag. They will remain warm till the whole person becomes chilled. I could describe some useful practices about the feet, if wanted.—THE FIR HILL.

[58591.]—**Voyage to Australia.**—I don't think "A. F. N." could do better than by taking a passage on board the *Sobraon*, an excellent vessel, especially if still commanded by Captain Elmslie. Several friends of mine have sailed in her, and all speak in highest praise of her. And the Wigram ships are very comfortable, but now, I think, all converted into steamers. I took a voyage to Australia in one of these in 1870 for tubercle on the lung, and spent a year and four months in Hobart, Tasmania, a charming place of residence, going to the Riverina district of the Upper Murray, Victoria, for a few winter months. I have had no lung troubles since.—C. H. C.

[58601.]—**Geometrical.**—"Puzzled" may perhaps find the following more satisfactory than Mr. Dancaster's reply. Draw any chord A B in a circle, and the diameter bisecting that chord. If P is the end of the longer piece of this diameter, and Q any other point on the circle, obviously the isosceles triangle P A B is greater than Q A B, for P being the highest point of the circle above A B, the former triangle has the greater altitude. Therefore, when a triangle in a circle has a pair of sides unequal, we can always make a larger triangle on the same base by equalising the sides as above. It follows that an equilateral is not only larger than the particular triangle mentioned in the query; but the largest possible triangle.—L. S.

[58623.]—**Induction Coil.**—TO MR. ERNEST BAUGH.—My indebtedness to Mr. J. Brown, of Belfast, for his numerous and valuable contributions to this journal, and the respect for his ability and information which I share with many readers of "Ours," are such that I am reluctant to oppose any recommendations of his, although, in the present case, I am morally obliged to do so in the interests of a querist who has personally appealed to me. The suggestion of the employment of water at 65° C. (the exact temperature at which ebonite is "cured" in manufacture) as a means of remedying a fault of the character indicated, is, in my opinion, scarcely worthy of its author; for, unless extreme care were used in adjusting the temperature, there would be a danger of distorting the ebonite, and so spoiling the coil, and, even if the querist succeeded in the attempt to "melt the paraffin near the tube" without damaging the tube itself, the probable result would be that some of the neighbouring convolutions of the secondary would become loosened and fall towards the primary, thus adding to the number of the weak places which Mr. Brown supposes to exist. The suggestion of comparing the sparks given by the various pairs is good, but needs supplementing. The querist must first disconnect all the pairs in the coil, recollecting that if the ends of any section are permitted to touch each other, an external "short-circuit" will be formed, which will have the effect of greatly lowering the efficiency of other sections in the same locality, so that results will be got which the experimenter may wrongly interpret. One is forced to the conclusion that Mr. Brown, in advising "W. G." to make the admittedly perilous experiment of bringing one of the sparking terminals near the core, has overlooked the well-known Leyden jar action between the primary and secondary. Torrents of sparks would certainly pass, but their passage would by no means prove that "probably there is a leak." For my own part, I am not yet convinced that "W. G.'s" coil is seriously defective, and I strongly advise him to carry out the changes which I named last week before tampering with the instrument. In rewinding his primary he will, of course, avoid contacts between the primary and the core, or between any two turns of the primary wire itself. The length of the carbons should not be less than about 8in. in a Bunsen battery employed for such a purpose as that of the querist. I shall await "W. G.'s" further report with much interest.—ERNEST BAUGH, Haverfordwest, Pem.

[58623.]—**Induction Coil.**—I am sure Mr. Baugh will pardon me if I supplement his kind and lengthy answer to "W. J." I think I may speak with some knowledge of this matter, inasmuch as I personally had the construction of the great Polytechnic coil of '59 intrusted to my care, for Mr. Apps, whose coils are undoubtedly the finest in the market. First, the diameter of primary in small coils—say from 4in. to 8in. long—is about $\frac{1}{5}$th to $\frac{1}{6}$th the length. As the coils get larger, the proportion of length to diameter increases a little. For instance, in the last great coil which I exhibited for Mr. Apps at the Paris Electrical Exhibition, and made by that gentleman, the length of one of the primaries is somewhat over seven times that of the diameter. In "W. J.'s" primary the length is very nearly eight times greater than the diameter, an unnecessarily large proportion. He would do better to wind it with three layers of No. 12 B.W.G., cop., 93 per cent. conductivity, and reduce the length to 10in. I notice, too, that the length of his primary tube is just the same as his primary. This will never do for a coil made to give more than $\frac{1}{2}$in. spark. The usual proportion of length of tube to project beyond ends of primary is $\frac{1}{4}$th of the length of primary for each end. The proportion of length of body of secondary to that of primary should be about $\frac{1}{12}$ less than primary length each end. So that "W. J.'s" secondary should be 9in. instead of 5in., as at present. The thickness of his ebonite tube should be $\frac{3}{16}$in., and it is better to scrub the inside skin off with coarse emery-paper, especially at the *ends*, as there is a film of very good conductivity, for high-tension currents, attached to the interior of ebonite tubes as they come from the makers. He will do well, if possible, to get his tube "tested": that is done by inserting a cylindrical band of metal, about 2in. long and about the diameter of inside of his ebonite tube, and the same for the outside of his tube, and connect the inner ring of metal with one of the poles of an existing coil (about 5in. spark will do), and the outer ring with the other pole, and work the two bands gradually from one end of his tube to the other, letting the bands, of course, be in the same relative position to one another during this operation. The diameter and thickness of his ebonite discs is right, and he *must* scrub every trace of glossy surface from them; and the number of his sections, instead of being 26, should be 60, at least, for a 9in. body. He should use ebonite rings cut from a prepared tube, of about $\frac{1}{8}$in. in depth for the middle 5in., and $\frac{3}{16}$in. deep for the ends; and they should fit tolerably tightly on the tube. For a coil the size he mentions he need not use any kind of insulator beyond what I have described. He can now proceed to "build" his skeleton up, presuming, of course, that he has got a thick ebonite disc screwed on to one end of his tube. (I used to *fit* these on for Mr. Apps.) I suppose he knows how to make his discs for winding (when he has got his skeleton finished and fixed). His best plan for treating his 36 B. W.G. wire is to plunge reel and all into hot paraffin wax (about 110° C.), and let them remain in about a quarter of an hour, end up. When he commences winding, let him put only $\frac{1}{8}$in. depth of wire into first groove, and rise by $\frac{1}{8}$in. until he has got his wire in the seventh groove, not higher than $\frac{1}{16}$in. of the top edge of his discs, and so proceed until he comes to the seventh (or whatever number it happens to be) groove at the other end, when he must drop by $\frac{1}{8}$ths, making the two ends symmetrical. A prolongation of the core at one end is necessary to work the vibrating break, whose head should be of solid iron, same diameter as prolongation, about $\frac{5}{8}$in. With the Apps break (automatic) it is possible to get sparks the same length as the body of the secondary, all things being proportioned. But with large coils, those giving from 18in. to 44in., it is preferable to use a dipping mercurial break, either "hand" or automatic; but unless the automatic is specially constructed it is preferable to use the "hand," as there is a knack of doing this to the greatest efficiency of which the coil is capable, which soon comes by a little practice. Any further information which I can give "W. J." I shall be happy to do.—PAUL WARD, 57, Chancery-lane, W. C.

[58630.]—**Length of Focus of Concave Lens.**—In reply to "Sine," I beg to extract the following from my commonplace-book:—Paste a piece of paper over the face of the lens, having two small holes in it exactly $\frac{1}{2}$in. apart. Now place the lens so that light either from the sun or an artificial source falls through it on a screen. Move it to or from the screen until the spots of light passing through the pin-holes are exactly 1in. apart. The distance of the lens from the screen is equivalent to the focal length.—ARTHUR MEE.

[58634.]—**Sound-Plate.**—The "Chladni's" plates, which I presume "An Old Reader" means, are made in various geometric forms, and are usually supported in the middle by a screw clamping them from the upper surface on to a support beneath. Their usual thickness is $\frac{1}{16}$in., and they are generally made of what is known in the trade as hard rolled brass.—PAUL WARD.

[58646.]—**Platinum Electrodes.**—Powdered asbestos made into a paste with silicate of soda (soluble glass) will act as required. It is used in the Jablochkoff candles, and also in thermo-electric batteries for the purpose of insulating at high temperatures.—SIGMA.

[58648.]—**Indiarubber Tubing.**—Why not bind twine round the hose from end to end. I have seen it done with the best results.—ARTHUR MEE.

[58650.]—**Intensification.**—Potassium ferricyanide is used in intensification in Selli's uranium intensification process, the details of which are as follows:—The fixed negative is well washed and is then flooded with a solution containing one gram of uranium nitrate and one gram of potassium ferricyanide in 100cb.c. of water. The negative is allowed to remain in this solution until it attains sufficient density. The colour of the resulting negative is brownish red. The plate is then thoroughly washed until the wash water shows no blue colouration, with a solution of ferrous sulphate; the potassium ferricyanide used must be quite free from ferrocyanide. If it be not free from this body a turbidity will be produced when it is mixed with the uranium nitrate, and the intensifier will not act satisfactorily. Negatives intensified by this process are very permanent, and according to Eder, "A negative which will not acquire sufficient intensity with this method may be laid aside as useless." The shadows may intensified by allowing the plate to remain a short time in a solution containing less uran nitrate.—LUCIUS.

[58651.]—**Intensificatio**
scribed above should suit
The process is simple an
is no danger attached t
used several times. I
Park" that intensificati

relied upon, take what care he may. Should he, however, be inclined to try it, I shall be happy to do what I can to assist him.—LUCIUS.

[58652.]—**Storage Cells.**—TO "SIGMA."—One cell of any size will be useless for lighting any lamp, and the number in series will depend on the voltage of the lamp to be used. Take the voltage of any secondary cell as 1·8, and this will give you the number of cells needed in series. The area of plates, or number in one cell only, governs the duration of the work.—SIGMA.

[58654.]—**Liquid Silex.**—Mr. Grey is theoretically right, and practically wrong in his description. What is known as liquid silex is made at soapworks for soap adulteration, and is a strongly alkaline solution of silicate of soda. It is always kept as a solution, and never evaporated to dryness. —THOS. FLETCHER.

[58655.]—**Trigonometry.**—For purposes of rough sketching, an angle of—

1°	is equivalent to a	gradient of	1 in 60
2°	"	"	1 in 30
3°	"	"	1 in 20
4°	"	"	1 in 15
5°	"	"	1 in 12

and so on. More accurately—

1° = 1 foot in 19·10yds.
2° = 1 foot in 9·54yds.
3° = 1 foot in 6·36yds.

&c., &c. Tables of gradients and corresponding angles of elevation or depression, and of "horizontal equivalents" corresponding to different heights, &c., are found in almost any work on surveying.—H. E. H.

[58658.]—**Æsop.**—The solution given by "T. C., Bristol," is not strictly correct, for the series $1 + \frac{1}{2} + \frac{1}{4} + \ldots\ldots$ is not always $= 2$; it is only so when carried to infinity. A method of exact solution may interest. We have, if m be the number of minutes required—

$$\frac{m}{4} = 4\left(1 + \tfrac{1}{2} + \tfrac{1}{4} + \ldots\ldots \text{ to } m \text{ terms}\right).$$

Evidently m will be something just short of 32. Let $m = 31 + x$. Then—

$$\frac{31 + x}{4} = 4\,.\left(1 + \tfrac{1}{2} + \tfrac{1}{4} + \ldots\ldots \text{ to 31 terms} + \frac{x}{2^{31}}\right)$$
$$= 4\,.\left(\frac{1 - (\frac{1}{2})^{31}}{\frac{1}{2}}\right) + \frac{4x}{2^{31}}$$
$$= \frac{8\,(2^{31} - 1) + 4x}{2^{31}}$$

Therefore—

$$2^{29}\,.\,(31 + x) = 8\,(2^{31} - 1) + 4x$$
$$536870912\,.\,(31 + x) = 8\,(2147483647) + 4x$$
$$16642998272 + 536870912\,.\,x = 17179869176 + 4x$$
$$536870908\,.\,x = 536870904$$
$$x = 59 \text{ sec. } \frac{536870668}{536870908}$$
$$m = 31 \text{ minutes } 59 \text{ sec. } \frac{536870668}{536870908}$$

—F. B. ALLISON.

[58662.]—**Brassfounding.**—"Moulder" should use Mansfield sand, dust with flour through a bag same as you use for iron castings, vent your moulds; but it is not necessary to dry. To avoid your castings sinking, get your metal hot and cast gently. I don't know what to say about metal receipts, as in these sharp days we have to cut our cloth according to price. Send what you want to sell at, and I will help you.—J. H. S.

[58665.]—**Stereoscopic Pictures.**—"R. B." is quite correct as to his interpretation of the theory of the above. He can take stereoscopic pictures by shifting his camera from right to left, or vice versâ, the exact distance his eyes are apart, centre to centre. He must mind not to get them mixed, though, when mounting—i.e., he must keep the same relative positions between the two.—PAUL WARD.

[58668.]—**Lighting Vacuum Tubes.**—In reply to Mr. Taaffe (with whom I am substantially in agreement upon the subject of the theory of the Wimshurst machine, and whose painstaking researches have, I venture to think, earned him the gratitude of all seekers after the truth of the matter), my own experience of the application of this instrument to the lighting of vacuum tubes has been extremely discouraging and unfavourable; so much so, that I am compelled to conclude that the practical value of the Wimshurst machine as a substitute for the induction coil, has been greatly overstated. I have found that small and medium-sized tubes can be more or less faintly lit (preferably by placing them in circuit between one of the insulated conductors and the earth); but tubes containing complicated spirals and devices—i.e., tubes of higher r[illegible] cannot be continuously illuminated, even [illegible] well within the limits of [illegible] the machine. For [illegible] the "U" tube, [illegible] are long [illegible] lighted by an induction coil, giving a spark of about 1in., with a single bichromate cell; yet my 15in. plate Wimshurst will produce nothing beyond a feeble flickering at the poles of the tube, although the machine yields freely with the Leyden jars detached, about 1½in. of spark. If the jars are added, anything approaching to continuous lighting becomes impossible, and an occasional bewildering flash in the tube is the operator's only reward for much patient grinding at the handle. My machine which I have had in use for thirteen months may be taken as a fairly good one, its maximum spark being about 4½in. under ordinary conditions. In frosty weather it has given sparks 5in. long. I have altered the number of sectors from 16 to 20. Perhaps some correspondent who has a Voss instrument will kindly inform me whether the discharges from it are continuous at the full striking distance, and whether the current can readily be diverted into any external circuit of low resistance without the setting up of reactions tending to lessen the power of the machine. The interesting statements of "W. J. B." in last week's issue confirm my impression that the Voss is superior to the Wimshurst as a source of illumination for vacuum tubes and for kindred purposes.—ERNEST BAUGH, Haverfordwest, Pem.

[58671.]—**Calorific Intensities.**—"Equivolt" will find some very interesting data bearing upon this matter in "Woodward's Arithmetical Chemistry," Part II., published at about 2s. 6d. If he reads French or German he should consult "Thomsen's "Thermo-chemische Untersuchunger," and "Berthelot's Essai de Mécanique Chimique." If "Equivolt" cares to exchange notes, the undersigned (address with Editor), who is very much interested in the question, and studied it recently, would be very pleased to lay his at "Equivolt's" disposal. He would mention, however, that his (undersigned's) notes bear principally upon heats of combustion, but calorific Intensities are, of course, readily deducible therefrom when spec. heat is known.—FERRET.

[58678.]—**Formula.**—The data given by "W. H. T." are not very clearly expressed. It is, however, necessary to assume that d, if produced towards the centre of the circle, would pass through it, and that the angle formed by the intersection of c and d is a right angle. Let A° be the angle subtended at the centre of the circle by the arc b, then c = radius × sin. A°, and d = radius × versin. A°. The angle A° bears the same ratio to 360° as the arc b bears to the circumference, which latter is, of course, radius × π. "W. H. T." will, I think, easily solve his problem from what is here stated. —A. O. E., Edinburgh, Jan. 25.

[58678.]—**Formula.**—The circumference of the circle given by "W. H. T." being πa, the angle subtended by the arc of length b is $\frac{b}{\pi a}\,360°$, as is evident. But c is the sine of this angle to radius $\frac{1}{2}a$; therefore, $c = \frac{1}{2}a \sin. \frac{b}{\pi a}\,360°$, and $d = \frac{1}{2}a \operatorname{versin} \frac{b}{\pi a}\,360°$, the formulæ he requires. Writing in the above for a 480,000 miles, and for b 188,441 miles, we find the angle to be 44° 59′, and c 196,656 miles, and d 70,245 miles. If b were a little greater—viz., 188,495 miles—then the angle would be 45°, which I suspect it was intended to be.—DUBLINIENSIS.

[58678.]—**Formula.**—The query does not state in what direction d and c are drawn; but presuming that d is at right angles to the tangent at the extremity of the arc b, and consequently running through the centre of the circle, and that c is at right angles to d, we have c = sine of the angle at the centre which the arc subtends, and d = cosine of the same angle subtracted from the radius—that is, supposing the radius to be = 1; but the radius or unity being here 240,000 miles, we shall have to multiply the sine and cosine when found by that number. Now, this angle will be $\frac{188{,}441}{240{,}000}$, and by ordinary trignometrical series we might find the corresponding sine and cosine. In actual practice, however, this would always be done with the help of the tables. The tables, however, do not give angles in this form, but in the form of degrees, minutes, and seconds; but we can reduce the above "circular measure" to degrees, &c., either by means of a special table or the following formula:—

$$3{\cdot}1415927 : \text{circular measure} :: 180° : (?)$$

We shall thus find the angle to be in this instance 44° 59′ 13″. The sine corresponding to this is 0·7069456, which multiplied by 240,000 gives (nearly) 169,667 miles as the value of c. The cosine in the same way will be found to be 0·7072679; and multiplying this by 240,000, and subtracting the result [illegible] we find that the value of d [illegible] HOWARD.

[illegible] "W. H. T." has not put [illegible] is, I presume, that the line d would bisect both the diameter and the chord of which c is half at right angles. If he does not mean this, there can be no solution to his question. For the point of intersection of c and d can be anywhere on a semicircle described on the chord of arc b, which would give an indefinite number of values to c, d. Taking the question as it appears on the diagram, "W. H. T." will, I trust, find the following solution to his satisfaction. First find circumference of circle by multiplying 480,000 by $\frac{22}{7}$. Divide this by double the arc 188,441—viz., 376,882. This will go four times for all practical purposes; which shows that double arc b is a quadrant. Hence, $(2c)^2 = 2R^2$, i.e., $c^2 = \frac{(240{,}000)^2}{2}$.

$\therefore c = \frac{240{,}000}{\sqrt{2}}$. Now, calling centre of circle 0, intersection of c, d, K, and intersection of d produced with circle beneath J, "W. H. T." will find no trouble in proving that $o\text{K} = c = \frac{240{,}000}{\sqrt{2}}$. And since $\text{JK}\,.\,d = c^2$ (see Constable "Geometrical Exercises"), $\therefore \left(240{,}000 + \frac{240{,}000}{\sqrt{2}}\right) d = \frac{(240000)^2}{2}$

i.e., $\frac{\sqrt{2} + 1}{\sqrt{2}}\, d = \frac{240{,}000}{2}$ finally $d = \frac{240{,}000}{\sqrt{2}\,(\sqrt{2} + 1)}$

—S. CONSTABLE, L.S.A.

["H. E. H.," Fred M. Parker, "C. A. B.," "A. W. H.," and others, have replied to this query.]

[58683.]—**Beam Engine.**—Length of links 1½in., and of bottom rods 2½in., also radius rod same length. You should make a scale drawing for remainder of dimensions. Perhaps following will help you, but two designers would scarcely be the same:—Piston rod, 6in.; centre of cylinder to bearings, 9$\frac{13}{16}$in.; bearings, ¾in. high; bedplate, 15in. × 4½in. You can't cut off ¼ stroke with single ecc. Steam ports, $\frac{3}{16}$in. × ¾in. Make ports, say, $\frac{1}{15}$ area of cylinder for models. Crank shaft anything you like, say 5in. Make a drawing and work to it.—T. C., Bristol.

[58684.]—**Card Trick.**—This is only a special case of a much wider problem—namely, to find in what position the heap containing the particular card is to be placed each time the cards are dealt, so to have the particular card in any named position—that is, any given distance from the top (or bottom) of the pack. We must first fix on what we are to understand by the "top" of the pack. Suppose, then, we define that the top of the pack is that end where we find the back (and not the face) of the end card towards us, and also that the cards (as in dealing for an ordinary game) are dealt from the "top," but turned up as they are dealt, so that a person may see them. Placing a particular heap first, second, or third in the pack is, of course, placing it top, middle, or bottom respectively. In the particular example mentioned by "Achilles," the mode of dealing will be found to be immaterial, and "top" may be considered as "bottom," provided, of course, that the same rule is observed throughout. In that example, when the 21 cards are dealt the first time, and we are told in which of the three heaps the particular card is, that heap being then placed second (middle), we know first of all that the particular card is *not* amongst the first seven cards of the pack, but that it is somewhere in the next seven. When the cards are dealt the second time, the first seven cards in which the particular card is not distribute themselves as follows at the "top" (see definition) of the three heaps: 3, 2, 2. The exact conditions of the problem will vary according to the heap in which the particular card now is. Suppose, then, it is in the first heap. On placing this heap second we have, as before, first of all seven cards in which the particular card is not; and then (in this particular case) three more cards in which the card is not—that is, the ten first cards do not contain the particular card. But we know that it must be amongst the next two cards, because in dealing the second time the second seven cards, which we knew contained the particular card, distributed themselves after the first seven cards thus —2, 3, 2; and the particular card was therefore either the fourth or fifth of the first heap (since we supposed the first heap to contain it). On dealing the pack the third time the first ten cards, which we know do not contain the particular card, arrange themselves thus—4, 3, 3; the next two cards dealt, of course, must be dealt to the third and fourth heaps, and we know that the particular card is one of these two cards. On being now told in which heap the card is (it must be in either the third or fourth heap in this particular case), we place that heap, as before, second, and we have 7 + 3 cards in which the particular card is not, and then the next card must be the particular card—that is, it is the 11th card from the "top"; it is also the 11th card from the "bottom." It will be found on investigation that had either of the other two heaps been supposed to contain the card after the second deal, the result would necessarily have been the same. The investigation of a particular example of this description is no doubt as good a mental exercise as a proposition in geometry. I shall next week, with the Editor's permission, consider the case of the general problem—viz., how to arrange the cards so that the particular card may be found in any required position. The question is here complicated by the number of cards in each heap (seven) not being divisible by three. I shall therefore take the case of a pack of 27 instead of 21 cards.—WM. G. HOWARD.

[58689.]—**Accumulators.**—To "SIGMA."—As I have several times stated, I have not examined the details of working in such a way as to justify my answering questions as to sizes, &c., suited to special work. I never do answer such questions except when I know all about the matter by actual working myself, because I will not mislead by any statement of mere opinion. Besides, these points are easily ascertained by an experiment or two by the querists, who will learn more by a failure than by merely following cut and dry figures. I got my own knowledge by failures, and I know that to be the best way to learn. I am always willing to explain the principles which are to be acted on, but the application of them to specific cases should be the work of the reader. There are means of automatically cutting off current when charge is completed, but I cannot describe them just now. The book inquired for is Sprague's "Electricity: its Theory, Sources, and Application."—SIGMA.

[58691.]—**Reflecting Telescope.**—You have no doubt spoiled the figure of your mirrors, and your only course is to send them to an optician to be refigured. The repolishing can only be successfully done by an optician.—T. D.

[58692.]—**Paper Mill.**—A very large plant is required for making even the commonest of paper, not less than £12,000 for machinery alone; and even with this outlay it is altogether problematical whether it would pay—most likely not.—QUOD DIXI DIXI.

[58696.]—**Contract.**—Building contracts generally arrange that all materials brought on the ground shall become the owner's property; but this only includes such things as would have been used up on the premises, as bricks, paint, wood, &c., and does not include the builder's tools, as these never would become the owner's property. As "Ten Years' Subscriber" has actually paid for the things by his advances, he had better annex the paint and similar things, and let the builder take away his bench and tools. Should the builder go bankrupt (as they sometimes do), the trustee will probably claim the things as having been in the bankrupt's possession at the date of his act of bankruptcy, when "T. Y. S." will have to give them up or their value, and prove for his own claim. This I should chance. Make a careful list of the things to be taken and their value, and then take them. If "T. Y. S." brought an action and recovered a speedy judgment, he could by means of the sheriff seize *all* the things; but I don't suppose the bench, &c., would be worth this, and should prefer the simpler course I have suggested. —B. H.

[58697.]—**Paper Boat or Canoe.**—I made myself a paper canoe a few years ago. It was 11ft. 6in. long, 2ft. wide, and 6in. deep where decked over, and was 10in. deep in hatchway where canoeist sits. It weighed, with paddle, 35lb. I am 6ft. and weigh 11½st., so that you could do with less dimensions. The whole of the framework was ordinary slate laths, 1½in. by ¾in. The hatchway was 4ft. long, and was 1ft. nearer the front than stern; it was formed by a rectangular frame at each end, the end pieces of which formed four posts to carry the top rails of the hatchway, the paper being nailed-to all the way round. Two laths ran along each side the whole length, the ends being fixed to small blocks of wood at each end, which formed the nose at each end, and these laths passed along the ends of the frames, and secured them in place. They also carried the seat. A small keel was inserted between the hatchway and each end, to prevent the paper bellying in. I used brown paper, got in sheets 54in. by 48in., weighing 1lb. each. I used five thicknesses, coating each sheet with hot pitch, laying the next on, and ironing it on with a hot flat iron. The resulting cardboard was about ⅛in. thick, and as hard as a board. The requisite shapes were then cut out, and nailed in position with plenty of flat-headed tacks. Successive coats of boiled oil, paint, and varnish were the final proceedings. I have been away from home for the last three years, but my brother still uses it. The flooring to hatchway was made of ¼in. boards. I shall be glad to give further information.—R. C. M.

[58705.]—**Seamless Lead Joints.**—If you have never made a "burned joint," don't attempt it on good work. Practise on bits of sheet first. It is a mere nothing—only joining the edges with molten lead instead of solder, and looks very easy; but it requires a lot of practice. The operations have been fully described in Nos. 912, 913, 915, by Mr. P. J. Davies.—S. R.

[58705.]—**Seamless Lead Joints.**—The vessels, if not of too large dimensions, can be lined with sheet lead bossed up without seams. There is no other way of lining such vessels with sheet lead, unless it be with soldered or burnt seams. Probably "Brass" has seen such vessels lined with burnt seams—viz., with seams made without solder, and if this is what he is referring to, his work cannot be said to be seamless, though solderless. I should be glad to give him instructions in the work if he will communicate with me, as this has been well explained in our journal only a short time ago, and cannot be expected to be reproduced in so short a time.—P. J. DAVIES, 78, Earl's Court-road, Kensington, W.

[58708.]—**Amalgamating Zincs.**—"George" should find no difficulty in amalgamating his zincs if he uses a solution of sulphuric acid and water 1 to 10. They should be left in the solution till they look clean (under ordinary circumstances half a minute will suffice), and then be covered well with mercury and left to drain off. Your failure appears to be in using H_2SO_4 undiluted.—E. E. V.

[58708.]—**Amalgamating Zincs.**—I found the same difficulty about this as the querist, and so got an experienced hand to show me. First, make a pad by wrapping some cotton cloth or tow round the top of stick, about the size of penholder; take an ordinary-sized dinner meat plate, and fill this with the acid (8 – 1). Rub the acid on to the zinc with the pad. Drop a globule of mercury on the place you have cleaned, and rub it in with the pad. Take care to rub the zinc well with the acid and pad, or the mercury will not adhere.—LONDINIENSIS.

[58708.]—**Amalgamating Zincs.**—Wash the zincs first of all with strong soda, to remove grease. Then immerse them in a dish of water containing one-tenth of sulphuric acid. As soon as strong action takes place, transfer them to another dish, and pour mercury over them, rubbing them well with a rag or a hard brush till they are bright. Any parts that refuse to take on the bright coat may be rubbed with the rag dipped in the acid solution. The free use of mercury is no waste; but take care to use only the purest, and have plenty of ventilation during the process.—BOBADIL.

[58708.]—**Amalgamating Zincs.**—If "George" will let his zinc remain in the dilute acid until gas is freely evolved, then take it out, and, without wiping or rinsing it, lay the cylinder down in dish containing the mercury, turning it round and allowing the mercury to flow backwards and forwards along the inside as well as outside of cylinder, he will have no difficulty in getting an even silver surface. A small mop is very useful for rubbing spots which appear to resist the mercury. And the dirty acid floating on the mercury is easily removed afterwards by blotting-paper. Rolled zinc is better than cast for battery plates, and takes less amalgamating: about ⅛in. thick is a useful size. It should be raised to a temperature of about 250° F. when attempting to bend it into a cylinder.—STELLA.

[58709.]—**The Wimshurst Influence Machine.**—Thomas Smith seems to be one who meets with trouble at every turn. It would be hopeless attempting to put such a machine into useful condition. He should read up the instructions which you have already been good enough to publish, and then make up a new machine.—J. W.

[58709.]—**Wimshurst Machine.**—In the first place you ought to have an even number of sectors on the plates, say 14 or 16, in order that contact may be made at the same instant by the neutralising brushes. A good size for the sectors would be 3in. long by ½in. in the broadest part. Some six months ago I accidentally broke both plates of a 12in. machine, one of them into three, and the other into two pieces, and cemented them together with Kay's coaguline. Although the machine has been in constant use during the above-mentioned period, yet it works as well as ever, and the plates are as strong as they were previous to the breakage. No. 36 wire is too thick and unpliable for the brushes. I used it at first, but discarded it in favour of the gilt lace wire, which is specially suitable for this purpose. As you say that you collect the electricity by means of brushes, be sure that each individual wire of each brush points directly to the plates, as should one of them be turned aside, there will be a great escape of the electric fluid. It does not matter whether those conductor brushes touch the plate or not; but it is of the utmost importance that the neutralising brushes come into metallic contact with each sector. Finally there ought to be no points or sharp edges on the conductors, but everything ought to be round and as smooth as possible. I notice that this question is addressed to Mr. Wimshurst, who, I trust, will excuse my replying to it.—T. D.

[58710.]—**Atoms.**—I recommend the querist to read "The Atomic Theory," by Professor Wurz.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[58710.]—**Atoms.**—It is not possible to answer "Infinitum" in the space of the "E. M." If he will obtain a copy of "The New Chemistry," by Cooke, published by H. S. King and Co., he will learn all he wants to know from the pen of a master.—THOS. FLETCHER.

[58710.]—**Atoms.**—Allow me to inform "Infinitum" that the theory of ultimate atoms is something more than "a freak of imagination." The immortal Sir Isaac Newton spoke of matter as consisting of hard, impenetrable, perfectly inelastic atoms. It has been proved by a host of the most eminent philosophers, such as Faraday, Tyndall, Hoffman, &c., that the view most consistent with chemical facts and theories is: that there is a limit to the divisibility of matter, and that all things visible around us are but aggregations of atoms: and we believe that every impartial student of nature will admit that this view agrees better with truths revealed by modern science. Some eminent men have conceived that no true matter exists, and believe in mere points or centres of force, but such mental conceptions leave the mind of every thinking man in a state of doubt and confusion. The expression, "being supplanted by such terms as combining quantity or weight, equivalent weight, &c.," is most inexplicable, for if there is anything in the whole range of animate and inanimate nature that proves the atomic theory, it is the fact that the weights of substances acting chemically upon one another, always remain the same after as before chemical changes occur: that their size and distances apart, form, &c., are not yet discovered is no proof of their non-existence. Judging from the manner in which "Infinitum" puts his questions he seems to us but an infant in science, and, as an outsider of the chemical world, should speak more respectfully of our great philosophers, who have, and do now, advocate the atomic theory.—TALIESIN T. JONES, [illegible], Cardiff.

[58711.]—**Aluminium** is a metal resembling tin. It can be drawn into fine wire, and hammered into very thin leaf. When cast it has a specific gravity of 2·56, and is about as hard as silver. It melts at about 700°, and does not oxidise on exposure to air at ordinary temperatures, and only very slowly when heated. Its tenacity is about the same as that of silver, [illegible] grammes for a wire 1mm. diameter. It does not volatilise when heated to bright redness.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[58713.]—**Burning China.**—If "Snowball" can call on me, I will show him how to build a very simple furnace, which cannot be explained without drawings and rather costly engravings.—THOS. FLETCHER, Warrington.

[58714.]—**Mathematical.**—The value of π to 607 places of decimals as first published by Mr. Shanks contained several inaccuracies. These have since been rectified by the computer, and the calculation extended to 707 places. It was obtained from the expression

$$\frac{\pi}{4} = 4 \tan.^{-1} \frac{1}{5} - \tan.^{-1} \frac{1}{239}$$

and was published in the *Proceedings* of the Royal Society, Vol. XXII. As "Ratio" would doubtless prefer this more correct value to the one he asks for, I give it as follows:—

π = 3·141592653589793238462643383279[illegible]
93993751058209749445923078164062862[illegible]
25342117067982148086513282306647093[illegible]
2317253594081284811174502841027019385211[illegible]
46229489549303819644288109756659334461[illegible]
337867831652712019091456485669234603[illegible]
6482133936072602491412737245870066063[illegible]
152092096282925409171536436789259036001[illegible]
48820466521384146951941511609433057270[illegible]
9530921861173819326117931051185480744[illegible]
956735188575272489122793818301194912[illegible]
40656643086021395016092448077230940[illegible]
2755693979869502224749962060749703041[illegible]
5110089202383770218141694119029885[illegible]
990465970008170029681237738734208418[illegible]
80570985, &c.—EAST ANGLIAN.

[58715.]—**Rust Prevention in Iron.**—Heat the iron to such a temperature that it will cause boiled linseed-oil rubbed over it to smoke lightly, but not to burn it. The surface will not rust, and it forms a perfect face to paint on.—SIGMA.

[58728.]—**Commutator.**—To MR. W. H. EAVES.—As my partner, Mr. W. H. Eaves is away on business, I take the liberty of answering this query, addressed to him by "W. H. B." [illegible] description and sketch, showing construction [illegible] commutator, was given by Mr. Eaves in Vol. [illegible] pp. 261. The commutator, as there shown, consists of a number of bars of copper [illegible] trapezoidal section, a sheet of insulating [illegible] being placed between each bar, and [illegible] forms a cylinder. The best methods of [illegible] commutator are now usually patented

· is subject to considerable strain from wear ıes and centrifugal force. A commutator ː rigidly fixed, or it will give way while urned in the lathe. It was no uncommon hen the old Gramme machines were in use, monotonous work of constantly feeling the s and adjusting the brushes to be varied by ıg out of a commutator bar. I am sorry I ıelp you any further on this subject. You dily understand, from what I have said, I at liberty to explain the exact method we ıounting the commutator bars on our own s.—R. STAFFORD, Coventry.

3.]—**Plante Battery.**—TO "SIGMA."—I ı question 58689 above: but I do not think l light many 5-candle lamps for long at a ·ith your surface. Both surfaces are ., as you suppose. The changes of formation utilised, charging alternately in opposite ns. The rests to be given during forma- · required while charge is in, so as to set up :tion between the outer surfaces and the ged lead below. The connecting strips need cemented; but either paraffin or shellac ist the formation of a conducting film with ː resulting leakage.—SIGMA.

6.]—**Hot Poles of Field Magnets.**—·fect of heating of one pole of the F.M.'s to r temperature than the other is due to causes more or less complicated. This ·ill be much intensified in dynamos having ojections from their armatures. As, for ., the Brush, Seimens H, and Pacinotti :es. In the Seimens H the heat is not l to one end of the pole piece, but both poles speedily hot. To explain this phenomenon be born in mind that when a line of force to move near or in a solid piece of metal, rrents are produced, and this is one of the ıl causes of the heat. In a dynamo there is some lead to the brushes, so that when the circulates round the armature the poles in ; do not occupy a symmetrical position with .o the respective poles of the field magnets, nearer to the pole pieces by the amount of l. In practice the commutator must have a umber of sections, therefore the current be quite steady. According to the textbook, :s in the Gramme armature are stated to stationary in space while the iron ring : this is only partly true, for the poles backwards and forwards through a small ry time a sector of the commutator comes he brushes, the amount of vibration depend- the number of sections into which the :ator is divided: as a consequence the part pole-piece near which armature pole is ıg is made hot, but I have never known the ·ce to get hot enough to burn the paint off. ly cure is to laminate the pole pieces. To mitigate the evil the armature is placed away from the pole-pieces than is mechanic- :essary.—R. STAFFORD, Coventry.

7.]—**Glycerine.**—I cannot conceive that ıe can eat its way through soft solder; some .y must be present, perhaps a fatty acid. ıs the glycerine been prepared, and under ınditions is the solder corroded?—B. B.

ANSWERED QUERIES.

ımbers and titles of queries which remain unan- ɔr five weeks are inserted in this list, and if still ·d are repeated four weeks afterwards. We trust :rs will look over the list, and send what information for the benefit of their fellow contributors.

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Hydraulic Rams, 269.
Differential Galvanometer, 269.
Electric Lighting, 269.
N.E. Railway Express Engine, 269.
ɟ.W. Railway, 269.
Engineer's Arithmetic, 269.
Cotton-seed Oil in Lard, 269.
Currier's Query, 270.
Black Boiler Composition, 270.

Copper Red, p. 350.
Bunsen Burner Lighted Automatically, 350.
Bricks, 350.
Sugar in Beer Worts, 350.
Violin, 350.
Square Threads, 350.
Milling-cutter's Arbors, 350.
Slide-rest Angular Adjustment, 350.
Laurent's Polarimeter, 350.
Molasses, 350.
ɟ.N.R. Engines, 350.

latest advertising dodge in America is an window tapper for attracting attention to indows.

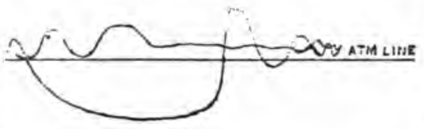
QUERIES.

[58740.]—**Dampness in Beehive.**—Could some of our bee-keeping readers tell me how to get dampness out of my hive? It is made from the instructions given by G. J. Hewson, in "Ours," Vol. XXXVII. pp. 527, 552, 578. The bees I put in the hive last September, and all appeared to go on right up till the first week in January, when I saw that the bees that came out were wet, and could not get back to the hive again. I spoke to a bee-keeping friend, who told me to take off the perforated zinc from the ventilation holes in the ends of the top, and to cover the holes up with pieces of wood, which I did. All appeared to be right again until last week, when the frost began to break up; water began to run out of the front of the hive, and the bees that came out perished on the flight-board or ground in front of the hive. I have lost more than a pint of bees this way. The hive and top is perfectly watertight against rain. Am I right with the quilt, which consists of four thicknesses of ticking next to frames, and two of flannel on the ticking?—J. J. K.

[58741.]—**Rheticus.**—I understand that Rheticus, in calculating his mathematical tables, used formulæ giving sin. na and cos. na in terms of sin. a, cos. a, sin. $(n-1)\,a$, cos. $(n-1)\,a$, sin. $(n-2)\,a$, and cos. $(n-2)\,a$. I should be much obliged if any one could give me these formulæ. The tables were first published in 1596, after the death of Rheticus by one of his disciples, giving the sine, tangent, and secant every 10″ for all angles between 0° and 90°.—FUNCTION.

[58742.]—**Twisting Moment.**—Will someone oblige by showing what will be the dia. of a round spindle that will wind up safely a weight of 2,400lb. by a drum 12in. radius keyed on? Also the breaking weight of the same?—AMATEUR.

[58743.]—**Indicating Pumps.**—I should be glad if anyone can fully explain this indicating card from a two-throw pump, 3½in. suction, 4in. delivery, only lifting from the floor, and running back to the same tank. I do not think it is right—about 5-16in. lift to suction valve.—HARRY KELLY.



[58744.]—**Astronomical.**—Is it possible to represent the pole of the moon's declination on a circular map of the northern hemisphere? The ellipse this pole performs in space is, I presume, simply an imaginary one, and would occur every two weeks as the moon passes from equator to equator.—X. Y. Z.

[58745.]—**Glass Founding.**—I am in interested in a glass works, using a Simens gas tank, and we are frequently troubled by the metal, after being properly founded and plain, in the course of a few hours, from commencing to work a full tank, turning thick and partly opaque. This is remedied, temporarily, by ceasing work and the application of a founding heat for a short time, the fault occurring again after working a few hours. Could any of the practical readers of "Ours" assist me by giving a remedy for this state of things?—TYRO.

[58746.]—**Spring Brass.**—I have a quantity of sheet brass, which I want to convert into spring brass for making springs for contact breakers, &c. Will some kind friend inform me how to proceed?—EWART.

[58747.]—**Faulty Electric Bell.**—TO MR. BOTTONE, OR "SIGMA."—Four months ago, I fixed a large electric bell with four large Leclanché cells, and three pushes to ring the same, and about 600ft. of cotton and guttapercha covered wire and 200ft. of guttapercha taped and tarred underground wire, which I fixed in tubes 6in. underground. There are no indicators to the bell. It answered well after it was finished, till a few weeks ago, when it would start ringing without any apparent cause. I examined the pushes, but they were all right. I also examined the branch wires, and when looking at them the bell stopped ringing, and went on working all right till last Saturday, when it again started ringing without any apparent cause. Will either, or both, of the above-named gentlemen tell me what to do to remedy it?—ONE IN A FIX.

[58748.]—**Incandescent Lamp.** — What candle-power lamp shall I want to replace ½in. paraffin burner of average power, and is there any closed battery that will work the same for eight or ten hours at a time, and, if so, will some of our electricians oblige with dimensions?—S. S.

[58749.]—**Accumulator.**—As I am kindly invited to explain construction of accumulators, I will do so as briefly as possible. There are six cells (glass jars), and each one contains two plates of 4lb. lead, the size of each plate being 6in. by 9in. They are rolled round each other, and separated by indiarubber strips, about ⅛in. thick and ⅜in. wide. I may mention that I was obliged to solder the lead strips for connecting, as I unfortunately did not allow for them when cutting the plates. Would this in any way influence the working, or would the slight sediment at the bottom of the jars be likely to short-circuit them? Since writing the last query, I have succeeded in obtaining a light from 8-volt lamps for two minutes after nine hours' charging with a 5-cell nitrate of soda battery; but, of course, this result is very insignificant. I have now just tested the accumulator after 12 hours' charging, and find, absolutely, no result whatever, which makes the matter still more puzzling to me. The solution is the right one, I believe: sulphuric acid and water (one in ten). I [illegible] charged the accumulator twice every day for the last three weeks, and previous to commencing [illegible] first charge I soaked the plates in strong solution [illegible] acid and water, as recommended in Hosp[illegible] Dom[illegible] Electricity." I shall feel [illegible] any [illegible] mation on the above matter.—[illegible]

[58750.]—**Photo. Transparen**[illegible] to glaze a window [illegible] lights, and want to [illegible] they best method of preserving them? Will matt-varnish stand the weather, as it wants this or ground glass to show them up? Would not the matt-varnish be bad to look through at picture if put on the film side, which would have to be towards the observer, unless the image is reverse-handed? Any information would oblige—PHILOCTETES.

[58751.]—**Engine Query.** — What should be the area of steam ports for piston, one sq. in., moving at 5ft. per second? The boiler pressure being 30lb. per sq. in., what will be the working pressure on piston? What area of heating surface in copper boiler, with charcoal fire and strong draught, will be necessary to supply 18 sq. in. of steam at 30lb. per sq. in. per second?—H. LAMBERT.

[58752.]—**S.E.R. Valve Gear.**—Could any of your readers give details of the steam valve gear used on S.E. engines, and say whether it has been found successful?—V. J. B.

[58753.]—**Teeth of Wheels.**—Will "J. H.," or some other correspondent, kindly tell me how to strike out the teeth for the wheels of the rollers of a wringer? Can they be made to work accurately since the distance apart of the centres of the rollers is continually varying?—IXION.

[58754.]—**Hook Tools.** — May I ask "M. A.," or "O. J. L.," to favour us with a sketch and dimensions of the hook tools used in soft-wood turning at King's Cliffe?—IXION.

[58755.]—**Gramme Dynamo.**—Will someone kindly give me instructions concerning the making of a 40-c.p. Gramme dynamo machine, size and quantity of wire, dimensions of castings, and C.? Also, could I, with this machine, work a small Richardson arc light for the purpose of lighting a room of 12ft. by 14ft.? If so, what sized carbons must I use?—ELECTRIC.

[58756.]—**Electrical.**—A gentleman of my acquaintance (aged about 70) is very deaf, and anyone wishing to converse with him is obliged to shout rather loud down his ear. Could not electricity be used in some manner or other to remedy this defect? I have heard of dead persons beginning to show signs of life, such as moving their arms and legs, opening their eyes and rolling their eyeballs, by means of electricity being applied to certain nerves. Any hints concerning this matter will be thankfully received by—ELECTRIC.

[58757.]—**Watch Jobbing.**—I got new Swiss turns the other day, and amongst the runners there are some I don't quite understand what they are used for? They have about two-thirds turned off them at each end, about ¼in. long, and then bevelled off to a point; and then, from the commencement of the bevel back to the body of the runner, they have a long hole cut through, and a very fine hole drilled at the point through into the large hole. I have Britten's work and several illustrated catalogues from different houses, and none of them show anything like them. Will "Escapement," or "Wen," or someone else, please say what they are used for?—VERGE.

[58758.]—**Hooping Iron Cylinder.**—Supposing I was hooping a cylinder, 3ft. 6in. in diam. with inch iron, what should I have to allow? For different thicknesses I should have to allow more. Can anyone tell me of any book with information on the above subject? A kind of ready-reckoner would be the most useful.—BLACKSMITH.

[58759.]—**Turning Commutator.** — Will some of our electrical friends tell me the best way to turn a commutator true? It has been in wear some time, and it has some flat places worn, so that I cannot keep the brushes from sparking for any length of time. Also, what kind of turning tool shall I require? Am pretty well up in turning iron. It is Edison's make?—BEND ORR.

[58760.]—**Specula Polishing.**—TO "PRISMATIQUE."—I should be glad if you would give the proportion of rosin, flour, and white wax that you use for making the polishers for figuring specula, mentioned in the "E. M." for Jan. 1st.—NINIP.

[58761.]—**Tramcar Stone Catcher.**—Will some kind reader oblige by giving a full description of an appliance to tramcars for the purpose of driving the stones off the rails in front of the car? I understand in London wire brushes are used; but this will only be meant to clean the rail, and not for the purpose of pushing off the stones from the rails in front of the wheels.—A. R.

[58762.]—**Furnace.**—TO "T. F. S. F."—Would you be kind enough to describe more fully the construction of your most valuable small furnace, as I think it would be a boon to many such as myself, having often to melt small quantities of scrap iron? I think if you were to letter or number the parts, I should be able to make one from it. Do you melt the iron in a pot, or place it with the coke? I do not understand what you mean by the narrow belt or casing; also the tuyere being all round the furnace: I always thought the tuyere was only a small hole just to admit the pipe from a fan.—ANCHOUS.

[58763.]—**Boat and Model Yacht.** — TO MR. MCOASH GOVAN.— Will you kindly inform me how to measure boat for length, strength, and position of mast, size of sails, weight of ballast, model yacht, weight of keel, or refer me to any work for information?—JOHN BROWN.

[58764.]—**Legal.**—A wall dividing two gardens at the back of two houses in the deeds of the property was specified to be 6ft. high. The owner of one house, a little over twelve years ago, built on this wall to the height of one story, nobody raising any objection. Has the owner of the next house a right to build against and utilise now that wall higher than 6ft. without paying rent, or half the value of the wall, to the owner of the house who had built the wall one story higher than the 6ft. more than twelve years ago? And could the owner of the house who built the wall more than twelve years ago, be now compelled to pull it down to 6ft. high? Will one of our legal subscribers kindly answer a perplexed one in the above?—H. INGHAM.

[587[illegible].]—**Dental Query.**—Being a working jeweller, I have been in the habit of occasionally repairing artificial teeth—i.e., fitting them with bolts, fastenings, springs, &c. [illegible] been informed that I am liable to prosecution, as [illegible] no diploma, I contend that as long as I confine my [illegible] teeth alone, I need no qualification [illegible] satisfaction. Will any brother reader, [illegible] where to draw the line between a [illegible] no diploma, and a surgeon [illegible]

[58766.]—**Boring Hole in Lathe.**—Will any kind reader oblige me with a sketch of the best form of drill for boring a $\frac{3}{8}$-hole through a wrought-iron spindle 5ft. long in the lathe, and the best means of doing the same?—J. M. S. C.

[58767.]—**Wimshurst Machine.**—Would any reader kindly inform me what is the best size and number of sectors for a 16in. plate?—DOUGALL.

[58768.]—**Locomotive.**—Will any reader give information as to the weight and coal consumed per mile of tank engines used by the L. B. and S. C. railway between Clapham junction and Addison-road, Kensington, and also the L. and S.W. railway locos. used between Addison-road and Hammersmith, Grove-road? A full description would greatly oblige—YOUNG ENGINEER.

[58769.]—**Lead for Gravity Battery.**—Will some of "ours" inform me if ordinary lead tubing is sufficiently pure to make the funnel of for above battery? If not, can they state where suitable material can be obtained? I can manage the zinc ring, &c., very well. It is intended to work a pair of small needle instruments.—G. D. G., Sheffield.

[58770.]—**To Mr. Bottone.**—I bought Mr. Bottone's book on the dynamo, and, from very clear instructions therein contained, I made a galvanometer. On sending a current round the coil the needle deflects as it should do. Will Mr. Bottone enlighten my ignorance, which I own, with sorrow, by telling me why the wire of coil is insulated, which, if it means anything, means that no current passes out? Why, then, does the current affect the needle?—ARTHUR D. SANKEY.

[58771.]—**Funicular.**—Two weights W and 2W are connected by a rod without weight, and also by a loose string, which is slung over a smooth peg. Compare the lengths of the string on each side of the peg when the weights have assumed their position of equilibrium.—FUNCTION.

[58772.]—**To Mr. W. H. Eaves.**—Many thanks for your reply to my query No. 58627. The F.M. coils are joined in series. The armature wire is connected to commutator by a screw with large head. The contact there is perfect. The resistances are, A., 2·07 ohms; F.M., 3·3588, working by a table of ohms to lb. If I couple the F.M. in parallel, the resistances would then be A. 2·07 and F.M. 1·6794. Would it work without much loss? I am rather in a mix about the relative resistances of A. and F.M. for dynamos. Should they be equal, or F.M. in excess? I would be very pleased to have particulars of Gramme machine for ten 20-c.p. 45 volt lamps. I have all necessary tools for making.—PUZZLED.

[58773.]—**Plain and Ornamental Turning.**—Shall be glad of the hints on "Pretty Things for Plain Turning" so kindly volunteered by "Anonymous" (25289, p. 449); and perhaps, in the mean time, some friend will advise me how to manipulate coroza and coquilla nuts.—DURSTON.

[58774.]—**Boat.**—TO MR. GODDARD.—In your reply to my query 58015, you gave in No. 1082 sketches of lug and sprit sails. I have now got a boat 12ft. 8in. by 5ft. by 2ft. 3in., outside measurements. Will you kindly give me dimensions of spars and ropes and measurements of sails to suit each rig? I have been recommended a single large lug. Would you approve of this? Where is mast to be placed? Does jib project over bows, and, if so, how much? What is the best paint—white lead and boiled oil, or equal parts white lead and red lead and boiled oil, but no turpentine or driers—for boat? Can you recommend a good book at moderate price, practical, on rigging of small boats?—ALEX. H. MOORE.

[58775.]—**Calcium Persulphide.**—Will someone inform me how to prepare this salt, so as to enable me to make hydrogen persulphide?—QUINONE.

[58776.]—**Reaction of Hypochlorite.**—When a solution of NaOCl is added to a solution of borax what occurs (equation, if possible)?—QUINONE.

[58777.]—**Troublesome Battery.**—Will some kind reader tell me how to remedy the following? I have a bichromate battery for lighting a small incandescent lamp; but I can't keep the solution from creeping up to the brass connections and corroding them. I have soaked the tops in melted paraffin wax, making the tops hot first, and then Brunswick-blacked them; but where I clean them for the terminals to go, the solution seems to attack them, so if any reader who has the same trouble will give his advice he will greatly oblige—W. G. BENNETT.

[58778.]—**Steam.**—Would any of our kind subscribers help a learner in the following? Steam is admitted into a cylinder at 25lb. on the sq. in. above the atmospheric pressure of 15lb. on the sq. in., and is cut off at a point so that its pressure at the end of the stroke is 5lb. below that of the atmosphere. What point of stroke was it cut off? Please state plainly, so that I may easily understand the meaning of the 5lb. below atmosphere. If the pressure was 25lb. at beginning, I suppose it would have to be cut off at 1-5 of the stroke to be 5lb. at the end of the stroke; but I don't understand the 5lb. below atmosphere. Would you kindly give a diagram, showing pressure throughout stroke? Perhaps our friend "Glatton," or others, would help a learner in computing the power of engines. Is the pressure that the steam gauge indicates taken, or is the atmospheric pressure to be deducted from it? Is there 15lb. in a boiler before any pressure is shown on the gauges? Please use figures.—ANXIOUS.

[58779.]—**Headstock.**—Would any kind friend give a sketch of the fast headstock of double-geared lathe, and say what is meant by backlash, and how prevented in screws?—ANXIOUS.

[58780.]—**Fulcrum.**—Given any weight to be placed on the end of any bar or rod, uniform throughout of any weight, will anyone give a rule in figures how to find the fulcrum where they would balance?—ANXIOUS.

[58781.]—**Chlorine.**—Will any of our chemical friends kindly say what is the cost of preparing chlorine on the manufacturing scale? How much is it per lb., or per cubic foot?—EX-GARRISON GUNNER.

[58782.]—**Walking Stick.**—I have some beautiful black horns, which I wish to make walking sticks of. Can any of your readers tell me the best way to straighten them when softened by hot water or steam?—H. S. S.

[58783.]—**Tuning Hammer.**—It would be a great boon to performers of musical instruments that are engaged in tuning if a tuning hammer could be invented so as to do away with the great strain which is necessarily put on the muscles of the hands by tuning, as all performers are aware how detrimental tuning or any manual labour is to pianists. I am sure many of your readers as well as myself would be glad to know if a tuning hammer consisting of cog-wheels in the head has ever been invented. Trusting these few lines may be the means of opening up a correspondence on the above subject.—PIANIST.

[58784.]—**Silvering Incandescent Lamps.**—Could any of our readers kindly tell me how I can silver the back of an incandescent lamp to answer the purpose of a reflector?—YOUNG ELECTRICAL ENGINEER.

[58785.]—**Biela and Andromeda Meteors.**—Were the November Andromedes seen previously to 1872? If not, why not? When Biela existed as a visible comet, he was followed by a shoal of meteors: the earth must have met these then as it does now. Is it supposed that the final breaking up of Biela has added to the display? By what process did Klinkerfues, in 1872, arrive at the conclusion contained in his telegram to Pogson, "Biela touched earth: look near θ Centauri." Mr. Proctor speaks of the meteor shoal as far behind the comet. Did Klinkerfues make a guess as to how far?—and why should such guess serve to locate Biela with greater accuracy than calculation from his known orbit?—L. S.

[58786.]—**Tube-Welding Furnaces.**—Do any of "ours" know whether the regenerative gas furnace is used for welding iron and steel tubes, both by the "butt" and "lap" process? If so, where, and with what success?—DROMIO.

[58787.]—**Case-Hardening Wrought-Iron Spindles.**—Will any kind reader inform me how to case-harden wrought-iron spindles in bearings? I have tried prussiate of potash; but it does not harden them sufficiently and far enough in. The spindles revolve about 300 revs. per min.—JIGGER.

[58788.]—**To Mr. Bottone.**—I have been trying to make an electric locomotive on the principle of a helix drawing its core within it on a current being sent round the coil. I wound two bobbins $1\frac{1}{2}$ by 3, full with 22 silk wire, using as a base a brass tube. I have turned an iron spindle to slide in them easily, and by connecting alternate coils the core is pulled sharply into them. I have mounted these on a suitable mahogany base, with wheels. Can you tell me if it is any use going on with it for the purpose I name, and the best way of applying the power to the wheels? I know it is not a good form of motor; but have set my mind on that pattern, if it is to be done. I have seen a beam engine on this principle (stationary).—WAG.

[58789.]—**To Mr. Bottone.**—I shall be glad if you will kindly tell me how to connect up dynamo to accumulators for charging, and how to place am.-meter in circuit to tell if the batteries are filling?—AMPERE.

[58790.]—**Reducing Density of Photograph Negatives.**—Being desirous of reducing too great a density of image in a dry-plate negative, I attempted the experiment by adopting a formula given for the purpose in "Mason's Practical Guide to Photography," which consists in first immersing the plate for a short period in a solution of 30 grains of ferric chloride in 3oz. of water, and afterwards washing and fixing same in fixing solution. Having carried out these operations minutely, being careful to use exact quantity of reducing solution by weighing and measuring and by thoroughly washing plate after fixing, I was surprised to find, upon the plate drying after these operations, that the image had disappeared altogether. I shall be glad if any reader can give me information as to cause of failure.—W. C. BATTEN.

[58791.]—**To Mr. Bottone.**—I have had made some zinc trays to hold the fixing solution and alum bath. Kindly inform me if the hypo. and alum solutions will have any chemical effect on the zinc, fatal to the dry plates used? Also same query in respect to alum and citric acid. Also please say if there be any method to clear a plate of fog occasioned by exposure to candle-light during development?—GWENT.

[58792.]—**Electric Loom.**—Can any of "ours" give me information respecting an electric loom which appeared in 1860? Faraday, I believe, lectured on it in that year. If not, I should be grateful for any references to books, &c., where such information is given.—W. H. A.

[58793.]—**Lifting Power.**—What horse-power would be required to raise five tons of coal from a mine 500yds. deep; weight of tackle, eight tons extra, so that 200 tons of coal can be drawn in an hour?—G. W. F.

[58794.]—**Boiler.**—What pressure will my boiler stand? Plates, Lowmoor; boiler, 18in. long, 1ft. diam., all rivets $1\frac{1}{2}$in. apart, all plain.—FIREMAN.

[58795.]—**Fishing Rod.**—What is the best preparation to stick cork to handle of rod to withstand heat and wet?—B. W.

[58796.]—**Punching Flannel Washers.**—I have a quantity of flannel washers to punch weekly. The present method, with hammer and punch, is very inconvenient. Would any reader kindly give me instructions, with sketch, how to construct a machine, either hand or power, for punching of same? Size of washers, 2in. dia., with $\frac{1}{2}$in. hole.—ALFRED DERBYSHIRE.

[58797.]—**Lathe.**—I have lately become possessed of a $4\frac{1}{2}$in. screw-cutting lathe, and being at a distance from anyone who could give me any lessons, I shall be glad to know of any work which will give me directions as to how to work same. I have bought "Lathe Work" and "Turning for Amateurs"; but they do not apppear to be what I required, as they only describe the tools used.—J. W.

[58798.]—**Induction Coil.**—TO S. BOTTONE, "BOBADIL," AND J. BROWN.—Many thanks to you for your replies. I have unwound the coil and found a break, although it could not be seen. I found it by testing every layer as I went on. Would you please tell me what size of condenser and number of sheets I should want, and the spark I can get with a certain number of cells?—BOLTON.

[58799.]—**Continuous Electric Bells.**—Will any of our correspondents kindly tell me how to make one of the above? I want one as a burglar alarm, so that if the wires were cut the bell will continue to ring till stopped by switch or lever. A rough sketch would greatly [illegible]—BOLTON.

[58800.]—**Safety Matches and Amorphous Phosphorus.**—Can any reader tell me what is the composition used on the sides of safety-match boxes. [illegible] is mainly amorphous phosphorus, I believe; but I [illegible] puzzled to keep phos. amorph. from absorbing water. I have washed it six times to free it from phosphoric acid, but to no good end. What method do the manufacturers adopt?—PHOS.

[58801.]—**Trustees.**—Can any of your legal correspondents tell me what is the position of a trustee in [illegible] following case? Two trustees apointed by will to [illegible] after certain funds in the interest of the [illegible] daughter. One of them goes out of the country on business, and, in the mean time, the other utilises the [illegible] for his own benefit, and loses the greater portion. Is [illegible] trustee who had nothing to do with the drawing [illegible] handling of the money in any way responsible?—J. [illegible]

[58802.]—**Saturn.**—At a recent meeting of the R.A.S. a photograph of Saturn was shown. So marvellous [illegible] the definition that we are told even the crape ring [illegible] clearly visible. Will some reader of the "E. M." who [illegible] the privilege of seeing this picture, tell us something [illegible] it? Was it a glass transparency, like a magic-lantern slide, or merely a print on albumenised paper from [illegible] negative? What was the size of the picture shown, and was it enlarged to this size from the original negative? Any particulars of the photographic apparatus by which this wonderful picture was obtained would be valued by many readers, as by—E. B. FENNESSY.

[58803.]—**Jupiter.**—Have there been any photographs of this planet taken showing a Satellite, or shadow of [illegible] Satellite, in transit? Now that Saturn has been so [illegible] done for, I hope to find Jupiter securing the attention [illegible] photographic astronomers.—E. B. F.

[58804.]—**Beam Engine.**—I want to make a beam engine, 2in. bore, 3in. stroke. Will some of our readers inform me the right sizes and lengths of the following? The beam, parallel rods, piston rod, connecting rod, [illegible] shaft. What distance should there be between the cylinder and bearings, and what height should bearings be? Width and length of bedplate? What size [illegible] ports and what height standards?—YOUNG [illegible]

[58805.]—**Motor Reverser.**—Will some of our readers please show how to fit reversing commutator to [illegible] motor other than Reckenzaun's?—REVERSE.

[58806.]—**Soldering.**—I want to take the [illegible] metal brooches. Can anyone tell me how I can melt the solder? I have tried a blowpipe with a candle flame, and it has no effect. Also, can anyone tell me of a cheap practical book on soldering?—C. HALES.

[58807.]—**Draught-Preventer for Doors and Windows.**—I shall be much obliged if any correspondent will tell me what plans there are in general [illegible] prevent draughts coming into a room through the [illegible] between doors and windows and their casings? I [illegible] care for the rubber tubing with lip attached, and [illegible] like to know what else is going.—OLD SUBSCRIBER.

[58808.]—**Electro-Deposition.**—Will any reader of "Ours" kindly inform me what electrolyte (and how it is made) to use to deposit platinum upon sheet lead?—VIGORNIENSIS.

[58809.]—**Chemical.**—Will someone kindly [illegible] why I cannot succeed in separating antimony and lead oxides by dissolving them in potassium hydrate, and precipitating the lead with sulphuretted-hydrogen solution, leaving the antimony in solution? I believe antimony should not be thrown down in alkaline solutions; but after acidifying the filtrate, I cannot get the orange precipitate of antimony. Also say what are the advantages of sulphuretted-hydrogen solution in glycerine, which I see in the chemical lists.—F.

[58810.]—**Small Brass Screws.**—I should like to know if there is any arrangement that could be adapted to any ordinary lathe (not back-geared) for making small brass screws, such as electrical inst. makers use? [illegible] a rough sketch would oblige—A. B. C.

[58811.]—**Pianoforte-tuning.**—Will any of your readers be good enough to say whether the instrument called a tonometer (mentioned in Deschanel's "[illegible] Philosophy," Part IV.) has come into the English market, and is really available in a practical way, and the price? Whether any improvement upon it has been effected for the same purpose, especially in the direction of optical [illegible] or making the vibrations visible after the manner of Lissajou's figures? A little information on these points would greatly oblige—THOMAS CLARK.

[58812.]—**Strength of Acids.**—Could anyone kindly inform me of a quick and simple means to discover the strength of any given acid, such as sulphuric, nitric, &c.?—CHIRGWIN.

[58813.]—**Blue Signal Light.**—Could any of our correspondents give any particulars or information in reference to the Government blue signal light, as I [illegible] the recipe. Mention is made in it, chlorate of [illegible] twice in the same; the first part of the recipe, [illegible] of potash and copper. The query is, What sort of [illegible] is used, and how is it managed in the combination?—[illegible]

[58814.]—**Sand-papering Machine.**—[illegible] "ours" give me a rough sketch of a machine to [illegible] surfaces only, 6in. wide, in lengths of 6ft. and [illegible] YESALLAW.

[58815.]—**Bright Yellow Dye.**—I want a canary-coloured dye, such as is used for colouring sugars for confectionery purposes. Must be [illegible] YESALLAW.

[58816.]—**Marking Sheep.**—[illegible] to use for marking sheep? I want [illegible] wash out with the rain, and yet not [illegible] of the wool, and thus interfere with [illegible]

[58817.]—**Engine Chimney.**—[illegible] an engine chimney of galv[illegible] diameter. It gives an exce[illegible] any fear of its being serious[illegible] action of the exhaust steam [illegible] sume?—The iron is $\frac{1}{4}$in. thick

BRITANNIA COMPANY'S J. K. P. CHUCK

IS THE CHUCK OF CHUCKS!!

HOLDS TIGHTER.

WEARS LONGER.

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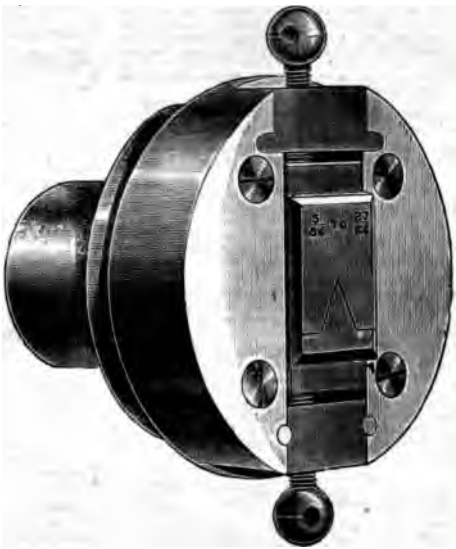

FIG. 1.

1b

With the Jaws as fixed it HOLDS DRILLS $\frac{5}{64}$ to $\frac{27}{64}$.

HOLDS ARTICLES $\frac{11}{16}$ to $1\frac{11}{16}$. With No. 1B Die.

1a

Die 1a is made to hold $\frac{1}{4}$ to $\frac{1}{2}$, $\frac{1}{2}$ to $\frac{3}{4}$, $\frac{3}{4}$ to 1-inch.

SPECIAL JAWS MADE TO SUIT SPECIAL JOBS.

PRICE £2 10s. 0d. with one Set of Jaws. 10s. per pair for extra jaws of either pattern.

Extract from J. K. P.'s letter in the "English Mechanic," Oct. 30, 1885.

This new form of chuck, instead of being made of independent bars of iron attached to a cast back, is GROOVED OUT OF THE SOLID, and is ECESSED AT THE BACK in the same way as the American scroll chucks, so as to allow of its being attached to a back or base chuck of ANY FORM OR LENGTH nsidered desirable. Where the mandrel is drilled through, a very short base piece is sufficient, but for use on solid mandrels I have occasionally made the back as long as 4in.

A little practice is needful in this before rapidity of shifting and chucking is attained. It is not pretended that this chuck is self-centring; but in point of fact, IS BETTER THAN IF IT WERE SO, for while it is capable of ACCURATELY centring anything that is round already, it will also CENTRE TRULY icles that are not quite round—that is, when the knack of doing so is arrived at; and, moreover, by slacking one set screw and advancing the other, you can ST YOUR WORK ECCENTRIC to some considerable extent, which in many cases, is a VERY VALUABLE QUALITY. For STRENGTH OF GRIP ere is NOT A CHUCK OUT THAT WILL TOUCH IT, and it will hold a screw without injury while you finish its head. I believe it will shortly be advertised a price that may commend it to workmen as MUCH AS ITS GOOD QUALITIES OUGHT TO DO.

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ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings r illustrations on separate pieces of paper. 2. Put titles queries, and when answering queries put the numbers well as the titles of the queries to which the replies ter. 3. No charge is made for inserting letters, queries, replies. 4. Letters or queries asking for addresses of anufacturers or correspondents, or where tools or other ticles can be purchased, or replies giving such informan, cannot be inserted except as advertisements. 5. No estion asking for educational or scientific information answered through the post. 6. Letters sent to correondents, under cover to the Editor, are not forwarded, d the names of correspondents are not given to inirers.

*** Attention is especially drawn to hint No. 4. The ace devoted to letters, queries, and replies is meant for e general good, and it is not fair to occupy it with quesons such as are indicated above, which are only of individual interest, and which, if not advertisements in themlves, lead to replies which are. The "Sixpenny Sale lumn" offers a cheap means of obtaining such informaon, and we trust our readers will avail themselves of it.

BACK NUMBERS.

E receive so many queries asking for directions how to make many instruments and appliances which have been fully described in back volumes, that we have compiled a list, which we shall insert in this column at intervals, of those most frequently sent, and as the numbers are still in stock, new subscribers should consult the list before sending their questions.

ookbinding: No. 612.
lectric machines: Nos. 1,008, 1,025.
lectro-magnets: Nos. 772.
acquers: No. 866.
attern Making: Nos. 9
955, 954, 958, 959,
986, 998, 1,000, 1,001
lver-plating: No.
arnishes: Nos. 476

he following ar
te Wednesday
elsewhere:—

E. Mat
T. R. B
Jackson
F. F. S.
E. L. E
—A. Fr

H. H.—P. C. Hornsey.—Caloric.—Glatton.—G. Bowron.—Fred. Carre.—Vladimir.—Prismatique.—Uranium.—W. A. S. B.—Paul Ward.—Steatite.—Bobadil.—C. L. Tweedale.—A Fellow of the Royal Astronomical Society.—Vulcan.—T. C. Bristol.

S. (We do not know; but Messrs. Williams and Norgate, Henrietta-street, W.C., sell the *Journal* of the Royal Microscopical Society, and will doubtless give you the information. You will find a description on p. 52, No. 1,043.)—A Constant Reader. (You will find much information in back volumes, and most of the textbooks have a chapter on it. See Maxton's "Manual of Engineering Drawing," Crosby Lockwood and Co., Stationers' Hall-court, E.C.)—Twelve Years' Subscriber. (There is Macregor's "Gas Engines," published by Symonds and Co., Bouverie-street, E.C., and a good deal about it in Bourne's "Catechism of the Steam Engine," latest edition, published by Longmans. See also recent back volumes. 2. If you mean joining a broken tire, there is no safe cement. Rubber solution will do to mend holes.)—Novice. (Tables are given in such works as Molesworth's Pocket-book. 2. On the contrary, we should understand it to mean that it is not to be polished up or faced in any way. 3. See a handbook of drawing.)—Sammy. (See indices under head of Indicator Diagrams, or refer especially to p. 201, No. 1,023. 2. Is it not equivalent to a ton of water?)—C. D. (See indices, or refer to the syllabus of any college which examines in the subject. Such a list would occupy space to no useful purpose, for we might have half a dozen lists, according to the tastes of the compilers.)—Bachelor of Engineering. (As to outfit, you had better wait until you get there. One good winter suit and one summer suit will do. Any strong kind of trunk. Limits vary with the different lines. No duty at all on such articles, provided they are bona-fide in use, and are not two or three times as many as can be reasonably required.)—Firearm. (How can any one answer such a question without either handling the gun or having details of its measurements, including the patent breech?)—Terrapin. (You can see an ordinary Maelzel metronome at almost any musical instrument shop. A cheaply-constructed metronome was described on p. 216, No. 841.)—[illegible] Our Correspondents. (The system [illegible] in generating secondary [illegible] be required, by means [illegible] so that each sub- [illegible]

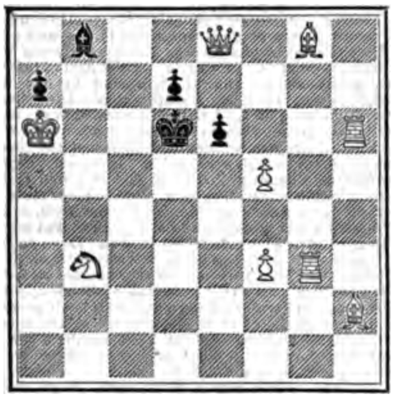
Post Office London Directory, and get an idea where to send for another plate.)—S. D. A. When you ask for "strongest or best," we must answer "We do not know"; but we should try good glue, to which a little nitric acid has been added. See p. 325 ante. Acetic acid or hydrochloric acid is also used for the same purpose, and strong vinegar will represent the former.)—J. Reside. (Have it dark by all means. 2. We scarcely understand. You can cut them out of thin brass or cardboard.)—R. J. C. S. (Would it not be as well to give the actual quotations, with their context? For instance, what does "a power of 40 on Jupiter" mean?)—Agamemnon. (Turpentine rubbed on gently will remove fine scratches; but let the varnishing and polishing alone if it is a good instrument. There are plenty of good works, but it is almost essential to take lessons of a master. See the indices of back volumes.)—Simius. (There is a great deal of information about violins and violin-making in our back volumes—even in XLI. Possibly Heron-Allen's work, or one published by L. U. Gill, 170, Strand, W.C., would suit you.)—Acid. (We do not know of any works of the kind, but there are articles descriptive of the process and apparatus in such works as Ure's Dictionary, Payen's "Industrial Chemistry," &c. 2. You will find recipes in back volumes, but Leroy's composition has stood the test of time, and can be recommended.)—R. J. C. S. (We have never been fortunate enough to find anyone willing to give 3d. for a penny of 1864. Have you?)—R. Goodearl. (The question was answered on p. 176, last volume. There are some towns which use oil lamps; but nowadays coal-gas can be made so cheaply that neither electricity nor oil has a chance if coals are at all handy.)—J. J. H. (You were answered at the time in this column and referred to back numbers for the required information, which has been given several times. The feathers are curled by drawing the plumelets between the thumb and a blunt knife. Some skill is required to do it properly.)—Quadratic. (You should procure a list of the members of the Mathematical Society. We cannot afford space to give such a list as you require, nor can we just at the present time find room for your problem.)—H. B. Fennessy. (Drawings and descriptions of the Mersey Tunnel have appeared in the illustrated papers, and we believe also in the local press. 2. You will not obtain any idea of the magnificence or sublimity of music as found in the works of the great masters from instruments of the kind mentioned.)—S. O. C. C. (See p. 256 ante. Some automatic couplers have been in use in parts of the United States for several years. Expense is the obstacle here.)—Sensative Jack. (We do not understand how it could [illegible] in one casting. See the papers on "Engine- [illegible] at Home," especially that in No. 1,050. 2. Bad [illegible] is the most likely cause.)—P. Byrne. (Apply to [illegible] our advertisers who are opticians.)—C. E. [illegible]y. (We gave the imperial standard wire-gauge [illegible] 11. No. 98[illegible] The other gauges are given in most [illegible] you can get them from those who [illegible] Ambora. (Steep in a decoction of [illegible] Boil, say, 6lb. in a vessel large [illegible] enough to hold the net, and leave the latter soaking in the hot liquor all night. Hang it up to dry, and then wash in clean water. Repeat until the colour is satisfactory.)—PARALOS. (You will find all about the indicator and indicator diagrams in back volumes. Try pp. 130, 244, 272, Vol. XXXVII., for instance; but look also through the indices.)—SHUNT CIRCUIT. (If you cannot refer to back numbers, procure the descriptive circular of the company.)—AMATEUR SILVERER. (You will find many recipes in back numbers—even those recently issued.)—A CONSTANT READER. (Consult the indices.)—A. CUTER. (Wash thoroughly in strong solution of soda, and then boil in decoction of logwood. Steep afterwards in solution of acetate of iron. 2. We presume you mean the composition known as bois durci. It is cellulose treated with sulphuric acid.)—ENDERBY-THRUM. (Why not have told us the composition of the ink? A good shoemaker's ink is made by boiling one pound of logwood chips in a gallon of water for about ten minutes; then add an eighth of an ounce of bichromate of potash and boil for another ten minutes. When cool, add half a pound of gum previously dissolved. Some use a preparation of nutgall decoction and acetate of iron, and apply a solution of gum to the surface when the ink has dried in, working up with a rag and tallow, and the jigger or shoulder-stick.)—F. B. A. W. (Directions of the kind will be found in back volumes. We presume you mean induction coil.)—WM. ROBSON. (Try what you can do with the aniline dyes. We do not know of a book on dyeing at that price, or anything like it. All useful works of the kind are expensive.)—PLUMBER. (Some of the numbers are out of print. You can procure the work in book form of the author, or of Messrs. E. and F. N. Spon, 125, Strand.)—EDISON. ("How to Make a Phonograph," giving full details, appeared in No. 683. There is no "must" about it; but brass is the most convenient and best metal for the purpose.)—ARCTURUS. (The fault is in the wick. Probably its interstices are choked, and the oil cannot ascend. Try a new piece, and don't put in a whole yard. If it reaches the bottom of reservoir that will be long enough.)—MEDICUS. (Heating would have no effect. We have given the methods of demagnetising watches several times. The simplest is to suspend the watch near the field magnets of a machine, and let it revolve for a little time in various positions. See indices.)—H. INGHAM. (Recipes for inks in nearly every volume.)—ROBERT TWISS, M.R.C.S. (No room for anything in connection with "squaring the circle." It may be exactly as you assert; but it is a matter of no moment to the practical man, who prefers to make his own measurements.)—MAGNETO. (Guthrie's "Electricity and Magnetism," Collins, Sons, and Co.)—OMEGA. (Selenium may do what you require.)—P. H. SE. (Only experience with originals and forgeries.)—FITTER. (Apply to the "Captain of Steam Reserve" at any of the Government Dockyards.)—SEMPERVIVUM. (It is prepared from pure terebenthene and concentrated sulphuric acid by rather troublesome processes. We have nothing further than what we stated on p. 444.)—JULIE COXWORTHY. (The summons must be taken out in the court of the district where the cause of action arose; but if the order for the goods was given or received by post, the summons may be taken out in either the district where the plaintiff or defendant resides at the plaintiff's pleasure.)—RECTOR TOT. (M. Glover and Co., of Leeds, advertise such a machine every other week in these pages.)

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLXXVII.—BY H. AND E. BETTMANN.
(From Mirror of American Sports Tourney.)

Black.



White. [9 + 5

White to play and mate in two moves.

SOLUTION TO 975.

White.	*Black.*
1. Kt-K R 6	1. Anything
2. Kt-Q B 4	2. Anything
3. Mates	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 976, by E. J. Barnes, J. Ough, James Gillan, G. W. Middleton, and J. Palmer.

CORRECT solutions to 974, by J. J. Spence, G. T. Stringfellow, E. A. G., Hensing; to 975, by J. Palmer and Harold.

C. J. LAMBERT.—Thanks for game.

C. DEAN.—No mate in 975 if 1. $\frac{\text{P-Q Kt 4 (ch)}}{\text{K takes P}}$ as 1.

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Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Double Cylinder **Engine,** each 2¾in. by 5in., metallic piston, mahogany lagged, turned flywheel, all bright. Exchange Engineer's Tools to 150s.—Apply, CYCLE WORKS, Bridge-street, Macclesfield.

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New Jones' or Singer's **Sewing Machines,** with covers, cost £8. Want offers.—STAFFORD, Repairer of all kinds of Sewing Machines, 17A, Bradshaw-street, Shudhill, Manchester.

Wanted, new or second-hand **Microscopical Apparatus,** by good makers, also Scientific Books, in exchange for first-class Micro. Slides.—C. COLLINS, Bristol House, Harlesden, N.W.

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Wanted, 42in. "**Facile" Bicycle,** damaged will do, or Lathe, in exchange for good Microscope and Lamp.—PETT, 68, Frederick-street, Caledonian-road, N.

Vertical **Launch Engine,** 4in. by 4in., and multitubular boiler, all complete, ready for fixing in boat.—G. C., 156, Barrell Well, Chester.

Half-Horse **Engine,** double oscillating
horizontal bed, in good condition, complete, with gover
offers?—JOURNET, 194, Gt. Portland-street.

Sewing Machine, hand or treadle, part p
£7 10s., nearly new. Exchange Bicycle, 50in. or
Bilston-road, Wolverhampton.

Wanted, ¼-plate **Photographic Appara**
change for Induction Coil mounted on stand and
Battery, value 25s.—E. CLARKE, Post Office, Croydon.

Burette Tube, 60cc. in tenths, minera
Society Arts," weekly throughout year. Want
Thermometers, chemical or electrical offers.—J. INNE

"**English Mechanic,"** unbound, from
1882, to present time. Exchange for ½-plate Recti
rapid doublet, or offers.—D. CALLICK, 13 K., Peabody-
friars-road, London, S.E.

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silver-plated fittings, slightly out of order, no use to
—T. BINDEN, 8, Buchell-road, Aldershot.

Model **Horizontal Engine,** 1in. bore,
governors, copper boiler, lever safety-valve, water
burner, &c. What offers? anything useful.—SHAPLAN
street, Wellington, Somerset.

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also fly rod; exchange "Amateur Work," 1885, or
gain.—TYSON, 80, Tweedale-street, Rochdale.

Model **Vertical Engine,** cylinder 2¼in.
Vertical Tubular Boiler, working; pressure not
square inch.—W., 14, Grafton-road, Plaistow.

18 Vols, "**English Mechanic,"** XXIII.—
70 numbers of "Knowledge," I.—LXX., all clean and per
good Clarionet, Rectilinear Lens, ¼ Instantograph,
25, Josephine-avenue, Brixton.

Instruments or cash offers for "**Engineer**
volumes "Ewart's Agriculturist's Assistant," "
Construction," any volumes.—Z. C., 62, Ledlige
London.

What offers for 70-candle **Dynamo,** finish
winding; Electro-motor, would drive sewing machi
separate.—HARRIS, 26, Southbrook-street, Shepherd's

What offers for one of Halse's 10-guinea
COILS and 12-cell Battery, in working order.—HARRIS.

Capital 3½-horse **Vertical Engine,** wit
valve, governors and guard complete, splendid con
good exchange to value £15 accepted.—S. GORTON,

Congo Free State — To Steam Laun
Foreign Traders, &c.—See advertisement under Situa
trading in above State.

27 Nos. "**Building News"** for 188
"Building News" and "Builder," literary
"Moseley's Engineering." Offers.—N., 3, Frogmore-

Wanted, **Twist Drills or Chuck**
ENGLISH MECHANIC, from Sept. 1, 1883, till
COX, Plumber, Buchin-grove, Watford.

Splendid Working Model **Horizontal Eng**
bore, 2in. stroke, all brass, worth £2. Exchange La
PEDDER, Lord-street, Millom, Cumberland.

Set of five **Wood Turning Tools**
Wanted, "Origin of Species," "Huxley's Elementary
or offers.—E. HOWGATE, Junr., Water Hall, Mirfi

Microscope, by Aronsberg, Liverpool,
2, 1, ½, ¼, ⅛ objectives, achromatic condenser, &c.
offers.—H. S., 95, Brixton-road, S.W.

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with offers, Captain W. F. SMITHWICK, Youghal

Wanted, 4½in. centre **Lathe,** or Parts of
change for Microscope, value £4.—W. HAGUE, St.

Stamp Album (Oppen's), containing
stamps, all different, worth 10s. Exchange for
locomotive photographs.—JACOB, 1, Landseer-road,

Microscopic Objectives, ½in. and 1
Pillischer. What offers?—M. D., East View,
Waterloo, Liverpool.

"**Culley's Practical Telegraphy,"**
"Preece's Telegraphy," 3s. 6d., in splendid con
for fossils or crystals.—Send list to W. L., 101,

A small, strong **Perambulator** in exch
thing useful.—Apply to D., 13, Anstey-road, Peckham,

3in. centre **Lathe,** Slide-rest, Stocks and
other Tools; Amateur's Outfit, cost £7 10s., in exchang
hand Gold Watch.—J. M., 4, Wellclose-square, E.

Model **Horizontal Engine,** 1in. bore,
Will exchange for neat model, ¾in. bore, 1in. stro
ISAAC LEYLAND, Park-lane, near Wigan.

"**English Mechanic,"** 1885, complete,
clean. What offers?—16, Lesbourne-road, Reigate.

Wanted, 3in. **Lathe and accessories,** with sl
exchange for English Silver Lever Hunter Watch and
78, Viaduct-street, London, E.

Steam Tricycle, 20 minutes' notice can
miles per hour; guaranteed perfect. Offer wanted
103, Todmorden-road, Burnley.

Last of my models.—Splendid **Water W**
foot diameter, hinged floats, made for exhibition; won
ful and beautiful; no useful offer refused.—JOSEPH
low, Ireland.

Banjo.—A good-toned, 7 string Banjo,
worth about £1. Offers requested; Violin or Piccolo
W., 39, Tasman-road, S.W.

Wanted, small steam jacketed **Copper Boil**
with outlet tap at bottom; good exchange.—T. A.
House, Warrington.

Large new **Silver-Plated Teapot,** 2
Silver Eardrops, Silver Albert; for Campbell's Melo
scope, Grocery, or other offers.—MALIN, Stretton Stop

A single **Gun,** 2½in. Achromatic Telesco
father's Clock, perfect timekeeper; 6 Vols., XX.-XXV
MECHANIC, bound. Offers requested.—MALIN,
Rugby.

Electro-Magnetic Machine, in mah
up box. 1 ditto ditto superior Machine, with all applia
nut box; 2 powerful Motors, Siemens armatures.—Add

Electro Motor, by Cuttriss, Leeds;
Medical Coil, nickel-plated; 2½in. Induction Coils,
duction Coil, 2 pairs of Telephones, 2 Electric Bells.

Half H.-P. **Horizontal Engine,** very su
½-gall. Bichromate Bottle Battery, strong double
offers for any of the above articles.—H. CARTER,
Uttoxeter.

Water Motors. Exchange. What
Thirlmere Motor, cost £5; Empress Motor,
or slide-rest wanted.—THOMAS WHEELER,

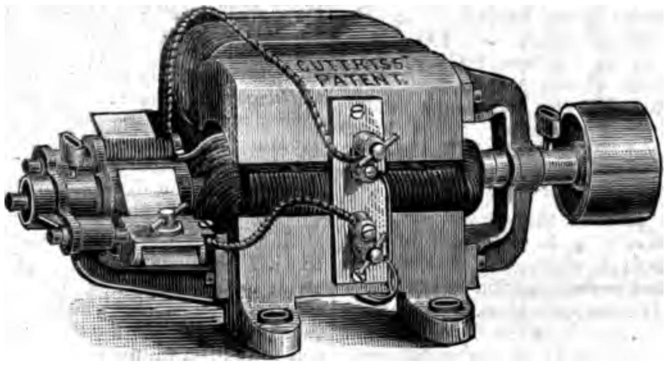
as trade secrets, and accordingly, in his article on the microscope in the *Penny Cyclopædia*, he does not mention them, giving only the earlier construction of my article in the "Transactions" (Royal Society). The same is given afterwards in the treatise which J. Quekett asked at the point of it publication to dedicate to me! And I did not feel required to disclose A. Ross's secrets. After a while I intrusted, with his consent—James Smith (1840)—to execute the same construction for inch and half-inch glasses. Even in 1843 it was with the understanding he should not go to deeper powers than the ¼in., and so Smith's "quarters" were long in repute. In these projections the endeavour was to keep the angle of pencil at each surface as moderate as was consistent with the other essentials, and by degrees the pencil has been enlarged beyond my expectation."

A learned professor thus graphically eulogised Mr. Lister: "He was the pillar and source of all the microscopy of the age."

In the next article further allusions will be made to the great microscopical wave of research which permeated the English circles.

CUTTRISS AND CO.'S "ECLIPSE" DYNAMO.

THE dynamo shown in the annexed illustration is one of the improved forms introduced by Messrs. Cuttriss and Co., of Leeds, as a modification of their small student and laboratory machine. The core of the armature is of the laminated type, and the shaft of steel works in long gun-metal bearings. The construction throughout is as simple as can be in such machines, and there is no part that a mechanic of average intelligence would fail to understand or repair. The "Eclipse" dynamos are made in three sizes, all shunt wound, unless specially ordered, and are rated to light in regular work 6, 12, or 20 20-candle lamps, with respectively 3-4, 1½, or 2¼ h.-p. These three sizes weigh respectively 40, 87, and 140lb., and the speed required is 2,000, 1,800, and 1,600 revolutions per minute. The brushes are kept up to their work by spiral springs, with just sufficient pressure to insure good contact, and sparking being entirely suppressed the wear is inappreciable. The use of the laminated core prevents the armature from being unduly heated, and enables the machine to be run continuously, thus rendering it suitable for small installations of the electric light, where power is available. The general design of the dynamo is shown by the engraving.



MOULDING.—VI.*

BY SAND RAT.

A few Practical Hints for the Apprentice Moulder.

1. REMEMBER that moulding sand contains gases, which is caused very much by putting horsedung and coaldust in, and is brought off by venting when the metal is poured into the mould.

2. A green-sand mould ought never to be very hard on the face, for if it is hard on the face it is almost sure to boil, and cause the casting to scab on the face.

3. Never allow the rammer to touch the pattern when ramming, or it will cause a loose scab, and leave a hollow place in the casting.

4. In ramming a large mould never ram nearer than 1in. from the pattern with the pin rammer, and 2in. with flat rammer.

5. Never use the water-can too much when you are mixing sand, as much water makes the iron boil and become full of air-bubbles.

6. Never put more sand in one ramming than you can; and make solid all through, for if not properly rammed it will strain and be lumpy on the face. When putting fresh facing sand, ram lightly all along before putting the sand up.

7. Never use 2in. of facing sand where 1in. will do, as one is sufficient for most purposes, especially for small work.

8. A mould requires ramming much harder a few inches from the pattern than it does near the pattern.

9. A mould requires ramming much harder on the outside than on the inside, as the outside has much more space to strain than the inside.

10. The more ramming that is required about a mould, it will naturally require much more venting.

11. Where the mould is a great depth and the floor not very good, it is wise to lay plates a few inches below the bottom of the pattern, laid on the edge to keep the metal from bursting out, as the strain is in proportion to the depth of the mould.

12. All brackets and green-sand cores should be well vented and very well ironed.

13. Always use stronger sand to the lower part of the mould than to the upper part; also stronger sand to a large mould than to a small job, and gates in proportion to the size of the mould.

14. Always contrive, where it is possible, to work in cold sand, as the moulds are safer cold than hot, and where it is convenient to have a coke bed, it is wise to have one with good vent-pipes to bring off the air and steam from the bottom of mould.

15. There is less gas in old sand than in new sand, the new containing coal dust and horsedung.

16. Never use the swab more than is required, as it often causes a mould to blow, or scab.

17. Sprig all fine and awkward places to keep the metal from washing them afloat.

18. Never plaster sand on the mould without first cutting it up; it is wise to cut up all bad places, and put the sand on with the hand, and scrape off with a straight strip, also venting with a needle wire before slaking the mould.

19. Never smooth a mould more than is required, as much smoothing causes it to scab by closing up the pores, and not allowing the air to come off the face of the mould.

20. For cistern plates or anything having a large surface, and being thin metal, the sand ought to be rather drier and much weaker than for a large body of metal: it will be much sounder and free from blowholes, and will not be so liable to be cold-shot.

21. Always be sure to twist the top part the way of the sun, it being a rule among the moulders, so that if one moulder rams a mould, another moulder would, of course, twist sunways; also do not be afraid of gagering or using a few sprigs, as it will save many moulds from dropping to pieces.

22. Never allow the gagers to stand up so much above the bars, as there is great danger of them getting knocked. When there is a deep lift, have as many hook-gagers on the top of the box-bars as you can, as they cannot give way without the bar going too.

23. When making a runner, always keep it clean, and swab round the edge of runner, and never pour the metal straight down the gate, as it throws great strain on, and more than is required; pour on one side of gate.

24. Never have a running gate higher than is required, as it increases the strain the higher the runner is, and takes much more weight than when the runner is kept low down.

25. Always leave the castings in the sand all night, as by doing so they are much cleaner than when got out red-hot: also, where the casting is much thicker in one place than the other, such as a flywheel with the arms cast in the rim, it ought to be bored and left exposed, so that the contraction will be more equal. Often they fly through unequal contraction, the rim keeping hot after the arms are cold.

26. One of the best things for an apprentice to do is to keep on a good footing with the men in the shop, and not be too large to be shown or told anything, as experience makes fools wise. I believe, also, in the old proverb, "If a job is worth doing, it is worth doing well."

27. Dry-sand moulds do not require so much venting or ironing as green-sand, and are not so liable to scab; but they require blacking with wet blacking and slaking.

28. There is less gas in dry sand than green sand; and if the mould is dry, the castings are stronger and much cleaner, and can be cast on the end with safety. Cylinders, rolls, shafting, or anything wanting to be very strong and clean, ought to be cast in dry sand on the end, having a large head cast on for feeding and for a receiver for all scum and dirt to rise into, as the dirt in the metal rises to the top, and often causes unsound castings when there is no feeding head on top.

29. It is wise to sleek all joints along the pattern down a little, so that when the mould is put together it will not crush on the edge of joint, especially in dry sand, as it is often [illegible] a fin before a crush, for there has been plenty of castings turned out wasters through the joints standing up a little.

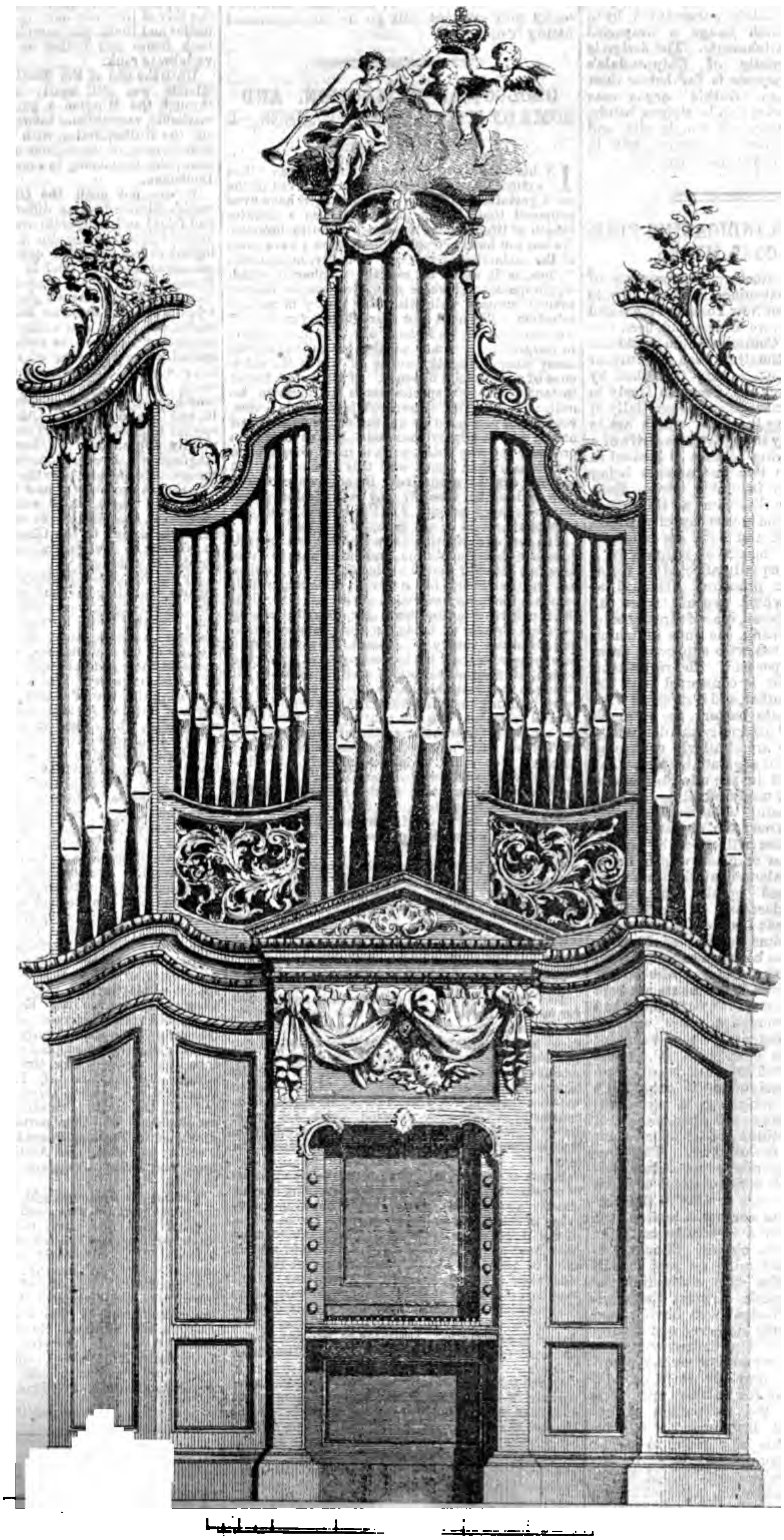
30. Dry-sand, the same as green-sand mixture, depends on what sand you have to mix it out of. Some sand is very close, and requires opening by having horsedung and coaldust in. Other sand is too open, and requires clay mixing with it to keep it together. Too much clay will make it crack very much.

31. In reckoning the weight of castings reckon the length by the breadth, then by 3[illegible] cast iron, as, for instance, a plate 3ft. long, 1[illegible] broad, and 1in. thick, will be about 1cwt. or a cubic foot would be about 4cwt. In circular plates the weight is much different. A circular foot is 29·405lb.; by taking 30lb. is near enough when we consider the strain that is always thrown on plates: the larger the plate the greater the strain, so that instead of a plate [illegible] diameter being 735·13, it will be about 75[illegible] that instead of reckoning on the circular principle, we can say 5 by 5 is 25 by 30lb. instead of 37lb., as for square metal, it will save much measuring, and will be near enough, as we are never sure of a run out, or that something may not happen we do not expect.

32. One very important thing is never to trust your life under a box when it is hanging in the crane, as there is always danger of a chain breaking, which will sometimes happen when least expected. Sometimes a chain will lift five tons and then break with three tons. Let the box be logged up or have it resting on tressels, while repairing the mould, which is very commonly required in jobbing moulding.

A VILLAGE CHURCH ORGAN CHIPPEND[illegible]

"THIS organ," says its [illegible] a small church"; [illegible] sure about the cupids on a crown as a finish to the [illegible] "if the ornaments on the



CHURCH OR BY CHIPPENDALE.

be disapproved, they may be omitted." On plan the case is canted forward, with a projected bay in the middle surmounted by a pediment, under which hangs a draperied swag, with cherub enrichments. The design is essentially characteristic of Chippendale's work, and in many respects is far better than the regulation modern "Gothic" organ case with the pipes in harlequinade stripes, bands, and zigzags. Here they are simply gilt, and the cabinetmaker's part is carried out in mahogany. A scale of feet is given.

APPARATUS FOR INDICATING FIRE-DAMP IN COAL-MINES.

A METHOD of indicating the presence of fire-damp in coal-mines has been devised by Mr. H. G. Carleton, of New York, and plans and full descriptions have, we understand, been forwarded to the Royal Commission on Accidents in Mines, with an intimation that any further explanation will be cheerfully furnished by Mr. Carleton, who gives the invention freely to the world. The apparatus consists essentially of one or more indicating balances, which are to be placed permanently in a goaf or a drift of a mine, while a registering balance is located in the testing-room, the two instruments being connected by properly insulated wires. Each balance holds in equilibrium a thin glass vessel of about 300 cubic inches capacity, which is hermetically sealed, and both are balanced at the same time by means of weights in a scale-pan, so as to be equally affected by variations of atmospheric pressure. Attached to the vertical index, which depends from the centre of the balance beam, is a soft iron needle, gilded to prevent rusting, the ends of which enter coils of insulated wire supported from the pillar near its upper end. The right-hand coil of one instrument is connected with the right-hand coil of the other, and is supplied with current from a separate battery, the strength of which can be varied gradually and delicately. The left-hand helices are similarly connected together and with their separate battery. The apparatus to be located in the mine is inclosed in a case of marble or unglazed tiling, and has a little holder containing chloride of calcium to keep the interior free from moisture. The principle of the device will now be understood. The two bulbs or glass vessels being equal in bulk and balanced at the same moment will be affected equally in weight by an increase or decrease of atmospheric pressure. The right-hand coil on each instrument will exert the same amount of force on its responsive needle, as both are supplied from the one battery, and the same applies to the left-hand coils. As both instruments are kept in an atmosphere of constant temperature and equal hygrometric condition, they will be sensitive only to a change in the pressure of that atmosphere or a change in its atomic weight. The bulbs are filled with pure hydrogen to lessen their weight, as it were, and a balance capable of weighing to one-tenth of a grain will give the percentage of marsh gas to one-third of 1 per cent., which is sufficient in practice. The free end of the vertical needle or index has a platinum tip, which makes contact with an insulated screw, and keeps a relay in the testing-room closed. When contact is broken (the spark is prevented by a resistance coil) the relay throws a bell into circuit. Should fire-damp accumulate in the mine or goaf it will find its way into the case containing the balance and immediately disturb the equilibrium, and the two instruments having been graduated together, the observer can readily ascertain whether the distant instrument comes to equilibrium with a weaker or stronger current than his own, and by shifting rider weights on the arm of his balance until it is brought into poise, the percentage of fire-damp in the distant instrument is at once calculated. The effects of a rising or falling barometer are also promptly indicated by the apparatus, which, as will be understood, can be arranged so as to disclose the presence of carbonic acid in excess—in fact, it will indicate any change in the composition or pressure of the atmosphere. The Carleton fire-damp indicator certainly appears to be a more promising device than some of those which have been suggested; but it remains to be seen how it acts when tested practically, and after that how many mine-owners will go to the expense of fitting it up.

GEOLOGICAL EXTINCTION, AND SOME OF ITS APPARENT CAUSES.—I.

By A. S. PACKARD.*

IN his "Origin of Species," Darwin says: "The extinction of species has been involved in the most gratuitous mystery. Some authors have even supposed that, as the individual has a definite length of life, so have species a definite duration. No one can have marvelled more than I have done at the extinction of species." Finally, he remarks, "Thus, as it seems to me, the manner in which single species and whole groups of species become extinct accords well with the theory of natural selection. We need not marvel at extinction; if we must marvel, let it be at our own presumption in imagining for a moment that we understand the many complex contingencies on which the existence of each species depends. If we forget for an instant that each species tends to increase inordinately, and that some check is always in action, yet seldom perceived by us, the whole economy of nature will be utterly obscured. Whenever we can precisely say why this species is more abundant in individuals than that; why this species and not another can be naturalised in a given country; then, and not till then, we may justly feel surprised why we cannot account for the extinction of any particular species or any group of species."

The fact of extinction is indeed not less marvellous than that of evolution, and one cannot in these days feel satisfied that the solution of the problem lies in the theory of natural selection, which accounts for the preservation of species rather than their origin or extinction. Mr. Darwin having been the means of bringing many naturalists to believe in the theory of descent, they are not to lie supinely on their backs, resting securely on the dogma of natural selection and cease from all attempts to investigate the cause of evolution, to cease building a foundation for the working of natural selection. On the contrary, the search for the causes of the transformation of species will be carried on with more energy, thoroughness, and success. The clues which we already have discovered will be followed up, and finally we shall, by means of observation in the field and experiment in the laboratory, wrest from nature the secrets of life and its origin, and of the phenomena of death and extinction, not only of species but of orders.

Extinction may be both slow and rapid, the causes of each becoming primarily dependent on slow or rapid changes in the environment. The object of this article is to endeavour to show that the extinction of species is intimately connected with geological changes. It is a meagre sketch or outline of the more salient facts and laws which appear to us to immediately bear upon this intricate and difficult subject.

In Palæozoic times the climate of the globe was far more uniform than now. The continents of the present day were then of much less extent, in fact archipelagoes rather than continents; the land-surfaces were of moderate height, and mountain ranges smaller and lower. While the land masses or embryo continents of the eastern western hemispheres were more or less independent centres of evolutionary creation, there was on the whole a great uniformity of plant and animal life. Species were perhaps more cosmopolitan than now.

When at the end of the Coal period the process of continent making and mountain building became greatly accelerated, resulting in that stupendous crisis in American geological history, the upheaval of the Appalachian mountain system, there must have been some degree of differentiation or setting aside of portions of the then continent into distinct areas or basins bounded by mountains, inland seas, and rivers, and some slight subdivision into local faunas. We know that there was a distinct coal basin, or series of them, for example, in Arctic America, another in North-eastern United States, and in the Central States of the Upper Mississippi Valley.

Other crises, extending over comparatively brief periods of geological time, however long when measured by centuries, were the elevation of the Rocky Mountains, of the Wasatch, the Uintah ranges, the Sierra Nevada, and Cascade ranges; and, meanwhile, the union of the Atlantic moiety and the Pacific moiety of our continent into a continuous land-mass. These periods of activity, signalised by extensive volcanic outpourings and great changes in the relative distribution of land and sea, must have been, as palæontology shows, periods of rapid extinction as well as of reparation or recreation. Progress in continent making was accompanied by progress and an onward sweep in the tide of life, not only in animals with jointed bodies and limbs, but more especially in those with back bones and brains to correspond with their vertebrate rank.

Until the end of the Tertiary period the earth's climate was still nearly uniform. There was through the Miocene a general, indeed most remarkable, resemblance between the flora of Europe and the United States, with that of Greenland and Spitzbergen, or the regions now lying in the frigid zone; this flora being in some respects like that of Louisiana.

It was not until the Glacial epoch that the earth's climate became differentiated into tropical and frigid and temperate zones. That great geological crisis, whether due to astronomical or geological causes, or both combined, by which over enormous tracts of land in Northern and Central Europe, and North Eastern America a frigid climate, with continental glaciers, was spread—that crisis produced results on the life of the glaciated region which we can easily appreciate. The extinction of life over the stated areas became widespread. The incoming of the Ice age also must have induced extensive migrations to the southward. As the glaciers melted, and the climate ameliorated, fresh migrations from the south set in, and thus in the early Quaternary period, when species were exterminated on a vast scale by causes readily appreciable, we have set before us, in a language which every one can translate, some of the geological causes of extinction, modification and consequent evolution of new forms.

We will begin, then, with a reference to the changes in the life of the northern and southern hemispheres due to the Glacial period. They are so familiar to the general reader that they need not detain us long.

By the end of the Tertiary period the northern regions, including the land around the North Pole viz., Spitzbergen, Novaya-Zemlya, Siberia, Greenland, together with Northern Europe and North Eastern America, must have abounded in life. Forests of trees, deciduous, evergreen, and palmaceous, in their general appearance resembling those of Louisiana, spread like a mantle over the land bordering the vast Tertiary lakes, and sheltering herds of herbivorous mammals, such as deer, oxen, mammoths, which were attended by packs of dogs or by solitary secretive cats prowling through the forest glades, waging war on the weak and defenceless or scattered ruminants.

This rich assemblage of mammalian life, with countless species of insects and other invertebrate organisms, land, fresh-water, and marine, was swept away. A large proportion died outright, perhaps a larger proportion migrated southward: a very small percentage survived. The mammoth and mastodon lived on, adapted themselves to the great change of climate but just as the ice had passed away and the climate had ameliorated, and when the conditions of life seemed more favourable they succumbed. The arctic bear, fox, lemming, and hare, with the white ptarmigan and snowy owl, by adaptation to a snow-clad land survived, so to speak the change, or rather, they are the descendants of species so plastic that they became modified, and adapted to an arctic life. Even man, who appeared in the old world before or about the time of the incoming of the ice, not only followed the retreat of the glaciers, but adopted a strange sort of existance in a region where the climate has a mean annual temperature of less than 32deg. F. Wherever the Eskimo lived he found the walrus and seal, the modified relatives of the sea lions and sea elephants of other parts of the world. The profusion of Tertiary insect life was succeeded by a scanty assemblage of Arctic butterflies, moths, bees, and other stragglers from the temperate regions.

The forests died outright, and where Sequoia the sweet gum, the palm, and other luxuriant semi-tropical trees flourished, now grow the dwarfed birch, willows, and low herbs of alpine and arctic barrens. It is sufficiently manifest that the circumpolar flora and fauna are the dwarfed or otherwise modified descendants of the Pliocene-Tertiary life of the same regions. Again, peculiarities in the distribution of plants and animals in North America and Northern Eurasia indicate strongly that there was an extensive migration southward down the Atlantic and Pacific borders of the continents as the glacial cold crept over the once populous circumpolar regions.

(*To be continued.*)

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* From the *American Naturalist.*

PTOMAINES AND LEUCOMAIN

THE physiological
putrefying mea
Gautier by extracting
them according to t
form, and amylic
by digesting with

rapid action of the heart, injection of the upefaction and contraction of the pupil in The chloroform extractives accelerated dly the respiration, and slightly the action heart, and also injected the concha; the ms disappeared in fifty minutes in a dog of n size. The amylic alcohol alkaloids parahe movements of frogs, dilated the pupil, lled with general relaxation of the muscles. ptomaines are more dangerous than their nd especially those that are soluble in ether. tion of the pupil, tetanic convulsions soon ed by muscular flaccidity, slowness of the action, absolute loss of cutaneous sensiand loss of muscular contraction were the henomena observed in frogs. Irregularity in contraction of the pupil, remarkable on of the concha of the ears due to vasoparalysis, slow respiration, somnolence led by convulsions and death, and loss of lar contractility were the main effects within dogs. For a long time M. Gautier has l that the alkaloids of putrefaction vary ing to the nature of the soil in which e developed. MM. Brouardel and Boutmy onsidered that they varied also according time at which the bacterial fermentation

Further, M. Gautier has noted that, whate the nature of the soil, the compound hydroalkaloids, and especially hydrocollidine, are in a constant manner, and appear to be the e products of bacteria that have most y, and suffocate all the other kinds. Turning omaines, M. Gautier in 1881 announced that cretions of animals contained bodies of the of ptomaines. If the elimination of these aines were diminished by any of their ry routes of exit, it is not improbable, in M. r's view, that they might lead to disease. the object of confirming his preliminary ations he has studied the muscular juice of nimals, and has extracted five new alkaloids, tly defined and crystallised, endowed with a r less powerful action on the nervous centres, g sleep, fatigue, even vomiting and ion, after the fashion of the alkaloids of , but less actively than the cadaveric

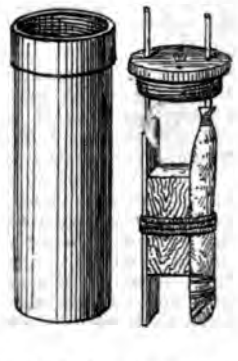
He appears also to have shown that alkaloids are produced side by side with ic acid and urea in the ordinary metabolic y of the tissues. It remains to consider by mechanism these alkaloids are produced; er they are engendered by physiological or ogical decomposition; what is the conseof their incessant formation in the ay; what happens to them, and how we from their evil effects. Thanks to the tion and to the circulation of the blood, is able to penetrate everywhere in the l organism; it does not follow, however, that ccessive phenomena of assimilation and dissation of tissues in animal life are essentially —in other words, oxidative. M. Gautier ours to prove, on the contrary, that many of nsformations in the tissues of higher animals aerobic. The mode in which we resist the of the alkaloids formed in our tissues is d—elimination and destruction by oxygen. ation is effected by the kidneys, alimentary and skin; oxidisation is probably chiefly d in the circulating blood. Any cause that ishes the access of air to the blood, or causes ease in the amount of hæmoglobin in the as in chlorosis and anæmia), or the introducto the blood of substances that prevent the tory changes, leads to the accumulation of d substances of the nature of ptomaines and aines.—*Lancet.*

TABLE CHLORIDE OF SILVER BATTERY.

EW form of chloride of silver battery has been devised by Mr. J. A. Barrett, of New which has many features to recommend it, portability is a prime requisite.

bottles which hold the fluid and inclose the its are of hard rubber, 3in. long and 1in. in ter (see Fig.) A plate of hard rubber has ts upper surface rows of projecting studs, ponding to the number of cells of the battery. e under side of this plate are permanently ed plugs or stoppers of hard rubber which the caps of the battery cells. These plugs e mouths of the bottles are provided with ponding threads, so that each bottle may be y screwed to its cap, or removed from it, withterfering with the others.

metallic elements of the battery are zinc and de of silver. These are connected in order to uds, which form the terminals of the suc- [illegible] up through [illegible] screwed [illegible] is whole. On this plate are stamped the number of the studs in the order in which the connections of the battery are made. The current reverser is located in the cover of the box, and to this are attached two silk-covered conducting cords, terminating in hollow plugs which fit over the tips of the studs. By means of these cords and plugs any number of cells may be selected from the battery. The current reverser is also provided with two split binding posts for attaching the cords which conduct to the electrodes. By constructing the battery in the manner thus described, the following objects have been attained,



which, it is claimed, place the apparatus above any other portable galvanic battery offered to the electrical public and the medical profession. The power to furnish the required quantity of electricity is stored up in the stable and insoluble compound, chloride of silver, and so long as the smallest portion of this remains upon the silver plate the chemical relation of the elements remains unchanged, and the electromotive force of the battery undiminished. The quantity and quality of current, which the battery will give after six months' or a year's service—in fact, up to the time when the metallic elements are entirely reduced—are found to be the same as when the battery is first used.

SCIENTIFIC SOCIETIES.

WESTERN MICROSCOPICAL CLUB.

THE members of this club and their friends assembled on Monday week last at 17, Pembridge-square, in response to the kind invitation of Professor and Miss Gladstone. Professor Gladstone had prepared a number of exhibits to illustrate the subject of the evening, which was entitled "The Growth of Crystals of Gold, Silver, Copper, Tin, and other Metals." Beneath a score of microscopes, brought by the members, could be seen shooting out, as if from space, though really from a clear drop of liquid, brilliant crystals of solid metal, which grew and increased as one looked at them.

Dr. Gladstone gave a short explanation to the following effect:—All the growing crystals of metals thus seen growing under the different microscopes are due to the replacement of one metal in a salt by another, which is more electro-positive. Thus, if a piece of metallic copper be put into a solution of nitrate of silver, the nitric element will combine with the copper, dissolving it and at the same time leaving the silver in a solid form upon the surface of the copper. Upon the first particles deposited will be added fresh particles of silver, in a crystalline condition, stretching far into the liquid, and growing by what must be an electrolytic process. This silver will be black or white in colour, and it assumes the form of moss, fern-leaves, series of superposed hexagonal plates, or solid crystalline knobs, according to the strength of the solution. In a similar manner, gold, in the terchloride, may be replaced by zinc; the gold (which may be of black, green, purple, or yellow colour) appearing as a compact metallic outgrowth branching out into tree-like fronds. Tin is also readily displaced by zinc, appearing either as a *cheval de frise* or a rectangular arrangement of spears. Copper appears as either black, chocolate colour, or red, according to circumstances. Bismuth affects the form of long black fringes. Lead gives the appearance of leafy branches of trees; thallium of a thicket of thorns. These forms can be produced by voltaic decomposition, and examples were shown of silver crystallised upon a plate of silver from fused chloride of silver by thermo-electric action. The same kind of replacement must also often occur in nature. Thus, native silver presents much the same crystalline aspect as in the specimens exhibited; but it occurs sometimes in non-crystalline threads twisted in every direction. form can be artificially produced by desing the nitrate by suboxide of copper; there are then seen to shoot forth silver threads of the form of Jove's thunderbolts, or still more irregular in appearance; on closer inspection these are seen to consist usually of straight lines which suddenly diverge at an angle of 120°, but sometimes they are actually curved lines. The usual thickness of these threads is about $\frac{1}{25000}$in., but they are often much finer. It would be very interesting to trace the changes that take place in the salt during these replacements, and to endeavour to form an idea of the process by which these crystals are silently built up. The whole subject offers many points of investigation for any experimenter.

A cordial vote of thanks, moved by Prof. C. Stewart and seconded by Mr. H. Virtue Tebbs, was unanimously tendered to Dr. Gladstone for a thoroughly sociable and interesting evening.

The hon. secretary, Mr. A. W. Stokes, F.C.S., announced that the next meeting of the club will take place on Monday evening, March 1st, when Mr. Henry Walker, F.G.S., will entertain the club and introduce the subject of "Coal: its Origin and Microscopical Structure."

LIVERPOOL MICROSCOPICAL SOCIETY.

THE second ordinary meeting was held at the Royal Institution, Colquitt-street, last week, the president, Rev. Henry H. Higgins, M.A, in the chair. Mr. Thomas Higgin, F.L.S., presented to the society his camera for photographing microscopic objects, with heliostat and other apparatus, and explained his method of using them.

The paper of the evening was read by Mr. Isaac C. Thompson, F.R.M.S. (hon. sec. of the society), entitled "The Copepoda of Liverpool Bay, obtained during the summer dredging expeditions." Mr. Thompson commenced by expressing the debt of gratitude owed by all local biologists to Prof. Herdman for his systematic and successful attempt to work out and classify the marine life of our neighbouring shores, the first report of which was in the press and very shortly to be published. The task of collecting and examining the material obtained was divided among a considerable number of workers, and it had fallen to his (Mr. Thompson's) lot to work out a class large in point of numbers but very microscopical in size—the Copepoda, one of the branches of the crustacea. The specimens were obtained mostly by tow-net during the several summer excursions, chiefly on the *Hyæna*, and during several excursions to Hilbre Island, and from material collected by Prof. Herdman at the Isle of Man. To show the profusion of these minute crustaceans throughout the seas, Mr. Thompson stated that the ocean near the Arctic regions is sometimes found to be of an almost red colour, from the abundance of one large species of Copepoda—the *Calanus finmarchicus*, which is known to constitute an important part of the food of the whale, and must therefore exist in prodigious quantities. Indeed the presence of Copepoda throughout the sea seems almost universal, and they are one of the many forms of life that give rise to the phenomena of phosphorescence. They vary in size from 1-30th to $\frac{1}{2}$in. in length in different species, 1-10in. being about the average size, and appear to be equally plentiful on a fine or stormy day. Mr. Thompson proceeded to describe the means adopted for permanently preserving and mounting the specimens of the various species obtained, many of which were shown upon the screen from carefully-prepared drawings by the aid of the oxy-hydrogen lantern. Amongst the latter the nauplius or larval condition was shown and its metamorphosis traced out, the embryological development throughout the crustacea being very remarkable. The paper concluded by commending the study of these and allied forms to the members as affording a continual feast of surpassing interest and instruction to the microscopist and lover of nature.

Music Stave Ruler.—Mr. Jabez Francis, of Rochford, Essex, has just brought out a new music stave ruling machine, which is certainly an improvement on the old form of pen. It consists of a roller with five ridges, which rub against a pad of felt saturated with ink, and transfer the ink to paper over which the "pen" is drawn. The machine works in both directions, and is not likely to get out of order, while the only thing that will probably require renewal is the little bit of felt which forms the ink pad. We have tried this device, and found no difficulty in ruling music staves. It will, no doubt, supersede the old music-ruling pen.

Electric Apparatus Company (Limited) v. St. George.—In this case evidence was given recently, according to the *City Press* of Jan. 27, that the defendant, Mr. A. F. St. George, carried on his business as an electrician at 85, Chancery-lane, and employed three men. An order was thereupon made for committal to prison for 10 days.

SCIENTIFIC NEWS.

THE death is announced at St. Gall of the distinguished naturalist, Nikolaus Friedrick von Tschudi, author of the "Thierleben der Alpenwelt," at the age of sixty-five.

Dr. Oscar Schmidt, professor of Zoology in the University of Strasburg, died recently at the age of sixty-two.

The first report on the fauna of Liverpool Bay and neighbouring seas will probably be issued during the present month. The papers, which are written by members of the Liverpool Marine Biology Committee, will occupy about 300 pages, with a map and several plates. The work is edited by Prof. Herdman, D.Sc.

An appeal is being made to the Fellows of the Royal Society and other friends of science to increase the capital of the fund which the Society administers for the benefit of scientific men in necessitous circumstances. Sir William Armstrong has promised a sum of £6,500 on certain conditions, the principal of which is that an equal amount is raised by others who are interested in science. The fund at present is quite inadequate to the demands upon it.

Prof. D. E. Hughes, as president of the Society of Telegraph Engineers and Electricians, delivered a characteristic address—that is, instead of being a réchauffé, it took the form of an important contribution to science, with the title of "The Self-Induction of an Electric Current in Relation to the Nature and Form of its Conductor." Prof. Hughes said that he preferred that form in order that the members might discuss the subject and disclose any new facts in their possession. We shall probably refer at length to this remarkable paper; but, meantime, we may mention that Prof. Hughes considers a solid rod of iron as the worst possible form of lightning conductor. If the conductor is of copper, it should have the form of a ribbon; if of iron, it should consist of numerous stranded wires or a wide ribbon.

At a meeting of the Dundee Mechanical Society, Prof. Ewing, of the University College in that city, exhibited the model of the high-speed friction driving gear invented by himself and the late Prof. Fleeming Jenkin, which was shown at the Inventions. This gear gives great range of multiplication or reduction of speed in a small compass. Mr. G. C. Douglas, of the Douglas Foundry, also read a paper on "The Explosion of Gases and the Rates of Cooling of Various Mixtures of Coal-Gas and Air." He stated that he had obtained diagrams with ratios of gas to air varying from one-tenth to one-thirtieth. A two-chamber eudiometer was used, the one chamber being separated from the other by means of a diaphragm of oiled paper, which was broken through by the explosion of the gas and air in the adjacent chamber, when the mixture was ignited by the electric spark. An indicator moved by clockwork at a uniform speed gave a diagram showing the rate of cooling. He stated that, so far as he knew, he was the first who had investigated the rate of cooling of such dilute ratios.

At a recent meeting of the Ophthalmological Society attention was drawn to the risk of injury to health run by workers with bisulphide of carbon. Mr. Marcus Gunn brought forward a man suffering from toxic amblyopia due to the action of bisulphide of carbon, which he used in preparing oil from coker-nuts. He had worked at the same occupation for fourteen years, but about sixteen months ago he changed his situation, and four months later the symptoms of illness began; the ventilation of the workshop was defective, and no doubt was a cause of the development of symptoms. There was complete red-green blindness, which might have been congenital, but probably was not. Jaeger 19 was the smallest he could read. There had been no improvement even in four months.

The National Fish Culture Association are making extensive preparations at Delaford Park for receiving the fry which are being reared in great numbers at South Kensington. The fish reared there last year will soon be ready for distribution. They consist mainly of whitefish and sundry species of Salmonidæ. The American Government have just sent to the National Fish Culture Association 2,000,000 of whitefish ova and a large quantity of Salmonidæ ova, which arrived in excellent condition. The Severn Fishery Board has also forwarded consignments of trout ova, which, on being incubated, will be placed in the Severn. The American Government have intimated their readiness to send larger supplies of ova this year in consequence of the success which attended the introduction of Transatlantic fish last year. The Marquis of Lorne has constructed special habitations in Scotland for the reception of the whitefish, which he is most anxious to acclimatise in the waters of this country. Amongst the stock of Salmonidæ at Delaford Park are the species *fario*, *ferox*, *fontinalis*, *iridens*, *sebago*, and *trutta*.

In Paris the municipal authorities get rid of snow by liquefying it with rock salt, and as soon as the traffic has mingled the salt with the snow sufficiently an army of sweepers appear, and the semi-liquefied snow is swept into the sewers. From an American scientific serial we learn that in the "business part of London" pits are provided with steam coils at the bottom, into which the snow is shovelled, and, being rapidly melted, is run through pipes into the sewers. It is a pity our contemporary does not indicate the position of those pits with a little more definiteness.

At the meeting of the San Francisco Microscopical Society on Jan. 13, the subject of "Culture Methods Used in the Study of Micro-Organisms," was introduced by Dr. C. P. Bates. After mentioning the numerous fluid and semi-fluid media employed in the culture—e.g., of bacteria, Dr. Bates referred to their respective merits, and expressed a preference for the method of Pasteur rather than for the gelatine of Dr. Koch. At the conclusion of the discourse, an animated discussion arose as to the respective merits of the "gelatine method"—introduced by Koch—and that of Pasteur, who still employs fluid media in his investigations. The advantages claimed for Koch's method will be explained and practically demonstrated at a subsequent meeting by Dr. Ferrer, who has returned from a sojourn among the principal laboratories of Europe.

The Admiralty have introduced an important alteration in the Queen's regulation with respect to patents for inventions. After citing the 27th section of the Patents, Designs, and Trade Marks Act, 1883, their lordships order that any officer or subordinate in an administrative, or a manufacturing, or an experimental department under the Admiralty, who may propose to take out a patent for any invention, shall first obtain the approval of the Lords Commissioners of the Admiralty, by application through the head of his department. A condition of such approval being granted will be that in any settlement of the terms for use by, or for, the Government of any such invention or improvement, regard is to be had by the Lords Commissioners to any facilities in working out and perfecting the invention or improvement, which the inventor may have enjoyed by reason of his official position.

Dr. Tumlirz, of Prague, has discovered that rock crystal possesses the property of retaining diamagnetisation whether the specimens show right or left-handed optical peculiarities. The axis is dependent only on the axis of initial magnetisation.

The sensophone is the rather peculiar name of a new telegraphic receiving instrument, the "phone" referring to the instrument commonly known as a "sounder." The patents are owned by the United States Electrical Company. The finger of the receiving clerk is placed upon a touch point, which delivers the message in a series of light "pricks," caused by a vibrating needle, and identical with the "taps" or "ticks" of the well-known sounder. It is stated that experts with the last-named instrument prefer the sensophone, as they can receive faster and with more accuracy than they can with the sounder. The new instrument serves a double purpose, as it acts as a sounder when the finger is removed from the touch-point. Deaf mutes can, it is thought, be trained to work the "sensophone."

THE Russian Mint will coin ten-rouble gold pieces, which, like the silver coins of full weight, will be composed of 900 parts pure metal and 100 parts copper.

LETTERS TO THE EDIT

[We do not hold ourselves responsible for the
our correspondents. The editor respectfully reque
ommunications should be drawn up as briefly as p

All communications should be addressed to the
the ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made
J. PASSMORE EDWARDS.

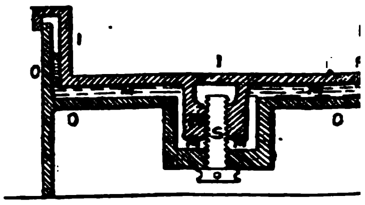
*** *In order to facilitate reference, Correspon*
speaking of any letter previously inserted, wil
mentioning the number of the Letter, as well as
which it appears.

"I would have everyone write what he kno
much as he knows, but no more; and that not i
but in all other subjects: For such a person
some particular knowledge and experience of
of such a person or such a fountain, that as to ot
knows no more than what everybody does, and
a clutter with this little pittance of his, will
to write the whole body of physicks, a vice fr
great inconveniences derive their original."—
Essays.

◆◆◆

A NEW REFLECTING ME TROUGH—CALENDAR AND MERIDES FOR THE ASTRONO AMATEUR—POLISHING ROC PRISMS—TELESCOPES: RE ING AND REFLECTING—MR. IN SOCIETY—THE 5th STAR TRAPEZIUM OF θ ORIONIS "JOURNAL" OF THE ROYAL SCOPICAL SOCIETY—A QUE THE QUEEREST—BIELA'S AND THE ANDROMEDA ME PHOTOGRAPH OF SATURN.

[25330.]—EVERYONE who has ever
mercury-trough, either to collimate a
strument with the so-called Bohnenbe
piece, or to determine his nadir point,
familiar with the worries and annoyanc
their origin in the tremors of the merc
face. In fact, it is well-nigh impossible
this simple piece of apparatus in or nea
or in a neighbourhood in which any ext
turbance or vibration whatever exis
December number of the "Bulletin
nique" of the Paris Observatory, how
tains a description and illustration, by
Mouchez, of an entirely new form of
trough, devised and constructed by M.
which, if it fulfils everything that is cl
it, should remove all difficulty in its em
Certainly, if the reflecting surface rem
quil in the Paris Observatory (surrounde
is, with streets full of cabs, omnibuses, &
reasonably be expected to do so in
locality in the slightest degree likely to b
for astronomical observations. M. Ga
paratus is shown in the subjoined figure.



Here we have two cylindrical mec
differing slightly in diameter, one upon
the lower, or outside one, *o o*, which is
of the two, containing the supply o
m m. Up through the middle of the
this lower cistern rises a stout male scr
axis. On to this screws the female
soldered on to the bottom of the secon
cistern, *i i*. This second cistern is its
with a little hole or pipe, *p*, 0·2in., or a
in aperture. When, by turning the cist
its screw *s*, we cause it to descend, the me
through this small tube, and forms the
surface, to which the telescope is direct
bottom of *i i*. A screw, *s'*, (seen at the
top corner of the figure), answers as a
closing the opening *p*, prevents the
getting into the quicksilver in the
between observations. The layer of me
introduced being drawn off by the tub
surface of the trough, is freed from
and is said to give the most b
Tremors of the ground are, it
pletely annulled by this half-flo
In order to obtain this result,
must neither work too tight n
If they work stiffly together
vert the two troughs into [illegible]

tions will obviously be transmitted, as in the ordinary form of apparatus. If, on the other hand, the screws work too loosely, so as to let cistern *i i* float freely in *o o*, then the movements of the ground will set up a series of longer and slower undulation in *i i*, and this, with its thin film of mercury, will be in a state of unstable equilibrium, and cause the reflected image to shift about. A medium condition of contact is asserted to afford the most perfect results.

I have just come across a little volume of ephemerides, which is about as well done and as suitable to the purposes of the ordinary amateur astronomer as anything that I have so far seen. It is called the "Companion to the *Observatory*," and has been issued by the editors of that well-known serial, for the current year. It would seem, from a short introduction prefixed to the book, that heretofore monthly ephemerides have appeared in the *Observatory* itself; but that it has been deemed advisable to collect them all and issue them in advance in a single volume. The result, as I began by saying, is excellent, and peculiarly adapted to the use of every possessor of a telescope. Let me illustrate this by an example or two, taken absolutely at random. First, say p. 3, February 12th. Against this date we find at a glance that it is the 43rd day of the year; that it is Friday, that as a fraction of the year it is ·1150; that the sun sets at 5h. 8m. and rises at 19h. 20m.; that the moon rises at 14h. 14m. and souths at 6h. 34m.; that the Mean Time at Apparent Noon is 0h. 14m. 27s.; and that the Sidereal Time at Mean Noon is 21h. 29m. 50s. The whole of this information is given in one single line. On the same page, too, we have the times of the moon's phases, and the dates when meteors and fireballs may be expected. This exhaustive form of calendar is followed by ephemerides of all the planets for every tenth day, with notes of their principal phenomena, and the times of their rising, southing, and setting. To take another illustration from these. The amateur has been reading about Mercury, and wishes to observe that planet on February 20th. Looking though, at the Ephemeris of Mercury against the date referred to, we find that he rises 19h. 10m., transits 0h. 4m., and sets 4h. 58m., and that hence he is, for the observer's purpose, invisible, and so on. There are tables of occultations; of the eclipses of Jupiter's Satellites, Ephemerides of those of Mars, Saturn, Uranus, and Neptune (with diagrams). Others for Physical Observations of the Sun and Jupiter, Mean Places of Variable Stars for 1886, with the dates of their maxima and minima (these tables are very complete), lists of remarkable Nebulæ and Clusters, of Stars with remarkable Spectra, and of Binary Stars; the book concluding with a list of one hundred noteworthy Double Stars, Test Objects, &c. If I say that the price of all this mass of information is one shilling, I do not think that I need add much in justification of my recommendation to every amateur observer to buy it straightway.

In connection with the paragraph in your "Scientific News" on p. 445, having reference to Prof. Langley's observations on invisible heat spectra, which, as you state, were only rendered possible by the use of the rock-salt prisms prepared by Mr. Brashear, I should really like to say half a dozen words on the behaviour of the last-named gentleman in this matter. He has actually succeeded in polishing so deliquescent a material as rock-salt in such an exquisite manner that the prisms worked by him out of it show the nickel line between the two D sodium ones! His method is simplicity itself, and is just of that character offering the very strongest temptation to its inventor to keep it as, what I fancy is called, a "trade secret." But Mr. Brashear is not a mere tradesman, whose sole idea is to make every dollar he can out of his own technical knowledge. He is a true man of science, whose first thought is for its furtherance, and he has communicated the whole of the details of his process to the American Association for the Advancement of Science for the benefit of anybody and everybody who may have occasion to repeat the construction in which he has so splendidly succeeded. Would that we had a little more of such personal disinterestedness and scientific zeal on this side of the Atlantic. But then, I fear, some of our "shopticians" might suffer. (See page 464).

It is impossible to answer query 58690 (p. 457) definitely without seeing the telescope to which it refers. It seems to me that internal reflection in the object-glass (if its component lenses have got shifted) might produce the effect complained of. I never remember an instance of internal reflection in the case of an ordinary four-lens terrestrial eyepiece, although it is far from uncommon—in the annoying shape of a "ghost"—in two-lens astronomical ones.

With reference to "R. [illegible]
[illegible]1 (same page), I [illegible]
[illegible] confidently. [illegible]
[illegible]rian of the [illegible]
[illegible]r's hands the [illegible]

paraboloid, and the little one a segment of an ellipsoid of revolution. No ocular inspection or even ordinary method of measurement would enable your correspondent to distinguish these surfaces from spherical ones; but from the latter they *did* differ in the directions indicated. By his polishing with rouge, "R. J. C. S." has simply hopelessly destroyed the perfect figures of his mirrors—that's all, and must send them to some skilled reflector-maker to have those figures restored. The mirrors of Gregorians aren't the bowls of silver tablespoons, to be polished up in the pantry!

Everyone interested in the progress of astronomy in this country will learn with unalloyed satisfaction from your "Scientific Notes," on p. 467, that Mr. Espin has been re-elected as special observer to the Liverpool Astronomical Society; albeit, the addendum to such announcement will set a good many people asking what on earth is "The Society of Science, Letters, and Art of London"? The association with this very pretentious title is not to be found in the exhaustive list published in "Whitaker's Almanack," and it rather looks as though it were trying to confer some vicarious honour on itself by proffering such as it can offer to a man like Mr. Espin.

With reference to what Mr. Numsen says (letter 25305) on p. 469 regarding the difficulty which he has recently experienced in seeing the 5th star in the Trapezium of θ Orionis, it may not be uninteresting if I say that I can entirely corroborate his statement as to the faintness of this object during the present apparition of Orion. It is much to be desired that rigidly accurate photometrical measures should be obtained of the 5th and 6th stars in this asterism, and repeated at intervals; in order that their periods of (unquestionable) variability may be determined. They have both pretty long periods.

Premising that I spoke of the "*seemingly* inexcusable delay" in the appearance of the title-page and index of the volume of the *Journal* of the Royal Microscopical Society, which was completed last December, I would venture to remark, in connection with letter 25329 (p. 474) that "One who Knows" would have made a much more telling reply to my inquiry had he justified his title and given us the real reason for such delay, than by the somewhat elephantine "chaff" in which he indulges. When Fellows of the R.A.S. have had occasion to complain of the needless delay in the issuing of the *Monthly Notices*, they have had, at all events, some objective reason (*quantum valeat*), given for the lateness of their appearance, such as that the printers were behindhand; that some F.R.S. who had sent in a mathematical paper was much too great a man to trouble about correcting his proof in time—and so on, and so forth. So far, however, they have not been met with suggestions (*more* "O. W. K.") that the compositors "may have" struck, that the acting editor "may have" gone to Rosherville Gardens to see the bear, or that the secretary's clerk "may have" been occupied in clearing the snow out of the quadrangle in Burlington House when he ought to have been addressing the wrappers to the Fellows. If there is any good reason why the Fellows of the Royal Microscopical Society should not have received the index and title page of Vol. V. before now, why are they not told what it is in a straightforward manner?

Query 58744 (p. 479) is not quite so intelligible as it, preferably, might be.

Query 58785 (p. 480), can scarcely be fairly answered in a paragraph; but I may shortly say that no observations have been recorded of the Biela Comet Meteors prior to 1872; but that when it was discovered that the comet had been disintegrated and had vanished (as a comet) altogether, it was predicted that its débris would probably take the form of a meteoric shower, when the earth crossed its orbit on the night of Nov. 27;—a prediction justified by the result. Presumably, "L. S." knows that astronomers altogether dispute that the shower seen by Pogson had anything to do with Biela's Comet at all.

In reply to Mr. Fenessy (query 58802, p. 480), the photograph of Saturn exhibited at the last meeting of the Royal Astronomical Society, was an albumenised paper-print from a glass negative enlarged from the original. The ball of the planet was, I should think, scarcely an eighth of an inch in diameter. Yet the detail was marvellous. Notably was the Polar capping more distinctly shown than it is usually seen in any telescope whatever. It was taken by the MM. Henry, with the 13in. photographic objective of the Paris Observatory.

A Fellow of the Royal Astronomical Society.

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57 AQUIL[illegible]—B 464.—CASSINI'S DIVI- [illegible] "[illegible]ENDA" TO "CELES- [illegible]AL O[illegible]

[illegible] [illegible]ks (letter [illegible] for [illegible] In [illegible]

connection with what Mr. Sadler says about the way in which the observations of star colours by the older observers were often made, it must be pointed out that though very important in its bearing upon certain alleged cases of variation, it is not quite relevant here, where the question is not whether two stars have been recorded as having been of certain definite colours which they have not now, but as to whether two stars which are now diverse were at one time identical. Smyth and Struve make the stars the same. Webb and others make them different: hence the suspicion of variability. Mr. Sadler's reference to the instances which, in the "E.M." for Nov. 15, 1878, he gave of occasions when the same stars had been recorded at precisely the same date as being of different tints, is hardly relevant to the observations of 57 Aquilæ which he quotes, or which are given in Webb, for the date of no single one is exactly the same as the date of any other in the list. The meaning of the observations can be better seen by tabulating them in order of date, but without reference to the precise hue recorded.

Date.	Observations.	Date.	Observations.
1781	Stars almost identical	1865·75	Stars identical
1822	Stars identical	1867·64	" "
1823	" "	1868·68	Stars different
1831	" "	1868	Slightly different
1833	" "	1869·61	Stars identical
1834	" "	1871	Stars different
1835	" "	1871	" "
1851	Stars contrasted	1872·54	Stars identical
1855	Tints entirely different	1872·69	Slightly different
1859	Stars almost identical	1875	Stars different
1861·73	Stars different	1876	" "
		1885	" "

In this table are included all the observations given in Webb, and by Mr. Sadler, as well as Mr. Franks'. It will be seen that the suspicion of variability is quite well enough founded for the pair to become the object of special observation with a view to ascertaining if such variability really exist. It will be noticed that some of the observations almost suggest that the period is but short, and as the different accounts of the colour of the larger star do not differ so very widely, when full allowance is made for personal and instrumental equation, it may be surmised that the variation, if existent, consists in the change of the smaller star from whitish to lilac or bluish. This object, and others presenting similar phenomena, will be found well worthy of observation, especially by those who do *not* think anything celestial unworthy notice unless it be a "double" which needs an 18in. to divide it, or a *comes* which requires well-nigh supernatural vision to detect it.

With reference to Mr. Sadler's suggestions as to possible reasons why Bessel did not observe B 464 (*loc. cit.*) I would like to ask two questions—first, did Bessel observe each region only once? and, second, as to Mr. Sadler's second suggestion, *did* Bessel, or *does* anyone, smoke a pipe with his eye *at* the telescope? For it seems to me that it would not tend to the improvement either of the observation or of the instrument, and would be decidedly inconvenient. As to Mr. Sadler's remark that he does not know whether Bessel was colour-blind to red, he could not have been so in the sense that he could not distinguish red, for in Birmingham it is distinctly said, under No. 277 (p. 330), "Bessel, in 1823, first remarked the striking colour of this star." My meaning in saying that I thought Bessel paid attention to red stars was mainly this: that, at the time when he observed, but little attention seems to have been in general given to them, and that notice at all might therefore be held to imply special observation. As to Mr. Sadler's reference to Karl von Littrow, does he mean that that astronomer saw Vega red, or saw Antares bluish-white? It would be very interesting to know.

Some remarks have been made in recent numbers of the "E. M." as to the possibility of seeing Cassini's division in Saturn's ring with 2in. of aperture, and one correspondent has said, "I stick to the imagination being required as well." In this connection, I would refer to an observation given on p. 13 of *Transactions* No. 2 of the Liverpool Astronomical Society, and made March 25, 1884. I can assure your sceptical correspondent that in this case there was no "imagination" at work, only a fine o.g. and splendid definition. However, in most of these cases it may be observed that the sceptics resemble those who say that the phosphorescence of the dark side of Venus has no existence—viz., they are persons who have not [illegible] to see the thing for themselves, and [illegible] make sure that no one else *can* have seen it.

[illegible] lists of "Corrigenda in Celestial Objects," published by Mr. Sadler and "Stella," in the numbers for Jan. 8 and 15 respectively, are both interesting and valuable. Certain of the corrections included in Mr. Sadler's list, however, are of such a character as to excite a desire to know the authority upon which they are made, for they amount to an alteration in the text of the work. Of course, in such matters as position-angles, distances, and similar details, corrections made by Mr. Sadler will be accepted unquestioningly; but the case is rather different when the text of the book is interfered with. When we are told to *dele* from the account of 56 Andromedæ these words, "more clearly deduced in this case from 'common proper motion' through space," we are inclined to inquire if the correction is made by Mr. Sadler in virtue of his superior knowledge, or because he has access to Mr. Webb's MSS. Then, from the notice of β Leporis, we are to *dele* the words "Most rapid bin. *Fl. 'Sun and Planet'?*" Why so? The most important instances, however, are the corrections we are instructed to make in the accounts of the Debilissima, of 61 Cygni, and of M 32 Andromedæ. As to the first of these, is the statement inaccurate, that the stars received that name from H? But even if it be so, why is the note giving Webb's explanation of the name, to be *deleted?* Is it an inaccurate explanation? Then as to 61 Cygni, why should the statement, "but probably exists" *re* the binary character of that object, be omitted? As to the correction to the account of M 32 Andromedæ, there is surely something wrong, for this is what the correction would turn the text into: "117 (M 32) is in the same field with a low power; small but bright; and Buffham's 9in. (With)." Surely, this is something like nonsense, and, therefore, *not* an improvement. A little information as to the sources of important corrections, when the work corrected is a standard authority, is advisable.

S. Maitland Baird Gemmill.

Glasgow, Feb. 4.

ASTRONOMICAL.

[25332.]—So much has been written concerning telescopes of 3in. or so of aperture, that almost everything of interest about their performance must have been said; but I am tempted to trespass on a little of "our" valuable space to give a short account of my experience with a 3½in. Wray, as possibly it may be of use to some of our younger subscribers, who generally acquire instruments of *about* this size. Saturn has been specially placed lately, and has, of course claimed a large share of attention, and in spite of indifferent observing weather, it is surprising how much detail has been brought out. Cassini's division is generally well seen all round, and the shadow of planet on rings is almost conspicuous. On a good night (and *how* scarce they are!) the delicate shading on ball is nicely shown, and once or twice the "crape ring" (which, of course, is easily seen where it crosses the disc) has just been visible in the ansæ. Of satellites, my means of identification are inadequate for exactness, but am sure of three. In double-star observation, much that is of great interest may be accomplished, providing a little patience is exercised, and good opportunities made the most of. For instance, I have nicely divided ξ Ursæ, ι Leonis, 52 Orionis, and π (Pi) Aquilæ, and have distinctly elongated ε Arietis, the close pair of ζ (zeta) Cancri, &c. On one occasion the *comes* to Delta Cygni was just discernible, I believe; but should like some confirmation of this: it appeared bright and close due N. Amongst Triples, ι Cassio. and ι Orionis are beautifully shown, and the faint component of λ Orionis just seen on a fine night (about the minimum of visibility in my telescope). Some multiple stars come out very finely, and I cannot mention a better example than that splendid group σ Orionis. With a medium power (say 100) ten stars are shown (eight well seen and two with averted vision), and the colours of some are strikingly displayed. In Theta Orionis only four stars have ever been certainly visible; but sometimes I can fancy a fifth near the brightest of the quartet. My object-glass is a credit to Wray, and I am justly proud of it; but it does seem almost to break down, when tried upon Venus against a dark sky, showing an almost gorgeous amount of "outstanding" violet: but most glasses I have tried do the same. Is this the experience of others? This letter is already too long; but I must just say that, like most students of the heavens, I continually long for "more light," and think of going in for a 6½in. Calver some day. Would some of our obliging correspondents kindly say if this would be a marked improvement on a 3½in. refractor? Twice lately I have been told (by men who know something of these matters), that, in consequence of silver-on-glass mirrors turning out disappointing, there is a tendency to revert to metal! I cannot think this; but should like to hear if there is a nucleus of truth around which the idea may have grown?

W. F. Longbottom.

Milverton, Worcester, Feb. 1.

EQUATORIAL MOUNTING, &c.

[25333.]—Je me permet d'appeler votre attention sur une nouvelle construction de monture équatorial, imaginée par M. Gustave Hermite (voir *L'Astronomie*, revue mensuelle, publiée à Paris par M. C. Flammarion, 1884, pages 384—387) et sur les miroirs en bronze phosphorique de M. Safarik (à Prague), couverts d'une conche d'argent ou de palladium par des procedés hydro-electriques (voir *Vierteljahrsschrift der Astronomischen Geselschaft*, Leipzig, 1883, l. 246—248, et 1885, 129). Ne sera-t-il pas plus avant a gent de remplacer les miroirs plans en verre argenté par de miroirs plans de M. Safarik en bronze phosphorique couverts d'argent ou de palladium, et de separer de la lunette les deux miroirs plans, qui formeront alors un appareil siderostatic, placé à quelque distance de la lunette dirigée vers le pôle nord? Comment pourra-t-on eviter les inconvénients de la rotation des images autour de l'axe optique dans le champs de la lunette fixe (voir Brünnow, "Astronomie Pratique," edition Française, publiée par C. André, 1872, pages 306, 307; la rotation de la lunette autour de l'axe optique [comme dans le "siderostatic telescope" de M. H. Grubb et les heliomètres nouveaux de M. Repsold] doit être evitée, parcequ'elle augmente excessivement les prix des instruments)?

Il me parait que les grands avantages de la monture, imaginée par M. Hermite, et des miroirs de M. Safarik, sont dignes d'un examen serieux et approfondi. Les lecteurs de ENGLISH MECHANIC n'auront ils pas le plaisir de récévoir quelques renseignements sur ces sujets si interessants?

Veuillez agréer, Monsieur, l'assurance de mes sentiments les plus distinguée.

Russie, à Smolensk, Jan. 21. **Grinenko.**

THE MUSICAL INSTRUMENTS FOR HOME.

[25334.]—Having watched with great interest the discussion which is going on in these pages on the above subject, I should like to relate my experience of the American organ. Some six years ago I determined to purchase one, and for about a month visited the various agents to choose a desirable instrument. After trying some scores of organs by all the well-known makers, I happened to hit on one made by Hunt and Co., of Boston, U.S., which, I believe, was a sample instrument, and for which I paid £32. The beauty and sweetness of its tone and the perfect action struck me at once, and I have never regretted my bargain, for such I regard it.

It has nine stops, including a remarkably good diapason, and two knee-swells. Its action now is as good as when I first bought it, although it is constantly played upon. Personally, I know nothing of the manufacturers, and have not since come across an instrument made by them.

With regard to expression, I am quite certain as much, if not more, can be produced from an American organ if properly manipulated than from an harmonium.

I believe that the longer we play an instrument we get a certain attachment for it, and consider there is none other equal to our own.

We seem to understand it, and it enters into our sympathies like an old friend.

In my opinion—and I'm sure a large number will agree with me—a good American organ will give greater pleasure in the home than any instrument we could have.

C. J. S. T.

[25335.]—Surely things that differ widely are confounded when the "orchestral organ" of Mason and Hamlin is put in comparison with the American organs by the same firm. Superb as it is, in principle it no way differs from the Mustel; the details no doubt do, but its price makes it again a white elephant. I don't think for a moment that "C. S." would, on mature thought, say that the American organ was without expression. The accentuated expression of the Mustel it has not, nor, as far as I know, claims it; but I can say this, that when I thought the automatic swell was on, my ears were deceived, and I got a very excellent expression without it, although it is an added charm to any instrument.

I should be very unwilling to say "C. S." libelled other makers because he praises an instrument that is independent of all praise. It has gained the Inventions Gold Medal, and so have Mason and Hamlin for a representative collection, and comparison with others not so honoured though they competed at their very best is invidious. Success always brings that kind of thing. Some of the makers say they can put forth as good. Let them.

"*Accepit palmam qui meruit*" is fair field and no detraction. Mason and Hamlin stand on their own incontestable and uncontested merit; they would refuse to be beaten even by the combined talent of all the inventors; but then my
opinion is only that of an "average
haps below it. I would not be satisf
catalogue description, much less a £24 i
cupboard included; nor do I swallow
logues say, nor degrade anything hu
comparison. I thought up to this tha
soul was priceless, and beyond any b
himself could make; but an appraisem
than £24 is scorning his birthright, and
thing he produces worth more than hi
used to be that the masculine was mo
than the feminine, and the feminine
neuter; but it is reversed. In Switze
say "the hen is, of the two, the best
that won't do here, where the cock is a
notwithstanding the average, one cock
as another, though companionship is
mark.

Henry Ussher, B.A., M.B.,

THE DIVISION PLATE,

[25336.]—"O. V.'s" objection to
mandrel is not too deep, the square or an
nullifying it; that is the plan I should
self. I hope this about the division
further interest him and others, as I thi
tolerably well worked out the multiplyi
tion.

The index he mentions is practically a
my first plate; but the original idea
was that the circles could be used to m
another, so long as they do not divide o
when the multiplication is already done,
should never be the case.

The capacity of multiplication may
trated by a plate of 7 circles, numbers
holes, which will cut a wheel of 8,648,64
any number that will evenly divide it
dividing one segment in each circle
numbers the capacity is squared, 133 h
a maximum of some 74 billions odd, a
likely to be required, and that would
time to cut.

A good all-round plate would be on
13, and 17 and 19, one segment each sub-
their own number, and with two pawls
about a tangent from the one trans
standing over the plate, the holes in bot
and circles starting from one radius. S
gear by fives from pinion to 110, and
200, with the odd fives 135, 165, 175,
cut; if fives to 150 are wanted, two c
and 29 are required, and two segments
require sub-dividing into 25, or 12½ ea
= 115, 25 (seg. of $\frac{10}{2}$) × 5 = 125, 29 × 5
In the first century there are only s
wheels that cannot be cut, not countin
of smaller numbers. They are:—23, 29,
43 (23 × 2 = 46), 47, 53 (29 × 2 = 58
= 23 × 3), 71, 73 (74 = 37 × 2), 79 (82 =
83 (86 = 43 × 2) (87 = 29 × 3), 89 (92
(93 = 31 × 2) (94 = 47 × 2), 97. If an
numbers are specially wanted they can b
a circle. A very large proportion of
century can be cut, many of the gaps be
tions of the smaller numbers in the
Where the odd-tooth wheels 169, 289, 3
required, the sub-division of the segme
17, 19 may be omitted, reducing the h
plate by 47, or to 156. Without an e
number of holes, one of these plates mig
a practically complete dividing engin
very large numbers were required, a pa
be convenient to each circle. As an inst
few holes that are required, and of t
tendency to increase as the number gro
ample is afforded by 100 = 10 × 10 =
and 175 = 7 × 5 × 5 = 16 holes, one h
10 or $\frac{10}{2}$ being common to both circle
ment.

Some of our experts would be gla
could describe as "O. V." desires, and
apt to keep the knowledge to themselv
could, unless they could afford to dis
value. I once described a method of m
once sent a sketch of a circular cutter th
to myself to be correct as far as the cut
cerned; but the sketch apparently went
it did not appear. The description occu
in the controversy; but if not clear, I sh
to attempt an "explicit" one.

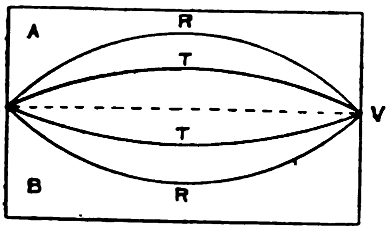
WORKING PERFECT PLANES ING PITCH FACETS—THAN

[25337.]—I notice that Mr. W
25276, criticising my method of makin
says, "It seems very simple, but appear
me totally wrong in theory."

As I did not give the theory when I
my method, I do so now. The conditi
pose the working to be conducted under
Diameter of glass discs, 2in.; diameter o
1½in.; length of stroke, 1in.; and the
the glass discs to be good enough to s
bands of colour all over the surfa
together. Now, we polish discs

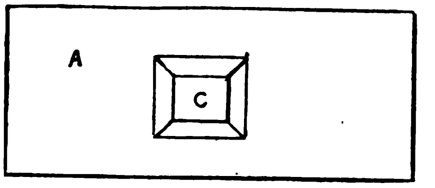
'ig. 1) for 3 hours each; by this time, owing to he regular motion of the polisher and glass disc, ll the irregularities will have disappeared, and he surfaces of the discs will have assumed as reat a concavity as the diameter of polisher and he length of the stroke used would produce. Let he lines S R V represent the concave surfaces roduced (see Fig. 1); now lengthen stroke, and olish each disc for one hour. The increased ngth of stroke will have produced its particular urve, which will be shallower than the first one. 'his can be proved by testing the discs together, 'hen the concentric rings of colour will be found › be broader than formerly. Let the lines S T V 'present the concavity now produced. By re-eating the process, it is obvious that the lines T V can be brought equal distances nearer each

F I G. 1



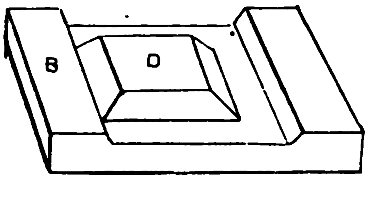
her, until they coincide and are in perfect con-ct. When two discs worked by this process show e parallel bands, it will be found on testing them ith a perfect plane that they are either perfect, so nearly perfect that a few minutes' work will t them right. Of course, if three discs are orked and all show the parallel bands, all are rfect. However defective the process may be in eory, it answers admirably in practice. A short ne ago I worked a 3in. plane on this principle. he surface was so convex to begin with, that it ly showed a ring of colour about ¾in. in dia-eter in the centre when tested. It took twelve ours to work down this hill into a plain; but at e end of that time it showed the parallel bands.

F I G. 2.



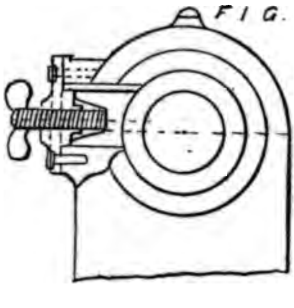
nis is, of course, an extreme case. The discs, to gin with, ought to show colour all over the sur-ce when tested. I hope Mr. Wigmore will try this ethod and report the results. I have been more suc-ssful than Mr. Wigmore in obtaining pitch; the nd I use is sold in cardboard boxes, each containing pound, and is very good and free from impurities. found a fruitful source of scratches in the rticles of sand, &c., which cling to the face of the irror, and came from the stops which had been ying on a stone bench in the cellar. I afterwards ok the precaution to wipe the mirror after test-g. I can sympathise with Mr. Wigmore on the

F I G. 3

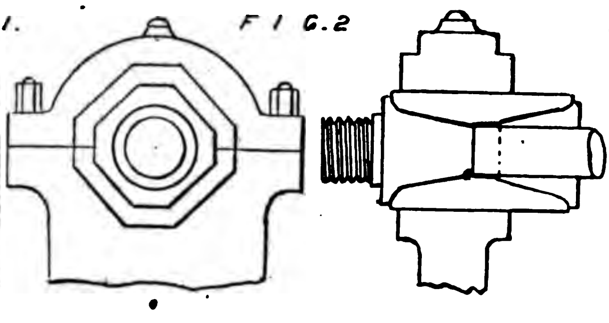


fficulty of figuring in hot weather; even here, in igland, I have found the pitch polisher change ape in the intervals of working. I got over this, wever, by immersing the polisher in water. Mr. igmore's method of casting facets is ingenious. ould he oblige by saying if the resin he uses cuts sily, and if it is better to handle than pitch? If has succeeded in making a substitute for pitch, ving all its good and none of its bad qualities, will deserve the thanks of all concerned, as the paration of a pitch polisher is at the best a nasty . For the benefit of those using the pitch 'isher, I describe a method of casting facets de-ed by me some time ago, and of which Mr. ssell approves. A (see Figs. 2 and 3) is the ster mould, B the top mould, which is made of d wood; the wood facet, D, is ⅛in. less each y than the facet mould C. To use: Place facet

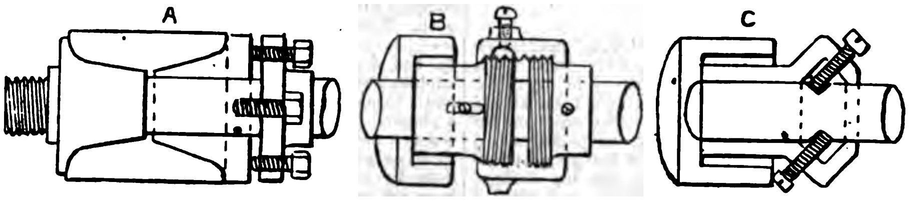
F I G. 1.



F I G. 2

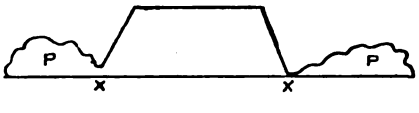


BACK SHOULDER ADJUSTMENTS



D centrally over C, and mark round top box on plaster mould A, so as to be able to put it in place at once. Now put sufficient pitch in C, place top box in position, and squeeze together. The spare pitch flows into the space round facet D. After cooling the facet will be like Fig. 4. All that re-

F I G. 4



mains to be done is to break off the pieces P P at X X, and there is your facet ready for the polisher. I cannot close my letter without acknowledging my indebtedness to Mr. Wassell for the instructions given in his admirable letters on the "Grinding and Polishing of Glass Specula."

C. L. Tweedale.

Crawshawbooth, Lancashire.

LATHE MATTERS.

[25338.]—There is always one pleasure in writing about lathe affairs, and that is that "F. A. M." will read and appreciate. I regret I am inexplicit, but I have not the time, if I had the inclination, to go into details—far, at any rate. Judgments vary, and I think a deal of the discussion, &c., that takes place is not sufficiently profitable to warrant the attendant labour. Further, that those whose ingenuity is not equal to working out a simple general idea ought rather to exercise that faculty until it is, than to depend at any time on others for minutiæ. But it is a pleasure to send up any apparently useful ideas that occur.

My sliding mandrel is capable of much variation, and there are several points in "F. A. M.'s" that I do not like. Splitting the head would, perhaps, work well; but there should be no practical wear, and round collars can easily be made a sound job of by turning and finishing them on the mandrel itself. A better job would be to make a large hole where the set-screw comes in my sketch—leaving sufficient metal round it, and giving an angle to the screw to jam the collar downwards a little—then inserting a brass bush about 1in. diameter, following with a gland, both a good fit in the hole, and the latter carrying the set-screw in a tapped hole. The gland might be nicely fixed by countersunk screws, little bosses to receive their threads being made on the headstock. I think that plan would be a sound, durable, mechanical way, and send sketch.

The entry of the bush at the front end is a mistake, as the time it would stand so would often be long, and grit would get in and lodge on the bottom of the hole. The edge of the collar, which should be rounded a little, or would soon become so, would set the grit when advancing; whereas, the flush collar or very slightly-projecting one could not set grit, as it does not enter the hole. Even supposing it did, a sharp edge is easily made, and kept on a hole with a filling cylinder in it and it would scrape the collar clean. The need of a key still appears to exist, or the bush would rotate when advancing with [illegible] released, thus setting oil-hole out, if nothing [illegible] capped head, with studs and [illegible]; to leave caps free to ease down. [illegible] red by some. The lengths of the bush should be proportioned to the travel desired, and the long bushes would enable those who like the double-coned American plan to use it with advantage.

In "F. A. M.'s" sketch the back nuts could not be got on without splitting them, as the tail of mandrel should be shown reduced. Also the long front nut would be better with an enlarged plain bearing on the fore part, with a little thread—three or four turns—at back to work against the lock-nut. There are better plans devisable than nuts and threaded mandrel, a sketch of one or two being added. Most amateurs would make the collar and shoulder soft, so that the small surface would hardly be so good as a coned shoulder, as the friction would be very light in any case. By putting a copper wire between shoulder and lock-nut, then squeezing shoulder tight against collar to centre it, then nipping the lock-nut, and finally forcibly turning back the shoulder while holding on to the lock-nut, drunkenness in the thread can be got rid of.

I send a sketch (2) of a general plan that I should think would make a very good job, and be well within an amateur's capacity, as the head does not need boring, but can be filed and scraped to slide correctly. As the coned mandrel could be adjusted to no shake, and the collar also, I think there is no fear of less steadiness than with any other sliding mandrel; rather less tendency, if anything. The head is capped, the bush a square set diagonally, and with the corners well rounded or taken off; the back bearing a small edition of the front, with one cone cut on mandrel itself, and a loose collar with set pin to form shoulder back and front; though the back can be nutted, or otherwise made adjustable. The bushes could have the corners taken off on the mandrel in the lathe, and the parallel lines to surface down to could be marked by the slide-rest and division plate; or lines might be marked to gauge one surface only, and when that was got up, its parallelism might be tested by screwing back to a tight fit on mandrel, placing its surface on a plate, and gauging the height of mandrel centre with a surface-gauge. The other surfaces might be finally tested the same way, being first squared off the one, care being taken to see that the turned places were all parallel and of the same width. No key is needed, the contact surfaces are always full and true. Setting can be done by nipping the cap, wear being taken up by scraping it down a little, or the bush might be made reversible, the part first put top being slightly larger than the bottom one; the wear should, however, be practically nil. I shall be happy to give other suggestions or details in connection with it; but having made a cake I think those who eat it ought to do the digesting mostly themselves, or to make some effort to do so.

Mr. Dancaster's counter is a developed device, but unless the counting point were of hard wood I should not like to use it, as I am jealous of the holes in a division plate; also, its range is small, 3 or 6 out of 72, for instance, not being attainable. Simplicity was the only claim I made for the pointer and mark, but it has the advantage for myself that in cutting wheels part round only the mark coming to another pointer shows when to stop. I should not think of putting a compass leg in the holes either. If the plate is clear a little thick oil on a pointed stick will make the mark.

"G. W. D.'s" device, though rather inelegant, is useful enough. It is not very apparent how a keyway, or pin-hole, or angled cutter-hole, and so on, in a 3ft. length of rod is to be expeditiously chucked and made by a practical man. The dogs have much too little nut, and would be apt to get in the way, or would be much handier if loose, as the article could be dogged anywhere. The outer edges of the V might be drilled about every 1½in. or so apart, the holes tapped, say ⅜in., and the dogs made with clear holes, and the proper angle and form to be screwed down by them outside the wings. It would be stiffer with the shoe off the rest, and the holding piece made bigger, so as to be bolted down by the central bolt. When the dogs were in the way a U clamp, the screwed ends passing through holes in the wings and a short piece of bar, so that the nipping could be done from behind, would be handy. I have a further development of the segmental division plate that requires fewer holes than the one before sketched. I think of sending it up when worked out.

Vulcan.

LATHE MATTERS AND VERTICAL PLANER.

[25339.]—I AM glad to see "O. V.'s" remarks on my hobby. I can hardly say that the form of the front-slide lathe bed is quite settled in my mind. I am not so enamoured of my own form that I cannot see it has yet some drawbacks which do not appear in others. Its simplicity, compactness, and ease in making the patterns have had great attractions for me; but in designing the top fittings, such as milling, shaping, and drilling apparatus, I have been feeling that there is not as much *surface on the top* as it is desirable to have, if milling is to be done as lately proposed by me, or shaping as proposed by Major Armstrong in his lathe. I am afraid, therefore, that when the lathe is to be a universal one, while I hold by the internal V's, the single girder must be charged for the ordinary double shear bed.

On the subject of milling, there are some, indeed many, small jobs for which I think there would be sufficient room with bevil on nose of mandrel; but I have, in page 450, proposed a lengthening bar when needed, and this I think could not be better arranged than on Major Armstrong's plan—i.e., a slotted bar running between centres with feather on the bevel.

I have to thank Mr. Wenham for his ready yielding to my request. Perhaps others who can more easily see and consult some one, with a *safe mechanical experience*, may not feel as I do; but I do think the opinion we have elicited is of the highest value, coming as it does from one who can speak *ex cathedrâ*, though he may not himself claim to do so.

The milling arrangement suggested by me *need not* take the place of the fly and milling cutter frames; but one object is to develop the capabilities of the lathe to the utmost; and there are certain forms of milling which can be more easily done by such an arrangement; therefore, in designing a new lathe, we would like to make provision for all cases possible.

I do not altogether like Allsop's arrangement for the front-slide lathe. The milling spindle must be same height above the bed as the mandrel, and this is too high for my idea of what it ought to be. What I would use instead of the bevel wheels would be what I think is called *spiral gearing*. I have lately seen an illustration of it, but cannot tell where, and would be glad if anyone could tell me. At any rate, the gear wheels I refer to are formed as sections of a many-threaded screw. The teeth work with a sliding motion, on the worm-wheel principle. This form of gear would enable me to work the milling spindle *underneath* the pinion on mandrel, or on the lengthening bar, which would be, I think, the more convenient height for it, while the motion would be much smoother.

"F. A. M." recommends the vertical planer, which appeared lately in these pages, and hopes it will be taken up. I have a fellow-feeling for *poor amateurs*, and to save them from loss and disappointment I have more than once raised a warning note as to notions coming from the same source as this. I hope, therefore, no one will set it down to fault-finding criticism if I demur to this being set forth as the best direction to turn to for a simple planer within the reach of a great number of beginners, who are precluded from other forms by their high price.

It seems to me very much worse suited for its purpose than others which have appeared in back numbers.

Unless the lathe is of 5in. or 6in. centre, the *length* of the work to be operated on is so short as greatly to curtail its usefulness. The position, too, I think, is awkward. The vertical frame is ill-suited to resist strain and vibration in the cut. The tool-holder, as pointed out, would, indeed, make sorry work. But what is there to recommend this *in any point* over the Northcott polarising arm, in some one or other of the forms which have not long ago been illustrated in the ENGLISH MECHANIC?

Let the slide-rest be bolted to a planer arm, made as long as the greatest length the amateur wishes to plane. Let him then get a table with T-stops on top, and with underneath planed to fit his lathe bed. This table can have an arm on right-hand end, with a boss to attach a lever to, the other end of lever working on a pin at back of lathe, and I think you have, for *one-fourth* the lowest cost at which the vertical planer can be obtained, a much more effective and simpler arrangement.

The only piece of planing in the whole thing which need be paid for is the bottom of the table, V-strip. Top of table and slots can be done when it is fitted to work on its bed; but it may be better to get the rough ends taken over the top by the makers, lest, when the strain is removed, the table should slightly cant.

The arm need not be planed at all; the file, even in the tyro's hand, will make a fair enough fitting on and between the shears, and on the top when rest is to be bolted. I am not advocating that these parts should be only so fitted; but I say that if the amateur is worth his salt he can, if need so compels him, fit them well enough to suit his purpose. Now, I think these two castings and the lever, as they will not weigh much over 1cwt., can be had for 10s. or 12s. The planing may cost another 10s.; but, at any rate, for little over £1, and I think for less, anyone may have this kind of a planer. If £6 is to be spent, my advice would be—get a set of planed castings, with such things fitted as you cannot do yourself, and this can be done by many manufacturers for £6. Fit up for yourself, and you will have something which, though it will not be perfection, will be very much better than throwing away your money on a little plaything which will be sure to fail you at the very point you most need it.

This is what I did myself, and at the time I fitted up my planer I had not even a slide-rest; but I had help from a very kind friend, who gave the lifting-screws and invaluable help in the way of written instruction. The other screws I turned by hand, or made with the die stock. Of course, all the hand-made screws have been replaced; but had I not had a good foundation to build on, my money and labour would have been thrown away.

Feb. 6. **Fredk. Carre.**

[25340.]—I WISH "Vulcan" would write fully on his proposed mandrel with sliding bushes. I should like to hear what material he would use, how he would harden and true up. There is, as "O. V." says this week, evidently another source of error in the moving bushes; if, however, the mandrel and bushes were left soft and turned on dead-centres, the mandrel necks being first carefully "trued" up, and then the collars fitted upon them, and the outside of the collars turned when fixed by the lock-nuts upon the mandrel; it is hard to see how any error could arise, and surely any amateur who would undertake a mandrel at all could do this. The introduction of the cone dispenses with the necessity for hardening; but, if the parts are to be hardened, I presume the necks and outside of collars would be got up true in the same way, except that an emery-wheel in the slide-rest would replace the tool. I feel an interest in the plan, and almost think I shall try to fit one, if only to see how it works.

As to the screw question, every one seems to be tired of it; but I quite agree with "O. V." that we ought to hear more. We want now something practical. First, to know what is the attainable limit of accuracy. I am still in hopes the Whitworth Co. will kindly enlighten us on this point, or refer us to some authority which gives the required information. Then, next, we want some practical directions for examining and testing screws; and, lastly, a description of the best methods of correcting imperfct screws, and of cutting correct ones.

I was glad to see Mr. Wenham's favourable remarks on the front slide; the idea, taken from Alsop's milling attachment, seems good; but I object to the gearing, and see that Mr. Wenham feels the same. I still prefer my arrangement, because always ready, large table, convenient for boring, and no gearing. I confess I am not yet quite satisfied with it, but don't see the poppet would be in the way nor the height insufficient, and I have my screw ferrule to fix cutter spindles into hole in mandrel, which is just the thing; my chief difficulty is still the backstay.

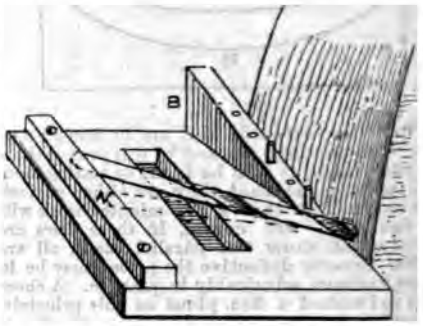
Would it be troubling Mr. Wenham too much to ask him to give a sketch of the guide-pulleys he mentions, which allow him to use the cutter-frame in an oblique position?

Mr. Dancaster's counting index seems to me very good and carefully considered; the simple ratchet and pawl I use is, of course, much quicker, and requires no eyework. The beautiful apparatus made by Mr. Evans will, of course, hold the division plate, which the ratchet does not, and that is where the expense and complication arise. I find, however, this is not absolutely necessary, for if you make the mandrel turn stiffly, the little drills and cutters do not move it, and for extra security you can make the cutting be against the ratchet, and then the band holds the mandrel from turning. **F. A. M.**

SHARPENING TWIST DRILLS.

[25341.]—I HAD meant last letter to have said something on "F. A. M.'s" method of sharpening twist drills. His plan is simple, and when there is not a machine for the purpose it can hardly be improved on. What I have done was perhaps simpler, but not as accurate. I have revolved the drill while lying on the grinding rest, which, in my case, is a flat board on level with centre of grindstone; the drill being held at proper length, and stone running towards it. When both lips are thus ground even, I relieve them, as "F. A. M." says, making the drill revolve round *two centres*, one being its own axis, the other the tail end of the axis. Thus, I rest end of drill against some projection on grinding board, the cutting edge of lip being just in contact, and *horizontal*, then slowly raise the point, while at same time you give drill a quarter of a turn in your fingers. This will give the necessary relief.

I give a rough sketch of a simple little attachment to grindstone, which will enable these two motions to be given whilst grinding, and though I have not tried it, I think it ought to work satisfactorily. It is simply a piece of wood, with a moveable stop A to rest end of drill against. B is a wedge piece nailed to side next grindstone; in this are several holes to take a pin—a 2in. wire nail will do. This frame is fastened by a couple of screws to grindstone frame, and about level of centres.



To grind, the peg is placed in hole at point of wedge piece; drill is laid on frame, as shown, with tail in notch in A, so that point will lie at proper angle on stone; turn drill round till both lips are evenly ground. Recess C allows fingers to catch drill, which is held while being turned close up against peg. As soon as lips are even, remove peg to two or three hole, and draw point of drill up the incline till it comes against the peg, giving it at same time a quarter turn. Be careful to commence this last part of the grinding with line of cutting edge of lips horizontal.

Jan. 30. **Fredk. Carre.**

THE ROBINSON HOT-AIR ENGINE.

[25342.]—I TAKE the following table from a lecture by the late Fleming Jenkin:—

Power.	Rev. per minute.	Dia. of pulleys. (Inches)	Appx. cost of gas per hour.	Dia. of pston. (Ins.)	Stroke (Inches)
1-man	270	5	½d.	6	5
1½-man	270	7	¾	...	—
2-man	270	9	⅞	8	5

One man-power is taken at 4,000ft.-lbs. per hour. I have been unable to identify the drawing on p. 442 with any of these; but the nearest is the 2-man engine, in which case the drawing would be to a scale of 1½in. = 1ft., and cylinder measures 7⅞dia. by 5in. stroke, the pulley being 10in. dia.; but these dimensions do not agree with those in the table, which also makes no mention of coal or coke, though your description seems to infer that gas is not used for a 2-man engine. **Glatton.**

WIMSHURST MACHINE.

[25343.]—I SHOULD like to suggest to Mr. Wimshurst the propriety of using another material than either glass or ebonite as discs. Whilst each of these materials is admirably adapted for this purpose in some respects, we all know that there are serious drawbacks to their use. First of all, there is great difficulty in making a clean hole without special appliances in glass, in addition to which the material is so fragile that it is attended with constant danger.

Again, although ebonit

fracture, yet it is liable to warp and, what is worse than that, the surface is subject to decomposition, which renders it useless. What we want, then, is a substance which shall be a perfect insulator, not liable to warp or fracture, and one that shall not be liable to undergo any chemical change which shall affect it electrically. I propose making a thin, hard disc, built up of silk and shellac. Three or four or more sheets of silk cemented together with shellac such as hat makers use, I think, would form a disc which would contain all the elements I have enumerated as essential to a perfect disc. I would beg to submit this idea to Mr. Wimshurst or others who are working at the machine, and ask their opinion. **O. Beckerlegge.**

A NEW COMBINED STELLAR PHOTOMETER AND CHROMOMETER.

[25344.]—AN outline of the present paper, shortly dealing with the principles, and describing the construction of this new design, was sent to an esteemed fellow member of the Liverpool Astronomical Society, in time, and with the request, to submit it to the Society at its first meeting in October, 1885.

It was intended merely to bring forward the matter, and so to be benefited by the criticism of members and friends of science, which would have enabled any alterations, improvements, or other suggestions received to be made use of in the practical construction and testing. Living some thousands of miles away from England, and the means of communication being but slow and imperfect, it was with some disappointment I received an intimation that "You need not depend on our Society making public your investigations in the *Journal* of the L.A.S.," &c. . . . Being personally anxious to place the matter before the scientific world for the information of fellow amateurs, workers, and students of science, it has been thought advisable to waste no more time, but to avail of the friendly pages of the ENGLISH MECHANIC whether or not the paper may be published by the L.A.S., and publish a description of the designs, together with diagram plans arranged to the best of my ability.

Our many able correspondents and scientists in general are kindly invited to follow the descriptions, to examine its principles, and freely to criticise, point out errors or suggest alterations and improvements. I have every confidence that this instrument, when once brought into a practical form and use will, after a little experience, be found to supply a want which must be felt by every practical observer at the telescope—i.e., "An easy means correctly to determine the magnitude, brightness, and colour of any object under observation."

With such instrumental means at his disposal many an amateur, now debarred from doing so, will gladly undertake wider fields of systematic work, such as (1) Regular series of surveys to fix Stellar magnitudes; (2) Determination of star variabilities; (3) Star colours; not to mention many other equally interesting lines of research.

This, certainly, is claiming much for the new instrument. But how far these very sanguine expectations will be fulfilled must be decided by the kindly criticism of friends of science, which, together with their suggestions, alterations, or improvements, will enable a perfection of design to be arrived at for its practical construction, so that the verdict of practical experience may be obtained.

It may be as well to mention that the drawing of the diagrams may not perhaps be so correct and clear as could be desired, nor may the nomenclature of the different parts be according to "practical terms." Such terms only as suggested themselves at the moment were made use of. It is hoped our description and drawings may, nevertheless, be clear enough to understand the principle of the new photometer.

Fig. 1 represents the plan of the entire design, or "combination of instruments," consisting of (1) photometer; (2) chromometer; (3) position circle; (4) ghost micrometer; (5) bright and dark field illuminator; (6) regulator for measuring and always determining the standard of magnitude; (7) new first surface solar eyepiece, for direct vision and spectroscopic observation at the same time; and (8) occulting eyepiece.

These eight distinctly different instruments are here combined in one, and any one may be used at pleasure, and with greatest ease, without interfering with any of the results, or be affected by the others.

Complicated as such a combination may seem, the details will be found very simple when described one by one. I will, therefore, commence with the "construction of the photometer."

A (Fig. 1) is an arc lamp (or it may be a paraffin lamp as well) fixed in a hollow cylinder or tube. W is a wedge of white and dark or neutral tinted glass. This wedge is fixed in a cradle, and moved at right angles across the opening to lamp A by eans of an endless screw, worked by the micro-ter head B. This wedge W must have its sides perfectly parallel, and thus at 90° to the axis of a cone of light reflected from the mirror M. M is a concave mirror, with A and K in its conjugate foci. F F F F F represents the framework of the one portion of instrument, which must be stout and firmly screwed together like one piece.

Turning now again to the wedge W, it is evident that if we divide the length of the wedge by (say) 12 equal parts, and then move the wedge past the axis of cone of rays from lamp, every 1-12th part will produce a certain fixed and proportionate dimming of the rays of light on passing through, corresponding to its position near, or away from, the dark end.

In the Fig. 1 divided wedge into 12 equal grades. Then bring the *p.* end of wedge to coincide with axis of cone from lamp A, zero is marked, and the scale S S is graduated each way (vide sketch), so that the two ends of W always act as pointers, or readers on opposite sides, indicating the amount of light diminution effected by wedge S S will be our magnitude scale.

The micrometer head B actuates the endless screw-driving wedge W, and is graduated or divided into, say, 100 equal parts. The thread of this actuating screw should be in proportion to size of wedge W—i.e., supposing the wedge W (as in diagram) 1½in. long, with the scale S S divided into 12 or 24 parts. Then 48 threads to the 1½in., or 32 to the inch, will give exactly four or two entire revolutions of micrometer head to a magnitude, and will enable a magnitude or light intensity of same to be measured correctly to the $\frac{1}{200}$th part.

The magnitudes being read off on scale S S, over against the opposite end of wedge, and the parts of a mag. on micrometer-head B, and vernier or zero V.

The rays of light directly from A, or off M, are brought to a focus at K, where the cone is intercepted by a thin metal plate, pierced with small but proportionately sized apertures (see Fig. 4. These (*a p*) metal slips are actuated by a rackwork and milled head M H, one each on the opposite side, and are graduated according to sizes of apertures 1·8 on the one strip or plate, and 9·16 on the other, which would correspond to different magnitudes. These metal strips may be readily removed, and be replaced by others, or may be brought in or out of position in a moment.

The concentrated light from lamp is thus made to pass through determined apertures, and passing through T, a small tube with a diaphragm to cut off stray light, it enters a small positive (plano-convex) lens N, placed so as to have the apertures (*a p*) at K in its focus. From N the rays of light emerge parallel and enter P, a total reflection prism, mounted inside, but capable of being revolved round its longer axis by means of a screw-head outside (not figured). Reflected or bent by P, they enter a double convex lens L, cut in half and mounted inside of tube (being also capable of a slight tilting motion) L, now brings the rays to a focus at E, from which it will at once be evident that an image of the small aperture in the metal plate at K (*ap*) will be formed. The magnitude of this image, or starlike point, will be at once indicated by the scale reading of *ap*, while its light intensity will be correctly given on the scale S S.

But as the entire instrument is to be screwed or fitted into the first draw-tube at eye-end of telescope, by inserting or screwing it in at D D, so that the cone of rays from object-glass may also be brought to a focus at E. We have two distinct images formed in the same field viewed by the same eye, and by regulating the size and brightness of the image produced of the K apertures, which can be done very easily, until it exactly equals the star under observation, the magnitude and light intensity has been determined, and may be very correctly read off at leisure. By slightly tilting the lens L, and revolving prism P, by means of the milled head outside, the ghost, or artificial star, may be brought to any position in "field" on the horn circle passing through centre of "field."

An outline of the principle of this photometer will now have been acquired. Before going further into its detail, it seems desirable, first, also to introduce and briefly describe the "Position Circle" and "Ghost Micrometer," as the former is intimately connected with the photometric apparatus, at the same time carrying the micrometer.

In Fig. 1, H H represents the "Position Circle," which is also given in plan in Fig. 4, while a rough outline perspective is intended by Fig. 3. It should be mentioned that in Fig. 5, *k*, is figured a square opening, while in Fig. 4 it is a circle. The circular form in Fig. 4 was accepted as more suitable, after having traced Fig. 3.

Figs. 3 and 4 will at once explain the principle of mounting.

The circle is of brass or other metal, resembling an ordinary Grubb R.A. circle, graduated to degrees and parts of a degree, as may be desired. At right angles to one another, on the side nearest lamp, [illegible] ted two "carrying boxes," K" K', Figs. 3 and [illegible] seen in cross section K' in Fig. 1.) Into one is fitted an ordinary micrometer, having its two opposite micro heads B' B' with their verniers *v v*. The micrometer may either have wires, in the usual form, or lines may be cut on plane glass slips. Thus lines on white glass would give dark lines on a light field, while lines cut on a slip of glass covered with some opaque film would produce "bright lines" on a dark field.

The "field" of micrometer being at the centre of the *k* opening, it would require no further explanation to show that a ghost system of wires will be thrown into field of view at E; and any object under observation may be measured the same as in the usual way. While the "position circle," with one wire of micrometer in centre of field, may be used in the same way. Angles of position being very easily read on limb outside by the vernier V'.

H H should be securely fixed or screwed to the general framework, F F F, &c., so as to form a solid or rigid whole with it.

F F' is fitted into the carrying-tube, O O, so as to revolve round the axis, as it were, of ray from A to P; O O being securely fastened to the draw-tube D D.

F' F', &c., a ring of metal screwed to F F, &c., is fitted to revolve round its axis (or at 90° to ray of light from A), inside of D D, with the object to keep F F F, &c., steadily in its place, and so allow a rigid motion of H H in one and the same plane —i.e., parallel to axis of cone of rays from object-glass.

Thus the "position circle," "micrometer," and even both the photometer and chronometer form one whole, capable of revolving round an axis at 90° to line of collimation of telescope, and thus in a plane (each in its own) parallel to this most important origin of measurements.

M H, M H, Fig. 4, are the milled heads controlling rackwork and metal plates *a p* containing magnitude apertures.

This must suffice for the description of "position circle" and "micrometer" at present. A few remarks as to mode of illuminating these two instruments may be added. It would not do to have the light focussed on wires same as on *k* apertures. To prevent this a slip of frosted glass is inserted in one of the colour spaces (vide Fig. 2, C.C.) and on being brought into position the cone of light will be rendered of a soft, dull tone, which may be reduced to any desired degree by wedge W, and so allow a wide margin to "set" for bright or faint objects. This matter, it seems to me, will be a great improvement, and will greatly facilitate correct measures of faint objects.

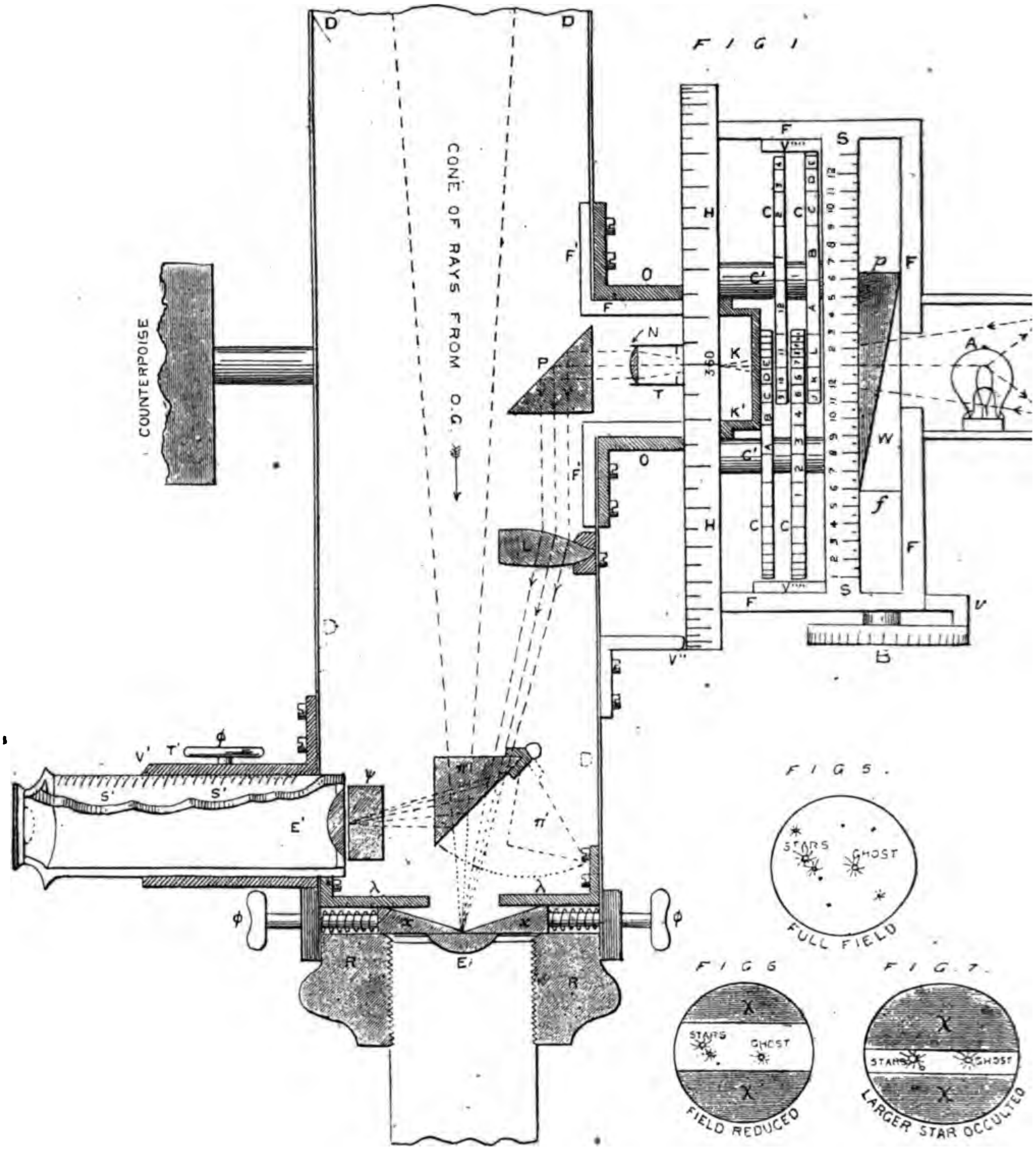
We will now go over to describe the "chromometer," leaving fuller details and other considerations for the last, or perhaps even for a second paper. In Fig. 1, C.C.C.C., are four metal discs (shown in plan in Fig. 2), fitted alternately on to the two firm axles C.C., and capable of being revolved around it. In each of these four discs there are eight spaces (see Fig. 2) into which are fitted small wedge-like coloured glasses, composed of the primary colour, and a white wedge, each forming thus—like W—a parallel-sided piece. It is thus evident that by bringing any one of these glasses between the field K and lamp, a corresponding coloured star will result in field at E, and by having these colour slides wedge-like, a considerable range of intensity of colour is obtainable. In each "colour disc" one space is left blank, so that when no colour work is desired the rays of light may pass freely, by setting all four in position.

Each colour disc is divided (outside) into the number of slides it contains, while each such division again should be subdivided, so as to indicate the degree of intensity. The readings of the colours may be taken at V'''V'', or any other suitable zero.

In the four discs there is thus provision for the seven primaries, and twenty-one other most useful tints, colours, or even shades.

Supposing a star is observed in the eyepiece E, and its colour required. All we have to do will be to revolve the "colour discs" until the "ghost star" becomes of the same colour. If a single-colour slide will not give it, try combinations of two or more until it agrees. We then only have to read off the colour on C C, which may be done with certainty and ease. And as the real as well as artificial stars in the field of view are brought side by side, and are viewed by one and the same eye at the same time, all errors of colour estimation must be done away with.

The colour of any star may always and at any time be reproduced simply by setting colour slides to the same reading. I would therefore suggest that the number of slide, number of disc carrying it, as well as the fractional reading of the zero at the time, be noted down in such a recorded colour observation. This determination of colour and light intensity may in a like manner be extended to the head and tail of comets, the different lunar formations, nebulæ, *comites*, planets, and, in short, to every object in the heavens, except meteors. I



Explanation of References to Figures.

Regulator.—π, total ref. prism; π', total ref. out of position; ψ, wedge, similar to W; T′, carrying tube for E′, eyepiece; θ, rack and focussing; S′ S′, scale; V′, vernier, or zero; ϵ, frame pivot for π; $\phi\,\phi$, $\lambda\,\lambda$, $\chi\,\chi$, occulting arrangement.

Photometer.—A, arc lamp; B, micrometer head, actuating wedge W; C C C C (four), colour carrying discs (vide Fig. 2); C′ C′ (two), axles discs; D D, end of tube slipping into draw-tube of telescope; E, field-lens of positive eyepiece; F F F, &c., stout framework of metal; F′ F′, inside of tube; H H, position circle (vide Figs. 3 and 4); K, small apertures at focus of M and N; K′ K′, carrying box for micrometer, B′ (also K′ K′, Fig. 3); L, double convex lens, cut in half; M, mirror, with A and K in conjugate foci; N, Plano-convex lens, with K in focus; O O tube, into which F F fits smoothly, being supported and steadied by F′ F′; P, total reflex prism, reversible; R R, stout metal bed-adapter for slides; S S, scale of magnitudes for light intensity; T, tube with diaphragm, and carrying lens, N; V, vernier to B; V″, do. to position cir V‴, do. to S′ S′ regulator; V″″ V″″, do. to colour discs; W, wedge of white and neutral glass; *f*, following; *p*, preceding.

Position Circle, Micrometer and Mag. Aperture Slips.—M H (Fig. 4), milled heads of rack and pinion, working metal slips with apertures; slips, with magnitude apertures, and scale of same.

believe that even sunspots, especially the umbræ, could be so measured.

For comets and nebula, a semi-transparent white slide should first be brought into position, while any "colour slide" may then be combined with it until the desired tint is obtained. All surplus light may be dulled by the wedge W, and so an accurate measure of light intensity be obtained as well.

The value of such an instrumental means of measurement in such an instance as the recent marvellous variability in 31 M must at once be apparent.

Having now briefly gone over the "Photometer," "chromometer," "position circle," and "Ghost micrometer," there remains only a description of the "occulting arrangement," and "regulator." See Fig. 1, π et. seq., and ϕ to χ.

The idea of the "occulting arrangement" is to limit the "field of view" to any desired extent, or to exclude brighter stars, or other brighter portions, while examining fainter objects or portions (vide Figs. 5, 6, 7). In Fig. 1, $\chi\,\chi$ are two metal plates ground down to knife-edges inwards, and are connected to $\phi\,\phi$, two actuating screws, which may be made to widen or narrow the "field," as desired (vide 5, 6, and 7). Round $\phi\,\phi$, between χ and the tube D D, are wound two spiral springs, drawing $\chi\,\chi$ outwards, thus rendering the widening motion automatic on withdrawing ϕ. $\lambda\,\lambda$ are two metal plates fixed inside of D D, and just fitting over $\chi\,\chi$, holding it securely in its place, and thus giving it a motion in one plane a stout metal bed screwed on to D D, int E the eyepieces of telescope are screv sketch). It is made stout, so as to give and strength to apparatus.

It should also be mentioned that the of metal (as figured in Fig. 1) of the tube D D would be much too weak in considerably stouter tube should be give perfect steadiness, strength, It is of great importance that the ment shall be true, as any ricke away much of its value as a "posit "micrometer."

The bright and dark field illu- have been the construction of the "P. circle" and "micrometer." And the description of these two arrangements has also included this important use of the "combined photometer." It is just so with the "new first surface solar eyepiece."

After having acquainted the reader with the regulator, and the important part it is designed to fulfil, a very few words will enable the "solar eyepiece" to be understood. So we proceed to the regulator.

π. (Fig. 1) is a total reflex prism similar to P, mounted inside of tube on the arm of a pivot E, which with a milled head outside, may be brought into position (as figured) or out of position (*vide* π and dotted figure). When not wanted, or when work is being done with photometer, chromometer, &c., this prism should be out of position, so as to allow the cones of light from o.g. and L to pass freely to focus at E.

π may readily also be mounted in such a form on E as to be reversible; but more of this when describing "solar eyepiece."

ψ is a wedge of white and neutral glass in every respect similar to W, and mounted like it in principle (though slightly modified to suit its position).

It is now evident that the cones of light from o.g. and L will be bent at right angles into ψ, and be brought to a focus at the field lens of eyepiece E′; but by interposing the wedge ψ these two cones may be extinguished, and this point of extinction is the measure again of the light intensity of the objects under observation, only given in a reversed order.

To be plainer. Suppose *α* Centauri is under observation. On the scale S.S. of the photometer, and *a.p.* scale of "*k* apertures," we find it equal to magnitude 1. π is now brought into position, and we move past the wedge ψ, until both *α* Centauri and "Photometer Ghost" are just extinguished—this point will be a constant ever afterwards on the scale of ψ—and if *α* Centauri is a constant star we have a fixed standard of measurement, which may at any time be appealed to. No matter, then, what the constancy of our lamp A or its intensity may be, we are now enabled to reduce it to the standard by means of W wedge, measured on ψ.

To increase our means of estimation an eyepiece E′, inserted in a carrying tube T′, is provided, actuated by a rack and pinion by the milled head θ, which will enable it to be used for correct focussing, &c. By means of this eyepiece the point of extinction may be very correctly observed.

The point of extinction being once determined on scale of ψ for a 1st mag. star, it is evident that those for all the lower magnitudes would become known, because W and ψ are equal and similar. If it were not for loss of light at the several reflections between A and ψ, their positions on scales S.S′. and ψ would be coincident. It will thus necessitate an independent determination for each zero.

The eyepiece E′ provides a still further check, independent of ψ, which, I may remark, seems to combine and bring into direct comparison two methods of photometry—*i.e.*, (1) The method described by Sir John Herschel, and no doubt carried out by him in his "Outlines of Astronomy," pp. 567, which I have been informed has also been practised in a modified form by Mr. T. E. Espin.

(2) The new method of direct comparison in the same field, and observed by the same eye, of the object to be determined with an artificial star of which the magnitude and light intensity are accurately known.

For this comparison ψ is moved out of position so as to allow the cones o.g. and L to pass undisturbed to their foci. E″ is now sharply focussed on star and ghost, and zero is marked on the scale, S′.S′. (shown on part of tube T′). The eyepiece is next moved out of focus until the rays from both cones, o.g. and L are just lost. Here, then, another point of extinction has been determined, and the reading on scale S′.S′. at V′ will likewise give the magnitude.

In my own mind the wedge ψ seems to be the most trustworthy, and will give more even results for different eyes. But there seems no doubt practice with both these "Regulator" systems (being combined in construction) will greatly increase the accuracy and value of determinations.

As the present paper is assuming a considerable length already, I will not now go into the detailed considerations and explanations required to be given of the general modus operandi of this new combined instrument. It will be endeavoured in a week or two to forward a further paper, dealing with such matters as the selection of standard colours, general photometric work with this photometer, loss of light from the several reflections suffered by cone from A, chromometry of stars, nebulæ, planets, comets, and the lunar surface; variability of lamp A, and how to overcome it; together with other general remarks on the instrument. The present paper will, therefore, be concluded with a brief description of the "new solar eyepiece."

As said before, π may readily be mounted in such a way on ε as to be reversible. Thus, by reversing π only a first surface reflection will be sent into E′, which even may be dimmed by ψ, while the greater amount of light will still proceed to E. Here, then, we are enabled to view the sun simultaneously by direct vision at E′, and through a

FIG 4

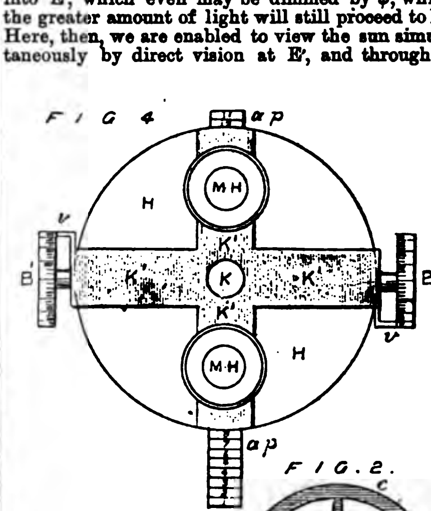


FIG. 2.

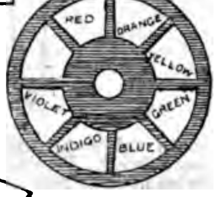
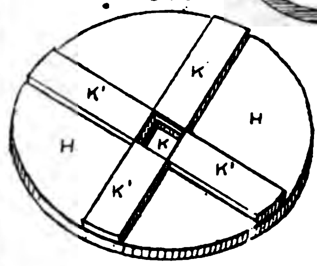


FIG. 3.



spectroscope attached at E. (Personally, I am entirely unacquainted with the use of the spectroscope, but should think it a great disadvantage in setting, say, on limb for prominences, or on the umbræ and penumbræ of spots, on faculæ, &c., to be able to have uninterrupted and direct vision of the field all the while.)

Any further explanations in my power to give, as well as any questions relating to the instrument, asked through the "E. M." will gladly be answered. Only querists will have to wait a considerable while for such replies, owing to the long time occupied by transmission of "E. M." from England to here, and my letter on its return there.

It is possible, however, Mr. Howard Grubb, of Dublin, or Mr. W. H. Davies, also well known to "Ours," may kindly undertake to reply, as both these gentlemen have done me the honour to examine the diagrams, which, together with explanations given in the different descriptions sent them from time to time, have rendered them, perhaps, quite as familiar with my views and principles assumed for the designs as I am myself.

To them also I am greatly indebted for their kind encouragement; the nature of which will be more fully dealt with in the following paper.

John Ballot.

Rolfontein, Transvaal, South Africa.

WHY DID FAHRENHEIT CALL THE BOILING POINT "212 DEGREES"?

[25345.]—THE reason that "Souza" (letter 25327) thinks "simple enough," I find by no means so simple as what I was taught: that the interval between freezing and boiling was first divided like a semicircle (these being in some sense *opposites*, therefore 180° apart), and then Fahrenheit found his freezing mixture carried him down 32 more of such divisions. If he began with these 32, there were at least 289 chances to one against so exact a coincidence of the longer interval with the most divisible number of the first 239! It would be simpler to say the number of minutes in an hour resulted from accident.

E. L. G.

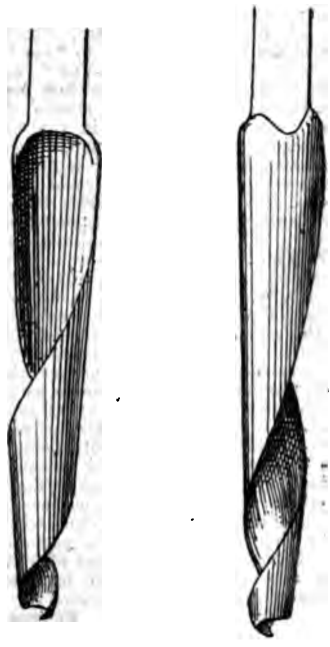
M. BERT'S EXPERIMENT.

[25346.]—A PIECE of tinfoil placed on a card and held over a lamp melts, because the tin is a good conductor and absorbs all the heat, whilst the card, being a non-conductor, does not keep enough to take fire. Is this sound reasoning? I should argue, on being told the facts (1) that the melting-point of the tin was below the ignition point of paper-gas; (2) that neither good (e.g. iron filings) nor bad conductors would burn in an atmosphere of steam and CO_2 which is to be found over a lamp chimney; (3) that the cardboard would catch fire. Trying the experiment over a gas jet, I find that the tin melts, and immediately after the card flares up. Over a petroleum lamp with the flame low, I find that a circular patch of card chars, then the tin melts, and the card slowly carbonises. With the flame higher the card swells in a bubble, then a jet of gas puffs out at the side, and meeting the air ignites. With the flame full up the card lights at once.

W. A. S. B.

NORWEGIAN GIMLETS.

[25347.]—I SEND the sketch of Norwegian gimlet, as promised. Don't let anyone suppose



from my imperfect sketch that it is only the English twist without the screw-point; it is superior in every way, though the make is rough and the steel very poor stuff.

Like many other things the proof is in the eating, for these gimlets *cut* and *swallow* their food, while any English ones I have ever seen, whether shell, or twist, or screw, only bruise and break the wood; the shavings getting so crowded in the narrow channel provided for them that they either split the wood, if thin, or else, if thick and hard, prevent the tool entering further until they are cleared out.

The one I have drawn is about ⅜in.; it can be worked up to the shoulder in hard wood with less labour than the ¼in. of ordinary make. If you want to go deeper, it must then be cleared of its shavings, and for this purpose *half a turn* back lets it come out perfectly free, without any of the tugging there usually is.

They are made of all sizes, from 2in. down to ⅛in. The larger sizes are used for boring holes down the centre of straight pine trees to convert them into the water pipes so commonly used in the country to bring the water, often long distances, to the cottage doors. I have seen these large augers, with shanks 10ft. and 12ft. long, with lengthening pieces, to enable a tree from 30ft. to 40ft. to be bored out. But only in one out-of-the-way little place, in a little shop where things of every sort—hardware and software—were sold, did I see the gimlets, and much do I regret I only bought a couple.

Fredk. Carre.

OPTICAL ERRATUM.

[25348.]—IN my last letter (25231, p. 405) the compositor has made me say "junctures," I intended punctures. I am glad that our experienced and esteemed correspondent, "A Fellow of the R.A.S.," has the same idea of "Dumpies," as most of our profession, and this leads up to a question as to how this limit, which is certainly peculiar as to its proportions, may be explained by the mathematics of optics. Why we cannot make a refractor of the form of a beer-barrel, is perhaps not so easily explained; but that it is not practicable, is, I believe, an acknowledged fact. Your able contributors, "O. V.," Mr. W. G. Penny, "F.R.A.S.," and others too, will, I hope, let in some light on this matter. I believe the trade have arrived at conclusions by tentative methods only. Your correspondent, "Pen-y-Van," (25257) goes in for such a thorough and sweeping condemnation of the "Newtonian," that I feel it impossible to quite follow him. The plea first set up for the silver-on-glass form of specula was, that the film was so extremely thin that it could not make any difference to the original figure of the glass; suppose this granted, it must follow that if all were polished off in places, or indeed all the unevenness possible produced, the figure would not suffer. I do not grant this myself, however. It would be of considerable use if our good friend, Mr. Wassell, would give us his experience, of the difference he finds in his specula after silvering and polishing. The refractor is limited at present, certainly; first, by the dispersive inconsistency, and secondly, by the difficulty of making such masses of glass pure or homogeneous enough. But what a limit! A few years ago 5in. was a glorious achievement. Now we have 25in. in this country, and our cousins "over the water" are going in for o.g.'s in proportion with the other "tall" things of that "great" country. Shall we not find it difficult to get a place to "see in" if we get much larger? "Pen-y-Van" has been fortunate in discovering the loss he speaks of, and remedying it. I always felt sure that the "centring pin hole" in the e.p.'s used with Gregorian and Cassegrainian, prevented the greatest amount of light from reaching the pupil; if "Pen-y-Van" has removed that weed, it is a good step. Speculum metal varies immensely in light-reflecting power; indeed, different deposits of silver vary. How, then, can the tabulated values serve? Fine "bluish white" speculum metal can yet be made, and will be bad to beat for telescopic work. Mr. W. G. Penny's letter (25277) very truly gives us all that is wanted *re* spurious disc; indeed, as is the case in all virtual images, they must necessarily be, as their name implies, "unreal"; those combinations which impress the mind, through the retina and optic nerve, as being the most capable of giving what I may call symmetrical distortions of the objects, under optical enlargements or reductions, undoubtedly, being the best. Hence we have the necessity for calculations and experiments, which really means "find out the best form to pull out all ways at once," or vice versâ. Mr. R. W. Wigmore (25276) will find Mr. Penny's diagram an answer to his perforated-plate effect. I should like to add that all out-of-focus objects are larger than when focussed sharp. When looking at the sky the perforation is out of focus. **Prismatique.**

USEFUL AND SCIENTIFIC NOTES.

A Winter Guest.—The *Frankfurter Zeitung* reports that the silk-tailed chatterer, one of the *Ampilidæ*, has been lately seen in several places in Middle Germany, after an absence of more than 30 years. A few days ago nearly 15 specimens of this rare bird were counted in the public garden at Naumburg on the Saal. As its usual habitation is a much higher latitude, its presence in Central Germany is regarded as an indication of the severity of the winter in Northern regions, which, making food scarce and hard to obtain, forces the chatterers to seek a less rigorous temporary home.

Clarke's Safety Rims and Rubbers for Cycles.—Mr. Clarke, of 180, Stockport-road, Manchester, is attracting the attention of cyclists to his patent safety rims and rubbers. The rims are little heavier than the hollow pattern, while it is claimed that it is impossible for the rubber tires to come out, although when desired they can be easily removed. The rims are made with two straight sides and a curved base, joining with slightly rounding corners. Two-thirds of the usual number of spokes make a wheel which cannot be buckled, with the advantages that it is lighter, and does not offer so much resistance to the atmosphere. The rims are slightly widened at the mouth, and consequently do not cut the rubber at the sides when the latter is spread by the weight of the rider; and as very little cement is required to fix the tires, the maximum of play is allowed, and injurious strains on the rubber are prevented.

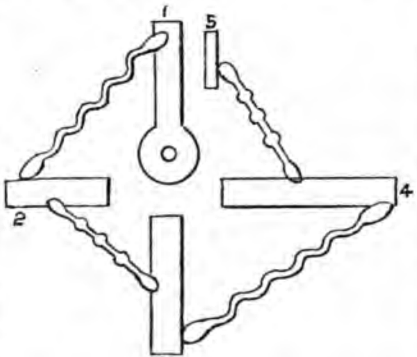
Miniature Drill Chuck.—Mr. Morris Cohen, of Kirkgate, Leeds, sends us a miniature drill chuck, which will hold drills as fine as a needle or as coarse as, say, No. 14 B.W.G. The "miniature chuck" can be fixed in the jaws of any chuck capable of holding anything three-sixteenths of an inch thick, and will be found very useful, not to say indispensable, especially as its price is only a shilling.

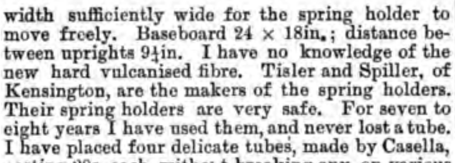
Francois's Price List.—Mr. A. Francois, of Ryland-road, Birmingham, sends us the third edition of his new price list, which contains model engines, microscopes, opera and field glasses, spectacles, and a special circular in connection with repoussé work, in which many useful hints are conveyed.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

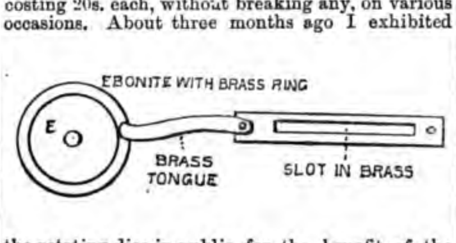
[55372.]—**Rotating Apparatus for Vacuum Tubes.**—The object of the small slot is to join up the fourth tube. The current passes through the axle to slot No. 1; from thence through the tubes till it reaches slot No. 5. The connection at the back for No. 5 is simple. Length of slot 3in.; width sufficiently wide for the spring holder to move freely. Baseboard 24 × 18in.; distance between uprights 9¼in. I have no knowledge of the new hard vulcanised fibre. Tisler and Spiller, of Kensington, are the makers of the spring holders. Their spring holders are very safe. For seven to eight years I have used them, and never lost a tube. I have placed four delicate tubes, made by Casella, costing 20s. each, without breaking any, on various occasions. About three months ago I exhibited the rotating disc in public, for the benefit of the School of Art. Applause on applause was the result. Tisler and Spiller had the R.A. for one year, with permission to make others like it, on condition it was to be known by the inventors' names. In another number of "Ours" I will give a simple way of showing off tubes in an upright position.—D. C.





[57632.]—**Chiming Clock.**—A chiming clock is far beyond my scope, and I should not dream of recommending that as an elementary exercise. Why must you begin with the hardest branches of an art? Try a kitchen clock first. To write proper instructions requires that one should work the thing out according to his own instructions, to see that they are correct and full. I shan't have leisure to do so yet awile, I fear.—W. A. S. B.

[58047.]—**Warming Room (U.Q.)**—I think your friend is right; it would not circulate if arranged with two pipes, both leading to upper floor and down again. You might fix your pipes near the top of shop, as per sketch, an arrangement which answers very well for heating; but is troublesome as regards keeping pipes full and free from frost. B is the boiler. The pipe from its top is carried along top of shop (all round if you like), and then back with a gentle slope to the bottom of boiler. This lower pipe C is connected with a supply tank T, which serves to keep the pipes full. The pipes may be concealed by ornamental ironwork.—Glatton.



[58077.]—**Gas Engine Query (U.Q.)**—The maximum pressure in a Clerk's engine is 206lb. $\frac{3}{16}$in. will be thick enough to stand this pressure; but ¼in. would be more to the taste of your ironfounder for casting without chilling. I s
I cannot answer your other questions from
ence; but should think ⅛in. water space w
and I should try a hole (square) a b
diameter, and enlarge it until experiment
that it was large enough for certainty of a
Glatton.

[58386.]—**Air-Gun Valves.**—These a
made of hoof, because it is closer grain
horn.—T. A.

[58452.]—**G.N. Engines.**—Does "W.
really think that the engines referred to
rigid wheel-base of 19ft. 1in.?—Hitchin.

[58454.]—**Furnace for Wrought-Iron**
—Will not the cupola illustrated on p.
you an idea?—Essar.

[58457.]—**Rifle Conversion.**—The
action would answer, of course; but it w
advisable to let a gun-maker fit whatever
he considers most suitable.—R. G.

[58459.]—**Dumpy Level.**—If "Johnny
will refer to Vol. XXIX. p. 57, he wil
full description of the Y level, which is bo
to make and adjust than the "Dumpy."
I think, see from that description that a t
level is far beyond the powers of an amate
cheapest and best way would be to buy w
wants. He ought to get one, second-h
£2 10s. or £3.—J. Stanyan Bigg.

[58463.]—**Drilling Machine.**—Would
answer this querist's purpose to take his m
from any of the numerous designs publi
Essar.

[58467.]—**Chemical.**—Why does not
analyse his crystals, and so obtain definit
mation instead of guesses?—F. C. S.

[58468 and 58722.]—**Furnace.**—For so
crucible as 8 × 16 I should make the
at least 14in. diameter inside, and line
thick with firebricks on end, cut or mo
shape (radially). A form of constructio
different from that formerly printed
be advantageous in so large a furnace, for
of simplicity and convenience in working
written description would of necessity be
complicated and lengthy. If the Editor t
worth while, I should be happy to send
drawing of a larger size. I should think
described, if properly formed, should
work. The casing is all wrought iron. I
know what clay is sold "at the oilshops."
Stourbridge or other good fireclay; but I
think that for a very small furnace the
composition sold by Mr. Fletcher would
mirably. Make the "base" a square p
wrought iron. Stand it on a few bricks,
four legs into it, so that it can stand like
stove, with the top of the furnace about
high. Cover the bottom inside with 1in. o
fireclay, and stand the crucible on a piece
brick. Blow gently at first, and gradually
the blast. No chimney is needed if no wo
is near.—T. F. S. T.

[58471.]—**Brass Fringing Work.**—I
think this querist would find no difficulty
taining what he wants by applying to th
merchants in Birmingham. No doubt an
tisement in the "Wanted" column would
the required addresses.—S. R.

[58477.]—**Clarionet.**—It is possible to
the wind escaping. Merely a matter of pra
Bandsman.

[58482.]—**Soap.**—Castor-oil and pot
make a soft soap only. Soapmakers ra
more than 20 per cent. of castor-oil in
with other fats.—Nun. Dor.

[58487.]—**Short-Circuit Bells.**—In r
"L.," I presume the bells you refer to are
of Bristol. I am not conversant with the
of construction; but on page 483, No. 1,0
is a description of the method of winding.
it I am unable to gather any practical re
am sorry I cannot help you in this parti
C. D. R.

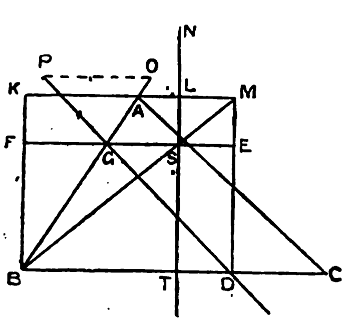
[58490.]—**Scissors, to Sharpen.**—Get
a pair freshly ground, and notice the angl
edge of blades. Then imitate. Punch t
out on a stake, and make new ones out of s
Rivet, in usual way, on the stake or
Essar.

[58496.]—**Sensitive Flames.**—If this
does not possess the back volumes, he w
bably find the information he requires in T
"Sound," which contains a number of
tions of burners for sensitive flames.
Dor.

[58497.]—**Currents set up by Fl**
These experiments are rather old, and sp
are not so good as the one in which a piece
is lowered into a bottle, and the current
set up by inserting a division down the n
querist will study the conditions, he ca
success.—Physicist.

99.]—**Perfect-tuned Piano.**—To "CLOCK —I have read your remarks on above, pub- on January 9th, and should be glad if you give in the "E. M." full particulars of your f stringing piano. It sounds rather sweep-) say that your system is superior to all ; but the hint you give as to requiring a revolution to raise middle C a full tone is, mind, a move in the right direction. I have o which has been tuned by the acknowledged ıner we have in the town, and yet in a month ut again, although the mechanism and general ıanship appear to be perfect. I blame the on the antiquated method of stringing on ınd relying on the friction between the iron nd wooden plank keeping the string at its tension. A sketch and explanation of fixing I am sure, be appreciated by more than— IELM Y. V.

537.]—**Bisection of a Triangle.**—The s to this query, p. 412, are not very satisfac- The first by "Elag" is wrong, and I see in st number of the "E. M.," p. 458, that he ' If a triangle be balanced upon its centre of y, it will also be balanced upon any straight assing through the c.g." Yes; but that is se the moments of the two c.g.'s of the seg- are equal, and not because the areas are "Verbum Sap's" solution involves a know- of conic sections, whereas the following is by ry geometrical construction:—In the figure



; is any triangle; P, a point from which it is ed to draw P D, dividing it into two equal Draw any line, such as P D, somewhere in sition it would assume when bisecting the le, and from G, where it cuts the side next draw G S parallel to the base cutting N T in eing the middle point of the base and N T a ndicular); join B S and produce to M, and M draw the perpendicular M D, meeting P D This point will not necessarily be on the as drawn in the figure; but may be above or , according to the angle at which P D is . By drawing P D at various angles, it will nd on joining the various resulting positions that a very flat curve is produced, or, in more t terms, the "locus" of D is a curve which nd to be a hyperbola. If we find two positions by slightly altering the angle of P D, and g these points, one being above and the other the base, and both being near the base, we close approximation to the exact point D, if joined with P fixes the position of the D, which will bisect the triangle, as may be thus: The rectangle K T standing on half se, and of the same height as the triangle, is to the triangle in area; also the rectangle s equal to the rectangle F D, as the diagonal through S; also the triangle B G D, being on me base and of the same height as rectangle s half the area of that rectangle, and therefore he area of the triangle A B C, so that the line isects the triangle. This, of course, is only a cal method of finding the point D, and I will ow how it may be found correctly. It has been that after drawing the lines above men- l the point D must be on the base, so that if ı fix the position of D or, which is the same the length of B D, we have solved the m. It will save trouble to use algebraic ls. Call B D, x, and D E, y; then area of le $= x y = A$ say; also call the height of P the base $= H$, also the distance P O (which iven distance as the position of P is known) Now the triangles P G O and B G D are r, so we get the equation—

$$= \frac{y}{H - y}, \text{ or } H x - r y = x y, \text{ also } x y = A.$$

these we can eliminate y, and we get, by g the resulting quadratic—

$$x = \frac{A + \sqrt{A^2 + 4 A H r}}{2 H}$$

call $\frac{A}{2 H} = m$, this equation becomes—

$$x = m + \sqrt{m^2 + 4 m r},$$

is $(2 H)\, m$, we can find the length of m geo- ally by drawing a rectangle on base B T with height H; draw the diagonal, and the point where this cuts K L will mark off the length of m. Now bring over m to the left and square, then $(x - m)^2 = m\,(m + 4 r)$, that is an unknown square = a known rectangle. If, therefore, we draw the rectangle, we can find the side of the square, or $x - m$, and therefore x, by Euclid II. 14. Thus the whole construction consists of drawing two rectangles and a circle. The above could, of course, be put in the usual geometric form, but would be tedious to follow, much more to print.—M.I.C.E., Bath.

[58557.]—**Refitting Air-Gun Valves.**—As no Birmingham reader has answered this query, I will tell "Another Amateur" how I cured a couple I have. The valves are (as your correspondent, E. R. Dale, says) made of horn. After several unsuccessful attempts to turn up the valves, and grind them in with whiting, &c., I put the gun away for a week or two. At last the idea struck me that horn would soften by heat. I then resolved to make one more attempt. I took out one of the valves with seating complete, placed the seating in a self-centring chuck in the lathe, brought the back centre up to the valve shaft, and put on a moderate pressure. I then held the valve-shaft tight with a small hand vice, and revolved the seating at a good rate until the friction made both valve and seating quite hot. I then let the whole cool, keeping the back centre tight up. I then screwed the parts together and pumped in some air, and found it quite tight. The gun has not had any air pumped in for at least six months, and a few minutes before writing this note I shot a bullet to see if the pressure had escaped.—REKSAT.

[58561.]—**Indicator Diagrams.**—Replying to "Sydney," he did not give the scale used, so I was unable to give exact average pressure, which I made as 47½lb. and 39½lb. respectively. I have already explained that the back pressure is allowed for, as you only measure the effective pressure. I must, however, apologise for not noticing before that the second diagram was at 125 revs. instead of 68, as I reckoned it, which would make it come out 105 H.P., as you say. Taking your own figures as 48·31b. in the first case, 62·7 is the power given out in the cylinder by first diagram, and 91 H.P. by second, with average pressure of 34·21b. In first case total pressure from atmo. line is 48·15lb. ∴ Calculation would stand—

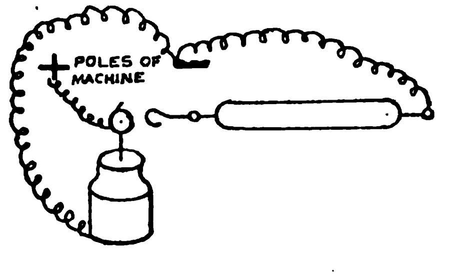
$$\frac{201 \times (48{\cdot}15 - 4{\cdot}85) \times 68 \times 35}{33{,}000} = 62{\cdot}7$$

as before.—T. C., Bristol.

[58623.]—**Contact Breaker.**—Mr. Brown's allusions to his "dismal failure with the platinum" break calls to mind my own sad experience in attempting some years ago to construct an efficient contact break for a large coil ("Inductorium" first communication). After repeated attempts, and resorting to all manner of contrivances, resulting but in a loss of time and patience, and, I may add, platinum also, I was fairly compelled to give it up as a useless endeavour, and to fall back upon the mercurial break—much against my inclinations, however, as considering the attractive force in core at disposal it certainly seemed a pity not to be able to use it. The usual plan of tensioning the spring of platinum break by means of the small screw always appeared to me to be faulty, as the platinum faces, however correctly fitted (and that this is done efficiently is of the utmost importance), must of necessity be forced out of their relative truth by the lightest pressure of said screw, with a necessarily reduced surface for contact, and its resulting concomitant, an indifferent secondary discharge. It was in Vol. XVII., I think, that I suggested a remedy, though possibly the arrangement may not have been new—namely, to mount the entire break on a sliding plate with a screw arrangement for gradually increasing or diminishing within small limits its distance from core, and a screw to clamp it firmly to base when properly adjusted. As will be seen in this case, the platinum faces once adjusted remain so, wear of course excepted. At the time I had no means of trying this arrangement, but have since; and I am happy to say proved its simple efficiency in fitting breaks to several coils; but I am bound to say of much smaller dimensions than the one above alluded to.—JOS. LEANEY.

[58623.]—**Induction Coil.**—TO MR. ERNEST BAUGH.—Many thanks to Mr. Baugh for his kind expression of opinion on p. 476. I am sure no apology is needed for his timely correction of my forgetfulness in not considering the effect on the vulcanite tube. I hope "W. J." was not misled by it. I must demur, however, to a portion of the rest of his criticisms. I do not think there is a "probability" of the inner turns of the secondary falling through the melted paraffin to the tube. In my own coil, after a few of the paper sections, with their contained wire, had been put on, melted paraffin was poured into the space between them and the tube, and answered perfectly. I believe the wire would be sufficiently rigid to keep in its place. Although I gave 65° as the melting point of paraffin. some paraffins melt at lower temperatures, and, as desperate diseases sometimes need desperate remedies, a careful heating might be preferable before taking all to pieces if the fault be a leakage inside the secondary. This might be done by passing a heated knife or strip of metal between sections and tube. Mr. Baugh is, of course, right in stating that an external short circuit on a portion of the circuit would lower the efficiency of the remainder; but if he will kindly refer to my reply, p. 453, he will see I think that no such short circuit occurs when we simply test the sparking power of various parts of the secondary by bringing out terminals as proposed, the main terminals remaining, of course, apart. I should not have expected the Leyden jar action between primary and secondary to produce sparks an inch long in a coil of this kind, and I fear I shall remain sceptical till I hear of the result taking place experimentally with a disc-wound coil. Respecting Mr. Baugh's remark on p. 455, that excessive burning at the points of the break indicates injurious leakage in the secondary, I may say that the platinum burned off my break in a few minutes, although the coil gave over 8in. sparks from 5½ miles secondary with a mercury break. Holes were also burnt through the paraffined paper of the condenser, but apparently without affecting the action of the coil, which is a very robust specimen of its class. The foils were, of course, not in contact, and the air space seems to have answered sufficiently as an insulator. "W. J.'s" primary is probably of rather thin wire. One would expect that this defect might be compensated—at all events, partially—by using a larger number of cells in series. A coil made by "Club Bearer" (Vol. XXV. pp. 239, 394) had a core 12in. by 1in. with two layers No. 16, and gave 3¾in. sparks from 3lb. No. 38 secondary. Now, referring to Mr. P. Ward's reply, p. 476, if "W. J." puts three layers of No. 12 on a core to fit inside his present secondary, said core must be only about ¾in. diameter—certainly too small for the coil. If Mr. Ward will investigate the relative inductive effects at all points along any given core and primary, he will find that the length of "W. J.'s" secondary coil is much better as it is at 5in. on a 12in. core than 9in. on a 10in. core. The Polytechnic coil, with its spark of ·19in. per mile of secondary, or the late Mr. Spottiswoode's, with its ·15in., are not much to brag of, I think, compared with the results got from various smaller coils. I have always had little doubt that in these cases the insulation as well as the plan of the secondary was at fault; and if the wire on these coils was treated as described by Mr. Ward, and then allowed to cool before winding on (as we are left to infer), I do not wonder at the more carefully-made amateur coils beating them so far, good insulation being so much more necessary in a large coil than on a small one.—J. BROWN, Belfast.

[58668.]—**Lighting Vacuum Tubes.**—F. Taaffe can light up a vacuum tube by an influence machine by connecting it according to accompanying diagram, but he will get no striæ. If he desires



to form striæ, he must use at least four 16in. plates driven about 200 revs. per minute, and he can then connect up direct to machine. The former way is intermittent and the latter continuous.—PAUL WARD.

[58678.]—**Formula.**—Will "W. H. T." please note that in my reply to this query, printed in to-day's issue of the "E. M.," I have inadvertently stated the circumference of the circle as being = radius × π, instead of diameter × π?—A. O. E., Edinburgh, Feb. 5.

[58691.]—**Reflecting Telescope.**—You have spoiled the figuring of the mirrors, upon which the good definition depends, and you will not be able to get them right again yourself. The only remedy is to send them to the working optician, and if you write to me or advertise your address I will give you the name of one in London who would most probably do them for you.—T. C. LINSCOTT, Ramsgate.

[58692.]—**Paper Mills.**—The smallest mill you can erect is one with a single paper machine. This machine should be about 80in. wide, and, of course, of modern make. The rest of the machinery is in proportion, and consists of steam and raw-material boilers, beaters, breakers, poachers, press-plate machine, calenders, steam-engine, &c., and a soda-recovery plant. Such a mill as this, building and machinery, would cost between £30,000 and £40,000. But you are too vague in your expression "commoner kinds of paper," as this might mean brown, and if this is the case a mill such as above might cost considerably less. The only way to get at the exact cost, however, would be to get estimates for the engineer and building work, and what the ground fee is. I rather think, however, that papermaking is a larger concern than you imagine, and I should advise you to be most careful in laying out any money on this line of business, as, like most things, at present papermaking is very depressed, and small mills have the worst of chances, for quantity alone pays.—PAPER MAKER.

[58692.] — **Paper-Mills.** — Supposing steam-power to be used (if water-power, the first cost would be less).

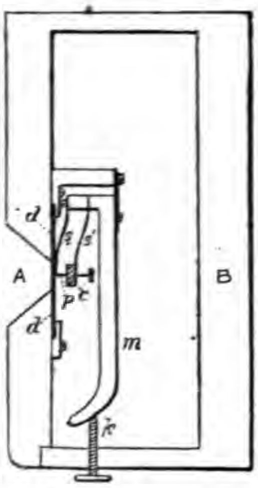
1 Steam boiler	£100
1 " engine	60 to 80
1 Small "	10
2 Rag " £25 each	50
1 " chopper	25
1 " boiler	30
1 Chest for soaking old paper	10
2 " " holding pulp, £10 each	20
1 " " making size	5
2 Pairs of scales, £5 each	10
1 Hydraulic press	100
1 Paper cutter	25
1 Paper machine	250
1 Wire for machine	20
1 Wet felt machine	10
2 Dry felts, £10 each	20
1 Cistern for lime liquor	5
Sundries	100
	£850

If the machine is a small one, that is, not more than four or five cylinders in the drier, one dry felt would be sufficient, also a screw-press could be used instead of hydraulic until the mill was fairly started, screw-press, £20. I think £100 for sundries quite ample; this amount would find one or two pumps, benches for finishing, and a few other little things that would be found requisite. I have based this estimate upon the supposition that rope, sacking, and waste papers are to be the raw materials; but to make paper from wood a much more expensive plant would be required. Wood pulp (dry and semi-dry, 50 per cent. moisture) can be bought, and is sometimes used with the rope, &c., for making browns; also starch, plaster, umbers, and ochres, alum, size, &c., &c. A great deal would depend upon the party who would buy the plant. If "Marchen" does not understand the machinery, let him be thoroughly satisfied that the party he is going to aid in starting a mill is honest. I know of a case. A gentleman let part of his property, with water power, to some men who *said* they were going to make millboards; they told the gentleman that a pair of glazing rolls would cost about £140. I know, from personal experience, that as good a pair of rolls as any that are at work in the country, and as good as can possibly be required, can be had delivered to any railway station in England for £70. It is quite likely that my statement may be questioned as to the cost of plant; but I know a paper-mill which is working and paying well in which the whole of plant is not worth more than £350, and a machine mill, too. I also know another mill, where the machine cost but £120 secondhand; at the time this machine was bought another was offered for £320, a splendid machine; it was being pulled out to make room for a larger one. I will just add, that even with the outlay that I have stated it would be problematical whether it would pay—most likely it would, if properly managed. I should be glad to furnish any further information, that is in my power, and wish you success in your venture.—J. G., Bristol.

[58694.]—**To Mr. Bottone.**—The rule for resistances of F.M.'s and armature is that the wire on the F.M.'s should be about one-third less in resistance than that on the armature, but about two gauges larger in thickness. Thus, if the armature be 16, the F.M.'s should be 12. This applies to series winding. For practice, owing to the fact that the outer layers of wire are further away from the core than the inner ones, and consequently less active, it is better to allow the same resistance on the F.M.'s as on the armature. For shunt-wound machines, the resistance of the fields should be at least 400 times that of the armature. A machine to give 30 to 40 c.p., if series wound, would require about ½lb. No. 20 on the armature, and about 6lb. No. 16 on the F.M.'s, if Siemens type and series wound. If of the Gramme type, about 1lb. of No. 20 on the ring, and from 2lb. to 3lb. of No. 16 on the F.M.'s, supposing the iron be soft and good. —S. BOTTONE.

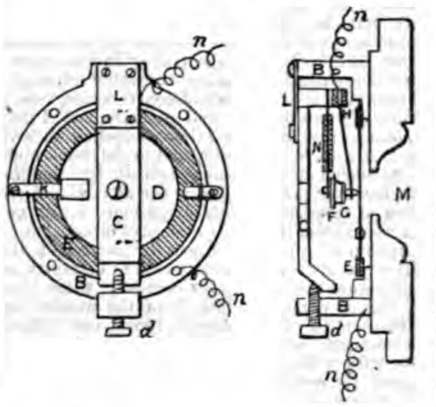
[58699.]—**Engine.**—Don't you want the engine to do anything else but turn the flywheel? If not, almost anything will do that, say, ¾in. diameter and 1½in. cylinder, according to pressure you use and speed of wheel; but above ought to make it spin lively.—T. C., Bristol.

[58700.] — **Microphone Transmitter.**—The transmitter used by the United Telephone Co. is an application of the "hammer and anvil" type of microphone known as the Blake. As shown in annexed diagram, it consists of a box B having a



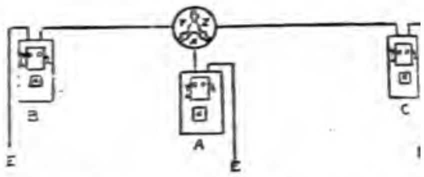
mouthpiece A to speak into, and a thin metal diaphragm *d d*. Against the diaphragm are pressed, by means of springs S S', a small piece of platinum *p*, and a button of hard carbon *c*. The hammer and anvil are formed by the platinum and carbon, the pressure being regulated by the screw K, which acts on the suspended piece *m*. An induction coil is employed, its primary being connected to battery and microphone, its secondary to receiver and line.—BOBADIL.

[58700.] — **Microphone Transmitter.**—The transmitter used by the United Telephone Co. is the Blake, of which the above is a sketch, showing interior construction in plan and section, which acts by varying the resistance of the local circuit, by means of a platinum point pressing against a hard carbon button. A is the front part of a



wooden case, in which the whole is inclosed, and in which is cut a circular mouthpiece M. B is a cast-iron frame C, an iron arm fastened to B by spring L carrying spring N, and brass carbon-holder F, and also carries, by means of insulating hub H, the spring and platinum point *c*. The whole is adjustable by a screw at *d*. D is the diaphragm of thin sheet-iron insulated by a rubber ring E; a steel spring K also presses on D, likewise insulated by a rubber cap. A small induction coil is placed in back of case. The action of the instrument is as follows:—The sound-waves striking the diaphragm D cause the platinum point *c* to vibrate in unison with it, and thus varies its pressure on carbon button F, and producing variation in current; the current flows from one pole of the transmitter cell to wire *n*, then to spring and platinum point *c*, then to carbon button F, and spring N to frame B and wire *p*, then to primary coil of induction coil (not shown in drawing) to other pole of battery.—F. C. A.

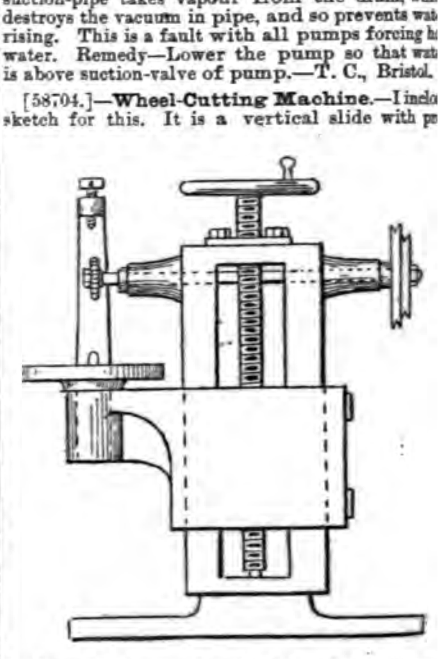
[58701.]—**Telephone.**— A B C = three telephone stations; E E E = earths; X Y Z = three-way plug switch. If Z and Y are both connected with X, B and C can both ring up A. The switch must be "left" in this condition. By removing the plug between X and Y, A can communicate with C. By removing the plug between X and Z. A can communicate with B. By removing bot these plugs, and inserting one between Y and Z, can communicate with B, and vice-versâ. B mu must ring once and C twice in attracting A's atte



tion. A will, by this means, know whom to answ This might, of course, be done by a couple of i dicators.—STEATITE.

[58702.]—**Water-Raiser.**—This is a pump, suppose. At any rate, the fault is simply th suction-pipe takes vapour from the drain, whi destroys the vacuum in pipe, and so prevents wat rising. This is a fault with all pumps forcing h water. Remedy—Lower the pump so that wat is above suction-valve of pump.—T. C., Bristol.

[58704.]—**Wheel-Cutting Machine.**—I inclo sketch for this. It is a vertical slide with pr



jecting table for carrying division-plate, and cent in a boss of the table, and an arm sliding up and down in another boss, and carrying a top-centre, provides for different lengths of mandrel. The arm must have a feather to keep it from turning and a set-screw to fix for height. Cutter spindle at back or front of slide, as "Brass" prefers, or if he likes it better, can make centres fixed and cutter to slide up and down on a carriage.—T. C., Bristol.

[58705.] — **Seamless Lead Joints.**—These joints are made by being burnt together—i.e., the edges are brought to such a heat by means of a portable gas blowpipe that they melt together. Mr. Davies gave some very good articles on doing this (in various positions) some time back. If you have never done it, you will be well repaid by reading them, and practising on small pieces before you start on the vessels you have to make.—T. C., Bristol.

[58705.]—**Seamless Lead Joints.**—The only way in which I know this to be possible is by "burning." If "Brass" works up his lead to the required shape, cuts the two edges to be joined quite straight, brings them closely and firmly together—in which position the article must be fixed for the next process,—lays a thin narrow strip of lead along the joint, and then brings the blowpipe to play carefully along the line of joint until, and just until, the lead becomes liquid, he will have a seamless joint. It is better to have some solid substance the shape of the inside of the article—if simply round a piece of half-round wood, for instance—in order to support the metal when it reaches melting point.—E. P. HANSON.

[58706.]—**Stationary Engine.**—Six miles an hour = 528ft. per minute. Resistance due to incline = [$\frac{100}{350}$ × 5 × 2,240] = 3,200lb. Resistance due to speed = 5 × 9 = 45lb. ∴ total power required = 528 × [3,200 + 45] ÷ 33,000 = H.P. nett. Let the engine indicate 80 H.P. to allow for its friction and other contingencies. If the rail curves much, you must put in a guid pulley for rope. I cannot say at what angle tru would leave the rails; but, personally, should allow more than 15° or 20° side pull, although would not probably leave at 30°.—T. C., Bris

[58708.]—**Amalgamating Zinc.**—"Ga should certainly succeed easily in doing this

litions he names. Perhaps he has not dis-
ff all the oxide. If he has sufficient mer-
the purpose, let him put ½lb. or so into the
dips his zincs in, and let it remain in con-
them and the solution of acid.—PAUL

8.]—**Amalgamating Zincs.**—There is n
so reliable as the Fahrig process (see
amating and Recovering Tin from
by Herr E. Fahrig, *Scientific American*,
y, 1872, and ENGLISH MECHANIC, I be-
ily, 1879, neither of which papers I have
now; I copied, however, the portion
ating, and have used it ever since. For
ating zincs for electrical purposes dis-
ch pound of caustic soda in one quart of
ot), each zinc to be amalgamated steep in
tion for one or two seconds; now have a
iron tray, and cover the bottom of this
h mercury; to each pound of mercury used
muriatic; now take the zincs out of the
g solution into clean water (cold), to each
ons of which add 2oz. sulphuric acid. From
e the zinc into the tray, and roll or move
wice to and fro, and if cylinders use a mop
washleather to amalgamate the inner sur-
will act immediately as soon as it makes
with the tray, and, no doubt, the iron has
ng to do with it. As soon as the zincs are
lgamated, take them from the tray and
em in clean hot water, which will insure a
rying and keeps the amalgamated zincs a
l colour; pack, if to be stored away, in
mixed with lime. Before I read of this
simple device I was very much troubled;
happy to say it is the simplest thing out to
ate successfully a great quantity of zincs
y few moments.—ZINC JACK.

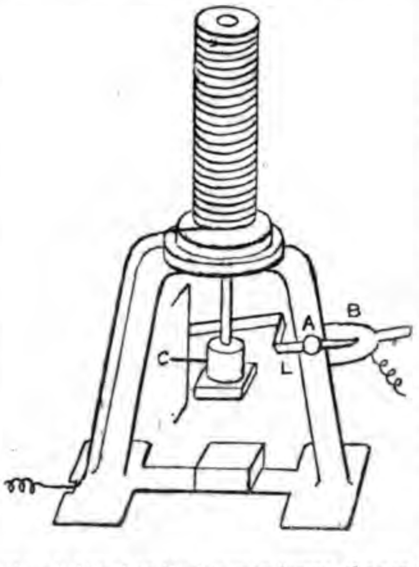
.]—**Atoms.**—The atoms are entirely
y, and are supposed to be some indivisible
material substances. Boscovitch con-
that they seemed to be centres of force
within the stellar universe; but he was
o discover a trace of their action on the
f it. In modern physics, atoms are said to
onents of molecules, and the molecules are
olumes or weights of the supposed chemi-
ents. If the molecules were larger or
than certain quantities which can be esti-
numerical values, the assumption is made
y would lose their characteristic properties
is heat, electricity, &c.; but mathematical
hy has failed as regards atoms or ultimate
matter, and is not likely to be successful
uestion until some definite action, either
boundary or from the outside of stellar
discovered.—J. SUTCLIFFE.

.]—**Rice-Husking Machine.**—I am not
nswer all "W. H. C.'s" questions in con-
with this, but can reply to some extent to
. Twenty years ago there was a rice-
machine in operation at the foundry,
i, Japan, which had been sent out from
; it resembled a quartz crusher, but
f steel crushers had wooden ones. With
an did more work, better and quicker, than
ive could do formerly.—E. P. HANSON.

.]—**Limelight.**—I have used zirconia
s for about 10 years for occasional purposes.
re about ¼in. diameter and 1in. long, and
en to the late Wm. Spottiswoode by a
chemist whose name I have forgotten.
ar out very slowly by the head or end
in. long) cracking off, when one uses the
ace. I mounted them in a spiral of plati-
e, No. 20 B.W.G. I tried all I could to
more through the kindness of Mr. Neville
askelyne, late of Mineralogical Depart-
ritish Museum, but failed. I am afraid
zircon cylinders cannot be bought.—PAUL

.]—**Dynamo.**—TO MR. BOTTONE OR
VES.—This dynamo is very small to give
ght. You do not say whether you have a
laminated armature or not. Supposing
er be the case, you may use about 1lb. of
armature, and about 10lb. of No. 16 on
. Drive at about 2,500 revolutions.—S.
E.

.]—**Solenoids.**—A solenoid is simply a coil
and generally has a hole in the centre. It
ower, when a sufficiently strong current
rough it, of sucking an iron core into the
l the magnetic centres of the core and
coincide. After reading the description
the hammer you will understand how to
notor for your models. You might make
emble a steam-engine. The coil would
place of a cylinder, the core that of the
d the make and break that of the slide-
You would, however, not get much power
cell. A boxwood bobbin having a hole
it, is wound with wire, and mounted on a
ing. One end of the wire is connected to
l, and the other is fastened to the brass
The current runs from one terminal through the bobbin, then along the casting to the nut A; it then runs along the lever L, and thence to the stud D, which is mounted on a piece of ebonite, B. From D a wire is led to the other terminal. When the hammer is on the anvil the lever is in the position shown. When the battery is joined on the hammer jumps, the pen C strikes the top arm of the lever and breaks the contact at D; the hammer then drops into the anvil, strikes the bottom arm of the lever, and makes the contact at D. The movement is then repeated, and continues till the battery is exhausted.—G. BOWRON.



[58721.]—**White Liming.**—You should have first washed off the old coat. Had you done this, you would have had no trouble. Wash off both, and do afresh.—C. D. R.

[58724.]—**Boiler Query.**—The boiler is large enough for the engine, but I should advise you to have a larger grate. Have 12in. × 8in.; you won't be troubled half so much with stoking. Boiler will be plenty strong enough for 80lb. if made in iron. For my own part, I should have the grate as large as the boiler, 12 × 14, say, like a copper firehole.—T. C., Bristol.

[58725.]—**Circular Milling Cutters.**—I drive these at about 20ft. per minute at circumference, and flute taps by fixing cutters between lathe centres on a mandrel, and feeding the taps to the cutter on the underside, being liberal with oil or soap-suds; and, as you say—the work advances against the cutter—it is apt to ride if fed the other way. Yes; front edge pointing to the centre is best for general work and shape of tooth, that of a shallow hand-saw tooth.—T. C., Bristol.

[58727.]—**Music Plates.**—These are made of pewter. I will endeavour to let you know where the tools are to be obtained. With regard to a practical work on the subject, I never heard of one.—C. D. R.

[58732.]—**Photo. Lens.**—My own experience with a Grubb landscape lens agrees with that of Mr. Clark. I have one of about 5in. focus, intended for stereoscopic work only, and as supplied it covers 5 by 4. I took the stops off and put in on my half-plate camera, and I found no dark corners; but as soon as I stopped it down they appeared. I then screwed the lens into another mount which allowed the stops to come closer to the lens, and the half plate was covered well up to the corners. If Mr. Clark can place his stops nearer to the lens, I think he will find his plate well covered; he must, however, take care not to place them at that distance which produces a flare spot, which is due, I think, to an image of the stop produced by internal reflection from the inner surfaces of the lens.—T. PERKINS.

[58734.]—**To Mr. Bottone.**—I should imagine your arrangement would answer. The position of the triangular piece is almost immaterial, as by virtue of its shape it is sure to break contact at the right time—at least, once in each revolution. I may write a series of letters on the subject when I am a little less busy; but I have no time now.—S. BOTTONE.

[58736.]—**Hot Poles of Field Magnets.**—I have seen one or two machines in which the same thing occurred, which on examination showed a short circuit in the wire, or between the wire and the iron itself.—P. C., Hornsey.

[58739.]—**Brasswork.**—You don't want the half cannon-ball for flat plates. Spread the pitch on a board, with strips nailed along the edges—an inch will probably be more than deep enough. Melt 7lb. of pitch and 1lb. of Russian tallow, and stir in 3lb. of plaster; less tallow is required in hot weather. But 24in. by 9in. is a biggish thing to begin upon.—W. A. S. B.

[58739.]—**Brasswork.**—The cup you mention is made of cast iron, very thick at the bottom, and is mostly used for concave or convex surfaces which require moving in various positions. Wood or stone coated with cement would be most convenient for your piece of brass. You may make a pad for your cap by taking a ring of iron or rope and wrapping rag or string round it until it is the thickness required. If you will advertise your address, I will send a few hints on brass-work I have printed.—A. FRANCOIS.

[58739.]—**Repousse Work.**—The cement used for this work is composed of pitch and plaster of Paris in equal quantities by weight. The pitch should first be melted at as low a heat as possible, and the plaster added by degrees, stirring the mixture all the time. If the weather is very cold, or if the pitch has been remelted very often, I add a piece of Russian tallow about the size of a large walnut to the kettle of pitch. The chaser's bowl is like a common bowl cut in half, and hollowed out inside. It is made of cast iron. The cushion has for a foundation a ring of iron ½in. thick and 7in. in diameter. This is wrapped round with rags or strips of flannel until it becomes 2½in. thick. Chasers use this arrangement for small articles and hollow work principally. It is very convenient for this work, as it forms a sort of ball and socket-joint, and the work can readily be turned in any direction that may suit them best. Of course a piece of brass 2ft. by 9in. cannot be worked in this way. A pitch block must be used—to make it, level a slab of stone, and pour the melted pitch on to the centre of it, distributing it with the back of the ladle. Add layer after layer until it is about ¾in. thick; lay the plate on this after having warmed it, and work with the fingers some of the pitch over the edge of the plate to help to keep it down. As "Brasswork" appears to be quite a novice, I should strongly advise him to commence with a smaller plate than the one he mentions. It is, moreover, an inconvenient shape. If I can help him further, I shall be happy to do so.—FAL.

[58740.]—**Dampness in Beehive.**—As your bees were not put in the hive till September, it is possible that there would be a quantity of unsealed food in the combs which would become thin and ferment, and run out of the cells on to the bees, or, possibly, snow has been driven in at the entrance, and caused the trouble by melting inside the hive. Treatment: The first mild day carefully turn up the quilt from behind, and if there are any frames without bees on, quietly remove them from the hive, wipe the floor-board as clean as you can, then, if possible, slide the frames containing the cluster of bees over the part you have cleaned, while you remove dead bees and clean the other part of floor-board. Do all this as quickly as possible, but do not disturb the bees more than you are obliged; keep the quilt over them while you are cleaning the floor-board. Take notice whether the bees have soiled the combs with their excrement, and whether they appear dull in their movements with their abdomens swollen; if so, they are suffering from dysentery. Having noted this, close up as quickly as you can, keeping out all combs not occupied by the bees when you opened the hive, especially if they are soiled and wet. For quilt use one thickness of dry warm ticking, and three or four of dry and warm flannel. If any bees crawl out and get chilled on the flight-board or ground, collect them in a tumbler, and lay a piece of perforated zinc over it; you can then revive the bees by taking them to the fire. When they have got lively, take and invert the tumbler over the feed-hole in quilt, and leave it there till they have all gone down. If the bees want feeding, give them a little syrup with the chill taken off every night. If suffering from dysentery, a clean, warm, and dry hive, wholesome food, and encouragement to fly on mild days should restore them to health.—W. COXON, Ambaston, Derby.

[58742.]—**Twisting Moment.**—If the spindle is of iron, and giving it a factor of 10 for safety, it will require to be 3½in. diam. Having a factor of safety of 10 it, of course, will break with a weight of 10 tons acting on the rim of wheel.—T. C., Bristol.

[58746.]—**Spring Brass.**—Providing it is of suitable quality, you can make it suitable for springs by passing it through rollers under considerable pressure several times, or, failing these, by hammering until hard enough for the purpose.—T. C., Bristol.

[58746.]—**Spring Brass.**—In answer to Ewart, I have successfully made springs out of sheet brass by cutting it first into strips about size required, and then hammering it on the anvil, or any block of iron that has a smooth surface, until you get the required degree of hardness; then shape your spring with the file, and finish by grinding, pressing lightly, and be careful not to heat. Another bit of information to soften brass for making bends, knees, joints, &c.: heat in fire to cherry red, and plunge in cold water immediately.—JOHN M. MACKAY, Glasgow.

[58747.]—**Faulty Electric Bell.**—It is evident that there is a short-circuit somewhere, even when the pushes are not pressed. The very fact of the ring stopping whilst being examined proves this. The contact is probably in, or close to, the pushes. —S. BOTTONE.

[58748.] — **Incandescent Lamp.**—There is no battery of the description you require in existence. The nearest approach to it is a bichromate, descriptions of which have appeared every week almost.—C. D. R.

[58748.]—**Incandescent Lamp.**—One 5-c.p. Swan's lamp should replace a ½in. paraffin burner. If a closed battery is absolutely necessary to work it, the chloride of silver would be suitable. It is an expensive battery to purchase and difficult to make; but if you are anxious to try its construction I shall be glad to give details.—BOBADIL.

[58749.]—**Accumulators.**—If you have soldered the lugs on your plates with ordinary solder, you will find they will soon corrode: they ought to be burnt on at least. Also, the plates ought not to touch the bottom of the jar, as it is liable to lead to failure. I suppose you removed all grease from the plates before putting them in the nitric acid, and of course you did not attempt to charge six accumulators (in series) by means of five primary cells, else that would lead to failure. Charge each cell up separately for four or five hours, and try that way. Four of your cells ought to light your 8-volt lamp.—P. C., Hornsey.

[58751.]—**Engine Query.**—The ports ought to have ¼ square inch area. If you have a strong draught, 1 square foot of heating surface should be sufficient for your engine.—T. C., Bristol.

[58753.]—**Teeth of Wheels.**—You require involute teeth for these rollers if required to work *accurately* for special reasons. The teeth may be struck out by winding a string on a roller, size of wheel, at normal pitch line, fastening a pencil in end of string and describing an arc as it unwinds. This gives one side of the tooth; the other, of course, is like it.—T. C., Bristol.

[58754.]—**Hook-Tools and King's Cliffe.**—A very interesting account of King's Cliffe and its industry, with sketches of some of the products and of the hook-tools will be found in Vol. XV. p. 402. The sketches of tools do not show more than the form of curve, and give no particulars of the shape of cutting edge.—GLATTON.

[58755.]—**Gramme Dynamo.**—Kindly refer to No. 1,007 of "E. M." for general instructions in the construction of a small Gramme dynamo.—S. BOTTONE.

[58758.]—**Hooping Cylinder.** — If "Blacksmith" adds the thickness of his hoop to the diameter given and multiplies by 3¼, he would get the length required. Thus, 3ft. 6in. + 1in. = 3ft. 7in. × 3¼ = 11ft. 8¼in.: sufficient length to make a hoop from iron 1in. thick. No allowance is made here for welding, as smiths are supposed to make their own allowance for welding hoops, &c. There are useful books to get, with dimensions for making all sorts of hoops, in the New Market, Newcastle-on-Tyne: Foden's "Mechanical Tables," price 1s. 6d.; Foden's "Boiler Makers and Shipbuilders' Companion," price 3s. 6d.; and S. Nichol's "Practical Boiler Maker," price 7s.—JOS. WEATHERBURN, Widdrington.

[58765.]—**Dental.**—You are not liable to prosecution for repairing artificial teeth any more than you would be for mending a cork leg; but there is no line to be drawn between a mechanical dentist and a surgeon dentist, as the word "dentist," with either affixes or prefixes, belongs solely to the dental profession. The law does not consider you (nor does it allow you to call yourself) a dentist of any kind till your name has been placed on the Dental Register.—OS.

[58765.]—**Dental.**—41 and 42 Vic. cap. xxxiii. No. 3. From and after the first day of August, one thousand eight hundred and seventy-nine, a person shall not be entitled to take or use the name or title of "dentist" (either alone or in combination with any other word or words), or of "dental practitioner," or any name, title, addition, or description, implying that he is registered and under this Act, or that he is a person specially qualified to practise dentistry, unless he is registered under this Act, &c. Any person so doing is liable to a fine not exceeding twenty pounds. "Urgent" will see from the above that he can mend artificial teeth (in a manner peculiar to jeweller's) without fear of being prosecuted, provided he does not infringe the above Act.—L. D. S.

[58765.]—**Dental Query.**—So long as "Urgent" does not call himself a dentist or send out circulars or business cards intimating that he does dental work, he may go on repairing as many artificial dentures as people like to intrust to his care. It's simply a business transaction with which no outsider has anything to do or right to interfere, and for which no diploma is required (in fact, that is the weak spot in the Dentists Act; it interferes with a trade). As regards drawing the line between the surgeon-dentist and the mechanical dentist (after an apprenticeship is served) it is an impossibility, and has never yet been done, as not only are the two so interwoven, but 90 per cent. of dentistry is mechanical, surgeon-dentist or dental surgeon being a title assumed, said title being practically of little or no value, as the public, both general and particular, always speak of "My dentist."—DENS.

[58766.]—**Boring Hole in Lathe.**—Support the shaft in a boring collar and force drill up by back centre; an ordinary flat drill will do, or, if wanted very clean, a half-round bit. There is no difficulty in the boring; but you must keep taking bit out to clear cuttings and to lubricate. If you twist the shank of drill so as to form a coarse screw, it will help to bring out cuttings.—T. C., Bristol.

[58767.]—**The Wimshurst Machine.**—"Donegal" will find sixteen sectors answer very well. They should be about 3½in. long by ⅝in. wide at the broad end, and a ¼in. at the narrow end. He should read up the description of the machine published in these columns, 16th Oct., 1885.—J. W.

[58769.]—**Lead for Gravity Battery.**—Why not use a glass funnel? Are you sure you don't mean Dale's signal battery?—C. D. R.

[58770.]—**Cause of Deflection of Galvanometer Needle.**—TO MR. BOTTONE.—The current traverses the wire, entering at one end and leaving it at the other. In so doing it converts the wire into a magnet, with its poles at right angles to the direction of the current; the needle then seeks to place itself in obedience to this magnet.—S. BOTTONE.

[58771.]—**Funicular.**—Let P be the peg, A B rod; weight, W at A, 2 W at B. Let T be tension of string and T' the thrust of rod. Since the peg is smooth the tension of the string is the same each side. Draw P K vertical, meeting A B in K, then, since forces acting at A are parallel to sides of triangle P A K, they are proportional to them.

$$\therefore \frac{PA}{T} = \frac{PK}{W}. \quad \therefore T.PK = WPA.$$

Similarly—

$$\frac{PB}{T} = \frac{PK}{2W}. \quad \therefore T.PK = 2W.PB.$$

$$\therefore W.PA = 2W.PB.$$

$$\therefore PA : PB = 2 : 1.$$

—IGNOTUS.

[58772.]—**To Mr. W. H. Eaves.**—I am afraid your dynamo will be a source of much trouble to you. I have no doubt you bought it at a low figure, so you must not expect too much from it. I hope it will be a warning to yourself and others that although a dynamo may appear cheap in first cost, yet when the same dynamo is put to practical work it may be very dear indeed. As it may interest others, I will show exactly what power it will take. You say that in the maker's list it is stated to be 160 c.p. Then eight 20-c.p. lamps require an expenditure of 60 × 8 = 480 watts. The amount of energy absorbed in the internal circuit will be found by the formula $C^2 \times R$. The current for each lamp is 1·3 ampère, so that the current flowing through the entire circuit will be 1·3 × 8 = 10·4. Armature res. 2·07; F.M. res. 3·35. Then $10{\cdot}4^2 \times 5{\cdot}42 = 586{\cdot}22$ watts. External circuit 480 watts (useful); internal circuit 586·22 watts (waste); total, 1066·22 watts. 1066·22 watts = 1·429 H.P.; add to this ·3 H.P. for friction, sparking, eddy currents, &c., and you have 1·729 H.P. required to light eight 20-c.p. lamps—a truly sorry picture of a modern dynamo efficiency.—W. H. EAVES, Coventry.

[58773.]—**Plain and Ornamental Turning** —"TO DURSTON."—Will you advertise your address? I dare not advertise my address as one who is willing to give away designs freely, and as I have not a lathe suitable just now, I do not like to publish designs that I have not worked; but would gladly give "Durston" private hints and sketches on the condition that he repeats his experience to me. My letter (25289) was only accidentally "anonymous." —W. A. S. B.

[58775.]—**Calcium Persulphide.**—Best prepared by slaking lime-water with an excess of flowers of sulphur. It crystallises out in yellow crystals of composition $CaS_2 + 3H_2O$.—C. F. P.

[58775.]—**Calcium Persulphide.**—Boil one part, by weight, of slaked lime with two parts of sulphur and sixteen parts of water. This will give a solution containing calcium persulphide, and on pouring the clear, cold liquid into dilute hydrochloric acid, hydrogen persulphide separates out as a heavy yellowish oil.—WM. JOHN GREY, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[58775.] — **Calcium Persulphid**
equal quantities of sulphur and calci
are boiled with water, the result is
coloured liquor, containing calcium
pentasulphide, and hyposulphite —
= $CaS_2O_3 + 2CaS_2$. To obtain hydr
phide, pour the solution slowly int
mixture of hydrochloric acid 1 part,
2 parts, stir frequently, and the hydr
phide collects at the bottom as a "y
oily liquid." Thus:—$CaS_2 + 2HCl = H$
—W. STANLEY SMITH.

[58776.]—**Hypochlorite of So**
Borax.—On mixing solutions of the
there is no visible change, and in all
no change at all. I mixed a small
NaOCl with much $B_4Na_2O_7$, and then
solution could be used as a test for i
usual manner. It answered perfectly.—
GREY, F.C.S., Analytical Chemist, N
Tyne.

[58777.]—**Troublesome Battery.**—
achromatic batteries for some time
corrosion of brass work, and it would
know what make of battery it is b
advice.—OS.

[58777.]—**Troublesome Battery.**—
clean your carbons thoroughly, dry the
some time in an oven. File a slot rou
each, cast a lead cap on the top of ea
to a convenient shape. Paint the carb
⅜in. from the lead with hot melted pa
will effectually prevent creeping.—S. B

[58777.]—**Troublesome Battery.**—
black and paraffin wax do not agree
the wax keeps the black soft. I am
have not soaked the carbons enough.
and be sure the wax penetrates right
carbons. You can drive off sufficie
quired by means of a hot iron. There
band of solid wax right through to b
C. D. R.

[58777.]—**Troublesome Battery.**—
querist's description, it would seem to b
element that is referred to where the
brass clamp takes place. It is, of cour
correct to soak the top in melted pa
but there is no advantage in using Brun
afterwards. All that is necessary, aft
just sufficient space for the brass ter
place a slip of platinum foil between
and the clamp. This plan I have used
years, and with complete success.—STE

[58778.]—**Steam.**—The steam in boi
to drive out the air that was in boile
could fill the space the air occupied,
being at a pressure of 15lb. sq. in.,
must evidently have at least that pres
it can take its place, and as the gauge d
pressure of air, it will not show pressu
taking its place only. Now, in all q
expansion you must add 15lb. to the pre
by gauge in both non-condensing and
engines, but in the former case you ded
computing the terminal pressure, in ord
the effective final pressure in cylinder:
in boiler = 25 + 15 = 40lb. total, and
example you give, it is expanded to
atmo. = 15 − 5 = 10lb. absolute—it wa
four times ∴ it was cut off at ¼ stroke.
pressure would be 23¾lb. throughout
that is reckoning from a perfect vacu
condensing engine (less 2 or 3lb. for bac
If in a non-condensing, the effective av
sure would be 23¾ − 15 = 12¾lb., and all
for back pressure, would be 10lb. avera
—T. C., Bristol.

[58778.]—**Steam.**—In estimating th
of pressures at different parts of the
engine, the *absolute* steam pressure is
absolute pressure is the sum of the
pressure, and the excess of the stea
above that of the atmosphere. In yo
initial absolute pressure is (25 + 15 =
square inch. The pressure of release
than the pressure of the atmosphere, or
10lb. absolute. The cut-off, to produce th
of release, if there is no allowance fo
will be $\frac{10}{40}$ = one-fourth of the stroke.
the same pressure inside and outside a bo
raising steam for the first time after fill
the boiler cools down a partial vacuum fo
if the valves do not leak the pressure
than that of the atmosphere. The st
shows no pressure until the steam pressu
that of the atmosphere, and then it ind
amount of the excess, whatever the at
pressure may be at the time. Rules for
horse-power are given nearly every we
you are not clear on the subject, and ar
willing, I will, when I can find time, giv
estimating the size of an engine
given power. In working out the
be remembered that the absolute

and what is. called the back pressure is g, the motion of the piston: The difference is to be taken as the effective pressure.—)N.

).]—**Fulcrum.**—The bar being uniform, rill be at middle of its length. Let $2a$ be h, and W its weight. Also let w be any placed at its end. Take moments about er end of rod thus: $Wa + w2a$, and divide m of the weights of the rod, and the added $= W + w$, so $\frac{Wa + 2wa}{W + w}$ you will find the at which they balance. Say rod weighs d added weight 5lb. and 20″ (that is to say it length, then—

$$\frac{10 \times 10 + 20 \times 5}{10 + 5} = 13\tfrac{1}{3}''.$$

Bristol.

0.]—**Fulcrum.**—If a be the length of b the weight of the rod, and c the given attached to one end, the distance of the from the end at which the weight is rill be $\frac{ab}{2(b + c)}$, that is the product of th of the rod into its weight divided by e sum of the weights of the rod and the eight. The above rule is found as follows: the given rod A B of weight b, and length balanced about the fulcrum C when a c is placed at B. The weight of the rod supposed to act through its middle point s, since there is equilibrium, we must

$$\times CB = b \times CD = b\left(\frac{A}{2} - cB\right)$$

e—

$$CB\,(b + c) = \frac{ab}{2}$$

$$CB = \frac{ab}{2(b + c)}$$

TION.

3.]—**Tuning Hammers.**—I suppose this to turn the pins; if so, get one made with n head, and into the holes in the head you a lever of any length you like. This would little or no exertion to turn.—Os.

1.]—**Silvering Incandescent Lamps.**— ald be accomplished by any of the ordinary of chemically depositing silver on glass, p being half-immersed in the solution, and ed by its pointed end. But I should think it worth the trouble and mess, when flectors may be bought that can be readily for the purpose.—STELLA.

7.] — **Case-hardening Wrought-Iron es.**—It is not possible for "Jigger" to den his spindles in bearings as stated in but they can be successfully hardened out bearings by adhering to the following ns:—Procure cow's-horn, horsehoof parings, her shavings. Horn can be cut in small ith a saw, or, better still, use coarse wood d keep what falls from it; next, get a malleable iron pipe, about 3in. longer than indles, and of a diameter sufficient to hold r four at one time. Mix horn, &c., with l quantity of bay salt, and sprinkle white negar on the whole just enough to dampen; iron pipe horizontal, put a lump of moist in one end to make it air-tight, if possible; it in a layer of cow's-horn, &c., lay on a cover with the mixture, repeat until pipe . If possible, do not allow spindles to touch ther during process of hardening. Next fill end with fireclay, and put the whole on a e, and kept at a blood-heat for 10 or 12 then draw out and plunge immediately in ter. I have several other ways of case- ng, but the above is best. Say in our next ssful; if not, I will give further instructions. M. MACKAY, Glasgow.

8.]—**Barbouze's Motor.**—TO MR. BOT- -The above is the name of the motor you nstructed. It is, as you say, a very bad form or. To connect it with the wheels of a ive you must use a crank and axle, and the axle shaft a toothed wheel to make ak contact with a spring at the right time. iot's "Physics," or Thompson's "Dynamo Machinery," for illustration of Barbouze's —S. BOTTONE.

9.]—**Accumulator Charging.**—To MR. NE.—Connect the positive pole of accumu- positive pole of dynamo, and the negative cell to the negative of the dynamo. The r may be placed at any point of the circuit. ing the dynamo at first a large deflection ace. Little by little the deflection should less, owing to the counter E.M.F. set up by mulator.—S. BOTTONE.

9.]—**Accumulator.**—Your cells are not ough for any practical purpose. The six cells have only sufficient lead in them to make two at the very most. Even if this were not so, of what possible use is a nitrate of soda battery for charging? Throw it on one side. Each pair of plates should have a charging current of at least 2 ampères. I don't suppose your nitrate of soda cells gave more than this altogether. Unless you have a dynamo, the formation of accumulators is a great bother and expense; besides, why use secondary cells when you can light with the charging battery, and by so doing save half the current? If, however, you want to conduct a few experiments, use some large Bunsens of sufficient surface to give you the current required—in your case 12 ampères—and form the plates; pass the current in until the gas comes off in large quantities; then discharge them through some resistance—a lamp, say; charge again and discharge, and so on. You will be able to see, as formation proceeds, how the cells increase in capacity at every charge. This process will take some time—weeks perhaps; depends, of course, upon the care used and size of plates. During the whole process of formation gas is evolved from the very first commencement. It has been stated in these columns that immediately gas is given off the plates should be discharged. This is totally wrong, as if this was the case the cells would require reversing every moment. Be sure the charging source does not run down. The E.M.F. of source must be at least 25 per cent. greater than that of the plates. Keep the plates off the bottom of the vessel containing them. After discharging, reverse the direction of the next charge—that is, the plate that was connected to the positive pole of source must now be coupled to the negative, and vice-versâ. As the plates approach completion, the current should be passed into the plates in one direction only, just as if they were in use, and should be allowed to retain their charge for two or three days at a time previous to discharging them. At this stage the positive pole of the plates, or that one which is to be connected to the positive of source, should be marked in some way to distinguish it. Red varnish is generally used. Should the liquid in the cells become hot, this must be taken as positive evidence that the plates are full. I hope this will assist you; if not, write again, and I'll try what I can do.—C. D. R.

[58790.]—**Reducing Density of Photographic Negatives.**—There is no failing in this case. The thing has been done too well. The "short period" has probably not been short enough. —Os.

[58791.]—**Photographic.**—To MR. BOTTONE. —Unless the trays were thickly varnished, I should not care to use them for photographic purposes. Why not use cardboard soaked in melted paraffin wax? I know of no good means of removing "light" fog.—S. BOTTONE.

[58793.]—**Lifting Power.**—You require to make 40 trips per hour, say, one minute for up trip, and half minute for return, if you have only one cage. This means 1,600ft. per minute—allowing 100ft. per minute for starting and stopping—too great a speed to be practical. However, your data gives—

$$\frac{13 \times 2240 \times 1600}{33{,}000} = 1{,}412 \text{ net h.-p.}$$

—T. C., Bristol.

[58794.]—**Boiler.**—Say that you allow a strain of $\frac{3}{4}$ tons to come on weakest part—viz., the joints. If made of $\frac{1}{2}$in. plate, this will give a total of $1\frac{1}{2}$ ton = 3,360lb. Dividing this by 12 gives a pressure of 280lb. square inch. You do not give thickness of plate, so I have assumed $\frac{1}{2}$in., and a factor of safety of $4\frac{1}{2}$, if well made and ends stayed. Be contented with 150lb.—T. C., Bristol.

[58796.]—**Spring Brass.**— Brass can only be made hard by being hammered, or, if it is rolled or drawn without being annealed; if you have no rolls, you can only do it with a hammer.—Os.

[58798.]—**Induction Coil.**—About 50 sheets of tinfoil 6in. by 8in. will make a good condenser. You should get a good inch spark with three pint bichromate cells.—S. BOTTONE.

[58798.]—**Induction Coil.**—TO S. BOTTONE, "BOBADIL," AND J. BROWN.—The number of sheets for a condenser is best ascertained by experiment. Their size will depend on the size of the base-board, in the cavity of which the condenser is placed. Begin with, say, 20 sheets, 5 × 4, if the cavity will admit this size. Connect them temporarily to the coil, along with the full battery power to be employed in future. Observe the length of spark, and add sheet after sheet so long as good effects are obtained. Giving a rough guess, between 30 and 40 sheets may be required. So much depends on the care expended on the construction of the coil itself, that it is impossible to state definitely the length of spark which will be got. At its best it cannot be much more than $\frac{1}{2}$in., judging from the length of secondary.—BOBADIL.

[58799.]—**Continuous Electric Bells.**—You will find several methods in back numbers. The most simple of them all is to put a pin in the ball of the hammer, and let a hinged lever rest on the pin. When the hammer moves the lever falls off and short circuits the bell. Of course the connections must be arranged with that object in view. —Os.

[58800.]—**Safety Matches and Amorphous Phosphorus.**—Safety matches are tipped with a mixture of powdered glass, sulphide of antimony, and chlorate of potash, which is not sufficiently sensitive to be ignited unless rubbed upon the mixture of 2 parts to 1 of amorphous phosphorus and finely-ground glass, mixed in gelatine solution.—W. STANLEY SMITH.

[58804.]—**Beam Engine.**—The query is answered in the same number as it appears, under No. 58683.—T. C., Bristol.

[58806.]—**Soldering.**—Pins can be taken off brooches by pushing out the joint pin. The joints are not worth taking off, as they can be bought for about 1s. 6d. per gross, unless they are fastened with soft solder, in which case they can be taken off by heating in almost any flame.—Os.

[58810.]—**Small Screws.**—I had occasion to make a lot recently, and I screwed the end of wire into a plate on the chuck, and, letting the other end run in a hole, I bored to fit the wire in the cone plate, and let it project sufficiently to turn a screw.—T. C., Bristol.

[58812.]—**Strength of Acids.**—The quickest, if not the surest, method is by taking the specific gravity; tables showing the amount of pure acid in dilute acids, according to the sp. gr., are given in most larger works on chemistry.—C. F. P.

[58812.]—**Strength of Acids.**—This is generally done by noting the specific gravity by means of a hydrometer; tables, showing strength for different specific gravities, are given in various chemical works.—Os.

[58813.]—**Blue Signal Light.**—If "22A" had quoted the recipe in full, the query would have been more intelligible. The copper salt referred to is doubtless the protoxide (CuO), which is a black powder, and is used in pyrotechny. It is perhaps as well to remind "22A" that the preparation of any coloured fire containing chlorate of potash requires care, as accidents are not uncommon. The ingredients should be separately reduced to fine powder, and then mixed together without more friction than is absolutely necessary. Take care that the mortar and pestle are clean when powdering the chlorate of potash. A safer recipe for so-called "blue fire" is as follows:—Nitrate of potash, 5 parts; sulphide of antimony, 1 part: flowers of sulphur, 2 parts.—STELLA.

[58817.]—**Engine Chimney.**—I don't think this correspondent need worry himself about his chimney. It is just possible that it will last quite as long as he will.—Os.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, "Glatton" has replied to 58047, 58077.

58181.	Sugar Inversion, p. 288.
58184.	Balancing Locomotives, 288.
58191.	Legal, 288.
58216.	Satin Wall-Papers, 289.
58217.	Fire Gilding, 289.
58227.	Lathe Query. To Mr. J. H. Evans, 289.
58237.	Load on Girders, 289.

58447.	Crank, p. 371.
58448.	Forging Swivels, 371.
58462.	Magic Lantern, 371.
58465.	Momentum, 371.
58484.	Lantern Details, 372.
58489.	Skates, to Grind, 372.
58500.	Cream Buns, 372.

THE "wines" sent to the Parisian market of late years have been, to a large extent, vile concoctions, not deserving the name of wine, and a movement is now on foot for replacing such wine by cider. The year 1885 has been exceptionally favourable for such an experiment; the crop of apples was so abundant in Normany and Brittany that growers were obliged to dispose of their products at low prices. Enormous quantities have been sent to Paris to be transformed into cider.

Alum in Gum.—Two grammes of crystallised aluminium sulphate, dissolved in 20 grammes of water, is added to 250 grammes strong gum-arabic solution (2 grammes in 5 grammes water). Ordinary solutions of gum-arabic, however concentrated, fail in their adhesive power in many cases, such as the joining together of wood, glass, or porcelain; prepared, however, according to the above recipe, the solution meets all requirements.

QUERIES.

[58818.]—**Violin.**—Will "A., Liverpool," kindly give us the following information? About what height should the strings be above the finger-board? Is a high bridge preferable? They are sold very tall, and have to be cut down. Can he recommend anything to preserve the E string? They are constantly breaking; sometimes will not tune up to the pitch. Is sixpence sufficient to insure getting a good string? What sort is preferable—silk or gut? My violin is a long one, so, of course, I have to put a greater tension on the strings than with a shorter one. I generally select a first string of the smallest area, so as to reduce the tension necessary to give the required note. Is this an advantage, or am I weakening it from loss of material? Anyhow, there must be something wrong somewhere, for no sooner do I put it away, then bang it goes. Sometimes it is not so considerate, and whilst I am playing it divides and gives me a swish in the "jaw" with the longest end. You know this is not nice. Lastly, should I lower the strings before putting it away?—N. G. W.

[58819.]—**Asbestos Gas Fire.** — Will any of our able correspondents assist me in perfecting the above, my attention having been called recently to several, which are in part, or altogether, failures? I may just give my experience of one in particular, which would burn apparently right for a time, then light at the bottom, thus blackening the asbestos and producing no heat. The gas supply is ⅜ led up to an ordinary cock on hearth. A copper tube leads from same into one end of ⅜ iron barrel containing five burners screwed at equal distances into same. The tube burners are ⅜ brass 3½ long, exclusive of hollow ball, 1¼ dia., with ⅛ hole through at underside for admission of air, inside of which is the burner proper, having a small hole in centre. I increased size of this hole, which I found improved them with regard to lighting at the bottom. The great objection now is the roaring noise from the five burners, which I must overcome. I fitted caps on the top of brass tubes of wire gauze. This checked the noise, but produced a white flame, and after a time one or more light at the bottom immediately the asbestos becomes heated. I have seen so many in this town failures, exclusive of those to which my attention has been called, that I hope through the medium of "Ours" to obtain the information necessary that will enable me to construct burners effectually; or the name of any known work on the subject will oblige. I may add, I searched the indexes of the last four vols., but no success; previous vols. I have not.—ATMOSPHERIC.

[58820.]—**Blowpipe Analysis.**—Lately I have taken up the study of blowpipe analysis, following the instructions given by Col. Ross in "The Lessons" published in the "E. M."; but cannot get on quite to my own satisfaction, owing to want of more details in the processes. May I ask Col. Ross if the "Blowpipe in Chemistry" (mentioned in letter 25280) contains more detail than "The Lessons" in "E. M."? I understood that it was only a reprint, but perhaps I am wrong. I presume the blowpipe manual enters into the subject exhaustively; but I fear the price is beyond my purse. In a work on chemical analysis (wet process) we find each element under a separate head, with the various tests, &c., and the causes that would interfere with these; and we have also the processes for separating and distinguishing the various elements then combined or mixed. The tables given in "The Lessons" answer partly to these, and the "Exercises," published after in "E. M.," give valuable help as to the methods of actual analysis; but still they seem incomplete, or rather disconnected, and I should be glad to know if the works mentioned give the information in a more concise form. Will Col. Ross also kindly say if the "base-plate" reactions mean without C slip, as I cannot get the Pb sublimate without it? Also, I cannot quite understand the reaction given in Table III. —Calcium-Phosphoric Acid Test—"Takes fire calcined with hot bead." Also in Table III., Pb Boric Acid Test, "Subt. transpt., vitreous." Does this mean subt. from Al plate? If so, which portion, as I get an "enamel-like" bead from it? Is not the subt. an oxide of lead (or rather different oxides), and, if so, why should it not give the "enamel-like" bead, as the heading at top says: "Reactions of Oxides, &c." ?—NEMO.

[58821.]—**Battery for Lamp.**—I have an 8-celled bichromate battery, which I use occasionally for lighting a 5-c.p. lamp, and sometimes I wish only to light a 2½-c.p., and always have a little bother by unconnecting the batteries and emptying the jars of the extra cells on purpose to light this 2½-c.p. lamp, and vice-versa for the 5-c.p., the battery being on a ratchet arrangement. I want to attach some sort of a shunt resistance on the side of the battery box. I wish it to be as small as possible, as it would not matter the least how hot it got through being small as long as it answered my requirements—viz., to shunt off the current from the eight cells, so as to leave sufficient for lighting the 2½-c.p. lamp without disconnecting any of the batteries. Some time ago, I made one out of a thin carbon pencil, with a piece of brass tubing and screw terminal; but this did not last long, as the carbon rod wore out by the constant sliding of the tubing backwards and forwards. If any of our readers could suggest an idea I daresay I could work it out to suit my purpose. I am of opinion that using some sort of resistance or other in the circuit of a lamp where batteries are used is a great boon, as the light can be regulated by it when it gets dull, and thus maintain a constant and steady current till the battery solution becomes exhausted, provided the battery is somewhat powerful in accordance with the volt power of the lamp.—YOUNG ELECTRICAL ENGINEER.

[58822.]—**Voicing Organ Reeds.**—I have been a subscriber to the "E. M." for a good many years, and have often been amazed at the fulness and the kindness of the answers to correspondents asking for information; but there is one subject that I have looked in vain for, and that is the subject of voicing organ reeds. Granted that it is a difficult thing; granted that badly-voiced reeds are an intolerable nuisance, grievous to be borne, yet I suppose somebody knows how to do them, and I, for one, should be most thankful for the theory of voicing; for I have got to do them, and I am working entirely by experiment, which does not always succeed. I asked for information once before, some years ago, and only got snubbed for my pains; but there seems a "new hand at the pumps," Mr. Child, and to him I am indebted for the very best system of laying organ bearings that I have yet seen in any work on the organ. Will he kindly take up the subject, if competent, as I suppose he is, or, if not, will someone confer a favour on a person who lives a long way from an organ and has not got a long purse. I should be glad to see the subject thoroughly threshed out; but if this may not be, I want to know, at least: How are the tongues made? What effect on the tone is produced by their being thick or thin? Should the tongue project quite to the edge of the reed? How are they made to speak louder or softer? What makes them go entirely dumb at times and recover speech when the spring is lowered and raised to its proper place again? What is the matter when the reed speaks when the spring is removed, but gradually dies away as it approaches its pitch and then ceases altogether? What is the fault when the reed grunts? What causes it sometimes to suddenly break out into its fifth—for all the world like a child crying? Also, what is the difference between a cornet and oboe, a trumpet and a vox humana? Please don't serve me as I was when I was a little boy, and asked what was the cause of the funny-bone in my elbow, and was answered: "If you are such a fool as not to know, I won't tell you."—ANGULUS.

[58823.]—**Dynamo Efficiency.**—Mr. Bottone, Mr. Eaves, and other eminent contributors will much oblige by informing me what would be the difference in H.P. absorbed to run a 50-volt 30-ampère Gramme dynamo and a machine constructed to give 30 volts and 50 ampères, and about what revolutions should each dynamo be run at, to obtain best efficiency for power, and coal consumed? Also, are incandescent lamps made with thick filaments of longer life than those with very thin ones? I have bought a lamp of Swan, Edison, Shippey Bros., Bernstein, Woodhouse and Rawson, Todd, and Gerard types, all of which are sold by each firm as a 50-volt lamp; but when run together in same circuit some are bright and others just red. What is the reason? The machine used is a foreign Gramme machine of French make, marked 50 volts at 20 ampéres, which I purchased at a sale of one of the Electric Light Companies, driven by 2-H.P. gas engine. Being only an amateur, I have no real knowledge of testing instruments, therefore should be glad of any hints to guide me on the subject. I am anxious to know before buying my lamps.—NAMO.

[58824.]—**Tea Stains in Tablecloth.**—Can anyone give me a simple remedy for removing these—both recent and old stains?—T. C., Bristol.

[58825.]—**Tin Scrap.**—Will some friend of "ours" give me the number of "E. M.," or quote a copy of Fahrig's process, of recovering tin from scraps? To the best of my knowledge, it has three times since 1879 appeared in "Ours." —LIM JACK.

[58826.]—**Heat—A Mode of Motion.**—I find in "Metcalf's Caloric" the following explanation of the fact that if you heat a bar of iron it becomes red hot; but if you continue heating it it becomes cool. If you then heat it in the forge and allow it to cool you can again heat it to a red heat. Metcalf says the molecules of iron are surrounded by caloric; that the heating drives them to the surface, making them active instead of latent. Can any of your readers tell me how the advocates of the theory of "Heat as a Mode of Motion" account for the same phenomena? Can you so change a body by heating that the motion of the mass can no longer be converted into the motion of its molecules?—CALORIC.

[58827.]—**Wire Tramways.** — Can any of your readers give me some information on the subject of wire tramways? Can they be constructed regardless of the contour of the country? What weight per hour can be conveyed a distance of one mile, and at what cost, the greatest rise being one in three? What is about the average original cost per mile? Where can one be seen at work in the Northern or Midland counties? Any other information on the subject will oblige—H. H.

[58828.] — **Venus.** — Will your astronomical correspondents kindly say whether the angular distance of Venus above the sun at the time of inferior conjunction on the 18th is not a very simple basis of calculation of the sun's distance, and, if so, whether it has ever been made use of? If the orbit of Venus be inclined 3° 23′ to the Ecliptic, and at inferior conjunction the planet is about 8° above the sun, it seems a very simple calculation, the distance of Venus being known, to calculate the distance from Venus to the sun, and hence derive another means of obtaining or checking the distance from the earth to the sun. Also, if Venus be visible over her entire dark limb at inferior conjunction, is the moon ever so visible, and, if so, is she so at each new moon?—AL FARD.

[58829.]—**Motion to Convey Water to Higher Level.**—Having a supply of water (without force) in a vessel, I want to convey it to a vessel about 2ft. higher at the rate of a quart in an hour. Something simple, cheap, and self-acting would be most suitable. Warmth could be applied. It would be required to stop and start again?—Z. M.

[58830.]—**Dynamo.**—I have a dynamo, series-wound, with a Gramme armature, which I should like to make into a shunt machine for charging accumulators; but I do not understand how to go about it. A rough sketch showing the winding and the size of wire for field would oblige. The armature is wound with 18 B.W.G.—SHUNT DYNAMO.

[58831.]—**Battery.**—TO "P. C., HORNSEY."—I am making a bichromate battery, consisting of three 5-pint jars, two carbons, and one zinc, 7½in. by 2¼in., and want to know if it will light a 3 or 2½-c.p. lamp. Also, how much bichromate and sulphuric acid will it take to make 15 pints of solution? If used for half an hour or so at a time, how long will it last without recharging? Is it necessary to take the carbons out of the liquid when done as well as the zinc? Is soft gas carbon, which is easily cut, as good as hard for such a battery?—T. F. FORDE.

[58832.]—**Cough Cure.**—TO "OSBALDESTON, HARROGATE."—I have made the above accrding to the recipe given by you; but I find that, after shaking the required time there is a sediment at the bottom of undissolved ipec. and sul. of potash. Are these two to be filtered out? If so, will the mixture be safe?—N. RODLEY.

[58833.]—**Shunt Dynamo.**—TO MR. W. H. EAVES, COVENTRY.—Wishing to construct a dynamo capable of lighting about six 10-c.p. incandescent lamps, having a laminated armature built on the same principle as the one designed by you for a 30-lighter, would you kindly inform me what should be the proper length of armature together
with external and internal diam. of same;
quantity of wire, and how wound? As I sh
Gramme type of field-magnets with four coi
be the proper length and diam. of wrought-i
able for above; also size of pole-pieces and s
tity of wire, and how to connect? What
probable number of volts and ampères it w
what H.P. would it require to drive it?—Go

[58834.]—**L. B. and S.C.R. Locos.**
reader of the "E. M." kindly give sketch an
of the oldest express engines of this line?
Gladstone?—A BEGINNER.

[58835.]—**Japanning Furniture.**—Ho
getting the level surfaces, and how are co
What varnishes are used? Shall be obliged
on above, or references to any books on the s

[58836.]—**Wimshurst Influence Ma**
"J. W."—The only escape of electricity I c
from the sectors to the bosses, and this has b
by cutting the sectors shorter; but the spar
about 1in. long. I can obtain a brush d
distance of 2in. Taken altogether, the mach
energetically; but I expected a longer spark
to mention in my first communication that I
Leyden jars.—A. A.

[58837.]—**Automatical Musical Ins**
—TO MR. WENHAM.—I am making an instr
octaves of reeds, 8ft., using a harmonium
feeder. Perhaps Mr. Wenham would assist i
an idea as to how I must set my lever and
9in. of paper?—THOMAS PUGH.

[58838.]—**Analysis of Steel and Iro**
one tell me of some means of determining t
centage of oxygen in steel or iron? The pie
analysis was made by the Bessemer acid pro
blown. The C, Si, S, P, and Mn found by an
piece are all satisfactory; but the metal is n
or weldable, therefore useless. Can any
readers give me the name of the publisher of
on modern assaying?—BESSEMER STUDENT.

[58839.]—**To "Sigma."**—Will you please
is possible to transmit two or more messages s
along one wire with the telephone? If so, w
explain how it is that the messages do not ge
Also, can you tell me of a book that deals with
—S. C.

[58840.]—**Induction Coil.** — I have
interested in Mr. Paul Ward's letter. The
given is of much interest to me, as well as to
there is one point I cannot understand—will he
plain? In line 25 from top he says: "the tub
ject beyond ends of primary 1-7th the length o
If the tube is longer than the core, how can t
act on it? Then towards the close he says: "A
tion of the core at one end is necessary, &c."
understand the primary is wound close up to
core whilst the other end is left naked, and t
is so much longer than the primary, but not l
the core? Ebonite is expensive, and paraffine
are messy. I have been thinking of making
tube of silk, cemented together with shellac.
Mr. P. Wood think of that arrangement? W
explain how Apps' breaks are made? I have n
and want to know. Is the article known as
fibre equal to ebonite for tubes and discs?—
WICK.

[58841.]—**Traction Engine.** — A tractio
with cylinders 8in. and 12in. by 14in. stroke
engine in forward gear, and the crank on the
the lead of the valves of both cylinders is ⅛; w
ward gear the lead of the H.P. valve is ¼, and t
Will the engine work with the valves in that
If not, please say what alteration is required
do it.—THISTLE.

[58842.]—**Grinding Cutlery.**—Will som
brother reader kindly help me out of my diff
have fitted up an apparatus for grinding c
plant consists of a headstock on lathe bed, wit
nose to take one end of spindles, carrying gr
polishing buffs, &c.; the other end of spindles
dropped in a bearing at the other end of lath
motive-power is a man turning a 5ft. iron fly
ing a 1in. leather strap. I find I am able to gr
tolerably well; but razors are my difficulty. It
all bad, it takes me such a long time to hollow
I have tried emery glued on buff leather; but
they are so hot I cannot hold them. Also grin
water, both slow and fast; but it seems to
with but very little effect. I find it very diffic
them true. Ought I to have a rest?—COUNTR

[58843.]—**Herring Oil.**—What purpose
suitable for? It is said that glue can be made
so, perhaps the detailed information might be
chasing.—OIL.

[58844.]—**Solubility of Superphosph**
any of your readers inform me of a simple
testing the solubility of superphosphate? A
addition of a small quantity of gypsum wou
solubility, and, if added, how its presence may be
How a superphosphate of from 27 per cent. to
soluble may be obtained?—T. C.

[58845.]—**Volt Meter and Ampere**
Will Mr. Bottone or Mr. Eaves kindly furnis
instructions for making a simple and reliable
and an ampère meter to measure, say, up to 10
A sketch will oblige—VOLT.

[58846.]—**Storage Battery.**—I have
above pocket form. Will any beginner's frie
how I should connect it to battery for charging
the + be connected with the zinc, and the – wi
or vice-versa? Are the plates coated with any
before charging? If so, what?—POCKET BAT

[58847.]—**Petroleum Tank.**—What ceme
to caulk the joints of a large plate-iron ta
petroleum and naphtha?—HAMMER.

[58848.]—**Legal.**—A. leases a house fro
same to C., who agrees to pay rent quart
After two years, A. becomes bankrupt, b
in arrears to B., while C. has paid his rent
ing to agreement. Can B. claim from C.

,nd compel C. to thus pay double rent ? medy against A., who is bankrupt, and ed ? Will some kind brother reader, or reply to above query ?—C.

; **Mill.**—I have a 4½-horse engine and a mill, but cannot get a soft meal from it. om experience kindly say what sort of suitable for this power and produce a l it be advisable to get a pair of French d, if so, would 4ft. be too large ? Any ting a mill or stones suitable for grist commodate a few neighbours, will be or.—DUSTY.

ınsion of Mercury and Air.—ondent give me the relative expansion , a sphere, say, 1in. diam., at tempera and 212° F. ?—ION.

er and Mercury.—I have to employ ontain mercury for an indefinite period. ; amalgamate with the copper ? If so, l for a remedy.—ION.

and Engine.—What are the dimen o. 1740 ? Are there any more of this

ntions and Discoveries. — The Society of Engineers, in his inaugural many modern engineering inventions overies had been foreshadowed in the n definitively described. The electric lefined by Galileo in his 'Systema nturies and a half ago. The lightning kiln was used by the Etruscans. The d was described symbolically by Solomon since. Bacteria were discovered and l by Leeuwenhock two centuries ago. orpedo was foreshadowed by Ben Jonson. years ago, credited the astronomers of scovery of two satellites revolving about ctual discovery of Mars' moons only took e poet Drummond, 260 years ago, in very indicated some of the most important ry weapons of the present day, and for d letters patent in 1626 ; and, finally, Troilus and Cressida,' had anticipated great discovery of gravitation." Can rs supply the quotations on which these rtions are based ? The statement about Newton's "discovery of gravitation " that someone does not understand his therefore, not unlikely that he is mis its.—MAG. EST VER.

pound Engine.—I have to design a sing engine, to give out 40-horse brake ork ; and to enable me to make my cal , I wish to know what proportion the d power of the cylinders should bear to power" to allow for loss by friction and ; initial steam pressure, 60lb. per sq. in., ht times ? I also wish to know what for a surface condenser for the above surface, about 250ft. area. A word cal brother reader of "Ours" would URTING DRAUGHTSMAN, R. N.

amo.—TO MR. BOTTONE.—Would you tell me how many volts, ampères, and ght to get from a dynamo of the follow H armature, 2¼in. dia., 5⅝in. long, wound 21 d.s.c. wire ; field magnets. 6in. long, thick, wound with 8lb. of No. 17 c.c. ke 4ft. of No. 34 German-silver wire speed, over 3,000 revs. per min. By ve you would greatly oblige a subscriber

ery for Incandescent Lamp.—e what sort of battery is used for Vesey's pe (electric), sold, and I believe made, and Son, of Oxford-street ? It seems to Leclanché ; but I cannot get four very lls to work it. The battery that was lamp is failing ; I, therefore, want to ke a new one, as they are rather expen 35s.—C. H.

ashurst Influence Machine. — urst, or others having knowledge of the l me the diam. of all brass balls for , glass discs ? Are there four discharg only two, and whether straight lamp sed for the Leyden jars near about the ?—SECTOR.

hting Vacuum Tubes. — Many B." Will he kindly say what length of " lights well ? Also, what spark from e obtained from that sized machine ? I in." refers to diam. of small plate ?—

ling Sound with Telephone.—re is any remedy for the gurgling, or ard when using the "Gower Bell" tele only working on a short line, and act ects.—ALLIANCE.

er.—Can one of "ours" tell me the best n of a boiler to drive a model horizontal , 1½in. bore ? Gas is not available.— it.

ering Aluminium.—Can someone solder aluminium ? The ordinary soft o use.—P.

son's Reflecting Galvanometer. r inform me if there is a magnet passing nium vane which is suspended from the the coils ? There is a short piece of vane at right angles to it, and I want to a magnet, and what is the use of it ?—P.

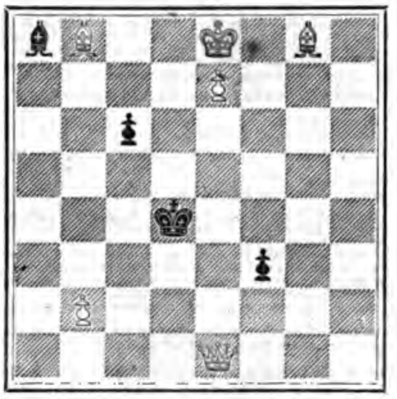
ring Solution.—Ten years ago I r electro-plating with cyanide of f silver. It has been kept in stop has become rather opaque and di htly diminished in bulk. It will n anyone tell me how to utilise it

CHESS.

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLXXVIII.—BY C. PLANCK.

Black.



White. [6 + 4

White to play and mate in three moves.

SOLUTION TO 976.

White.	*Black.*
1. B-K Kt 6	1. Anything
2. Q or B mates	

(Two variations.)

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 975, by C. F. Schünewald, Louis Morris, and Link ; to 976, by P. L. Alfred J. Woodford, Avon, W. J. Carpenter, V. S. Pochin, F. A. Vincent, A. Bolus, W. J. Baynes, I. S. N. O., A. W. Orr, Havelscombe Rodd, C. Southall, A. Dean, Constance E. Younger, A. W. Fisher, C. Tomlinson (but second variation omitted), Tommy Atkins, and C. F. Schünewald ; to 977, by A. Bolus, F. A. Vincent, and Tommy Atkins.

A. SHARPE.—If in 976, 1. Q-Q B 5, R takes P prevents mate.

C. PLANCK.—Thanks for the problems.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings or illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 10, and unacknowledged elsewhere :—

L. JOHNSTONE.—W. H. Bailey and Co.—P. A. Ransom. R. J. Lamb.—J. C. Montgomerie.—J. W. Queen and Co. —Young Turner.—Bristol.—Inky.—J. T. S.—Anxious.— F. H. Schmidt.—Alfard.—Perseverance.—Kent.—Alpha. A. E. B.—H. Sadler.—Damascus.—Class Honours.— F. W. Muncey.—T. H. W.—Pen-y-van.—Bangor.— Moulder.—E. Duckworth.—B.Sc., Plymouth.—Ernest Baugh.—W.—Shiny Boots.

READER. (Confection of senna is made up in a variety of ways ; but those who do not mind expending more than an article bearing that name costs to buy will find the following recipe from the Pharmacopœia a good one :— Rub together 8oz. of senna and 4oz. of corianders, and separate about 10oz. with a sieve. Boil 1lb. of figs and 3oz. of fresh-bruised liquorice in three pints of water until [illegible] and strain and evaporate in a w [illegible] n add sugar 2½lb. [illegible] inds, cassia, [illegible] d when [illegible] [illegible] lose ; From [illegible] is made in a variety of [illegible] specially [illegible] with [illegible]

replies on "Electrical Units.")—YOUNG TURNER. (Query not sufficiently definite. Do you mean in the lathe, with screw-cutting gear, or what ?)—T. RICHARDS. (The *Nautical Almanac* is published by John Murray, Albemarle-street, W., price 2s. 6d. It is four years in advance of its published date, so you must specify which year you want.)—CAPTAIN. (We forget. Refer to No. 1,042, and you will be able to form an idea from the sketch. There is the statement that the saw-spindle makes 1,500 revolutions per minute with ordinary treading. It will do all that we have said it can do. See letter by "O. J. L." on p. 362.)—A EIGHT YEARS' SUBSCRIBER. (Don't quite understand. Do you mean that you want to carve, so to speak, a piece of metal so as to look like a bit of rope. If so, the cheapest way would be to use gravers, as the necessary appliances for doing it in the lathe would be expensive.)—EDWIN G. CHAMP. (We have simply no room for it, especially as it has already appeared elsewhere. Such "theories" should be stated as briefly as possible to obtain insertion. As you have sent it to the R.A.S., it will, no doubt, receive all the attention it deserves.)—E. WALLACE. (Fuller's earth or blotting-paper and a warm iron will do all that is possible. 2. Soda ash or common washing soda boiled with water and a lump of quicklime. 3. Clean with benzoline. 4. Repolish, that is all.)—T. LEE. (See indices. Diagram of a 2½ row in No. 573, p. 17. 2. They can be used ; but not with any advantage.)—MUISC. (If the piece is learned it can, of course, be "played by ear," that is all.)—TRITON. (It will light an electric lamp for a few minutes, if a sufficient number of cells ; but how many depends on the resistance of the lamp, and has been explained many times. See replies in recent numbers. The bichromate is the best to use for the purpose, if the light is wanted for more than a minute.)— J. J. G. (Try glue, to which nitric or acetic acid has been added. See p. 325. There are many recipes in back volumes ; but the principle is an acid to slightly corrode the metal, and gum, paste, or glue may be the adhesive agent.)—HARMONIA. (No, we believe not. Williams, of Paternoster-row, has a cheap manual on the subject, and most music publishers have works of the kind.)—W. W. (An estate of the value of £100 per annum, or the reversion to one of £300. Application to the Lord Chancellor or recommendation of a town council.)—E. S. H. (The gestation period of the elephant is about two years.)—L. W. DAY. (Six years is the limit within which debts can be recovered. 2. One 273rd for each degree centigrade is usually taken. If taken at 32° Fahr. a 1,000 cubic inches is increased to 1,200 at 130° Fahr. Where a pump is used it should have somewhere about the same dimensions. 3. You refer to the old trouble in making essences. Have you tried filtering through animal charcoal ?)—CELLULARIA. (Put them into spirit, methylated alcohol, "pure,"—i.e., without any gum in it.)—PURPURA. (What is the "above subject," seeing that nothing specific is mentioned ? See the catalogues of D. Bogue, Van Voorst, and Churchill, which the local bookseller can, doubtless, show you.)— X. Y. Z. (Is not the query rather too wide ? Would not a whole volume be necessary, See Saunier's "Watchmaker's Handbook.")—A BEGINNER, F.A.B. (From 35 to 40 grains of nitrate of silver to the ounce of water, and a few grains of iodide of potassium ; but see one of the handbooks.)—LITMUS. (Why not ask the makers ? Possibly a solution of soda will do, applied at the back.)—H. B. SMITH. (A patent agent would search the Register for you, if that is what you mean ; but such a query is really of no interest to our readers.)— PORT JACKSON. (What made you coat the hot-water pipes of your conservatory with gas-tar ? Take it off as quickly as possible with mineral naphtha, grease, or caustic potash, using the scraper first.)—SCOTT. (Put it into the fire and let it soak there red-hot, and gradually cool down as the fire goes out.)—W. CHAPMAN. (Surely with the watch before you, the means of attachment to the case will be evident.)—WILLIAM GREY. (Answered last week—first answer. Any bookseller will procure it. The price is generally four shillings.)—BERTRAM SMITH. (We should say, No ; but as the person of whom you bought says he did, why not ask him to show you how ?) —FREDERICK BARLOW, Egypt. (Have you really started to make a coil without knowing how to go about it ? See the index of the last volume, for instance, and back volumes generally.)—A ARMATURE. (The Edco battery was fully described in No. 980.)—J. M. THOMSON. (It depends entirely on the terms of the indenture, not on what you "engaged" for.)—J. R. (*Cosmos* is published at 8, Rue François, Paris.)— A. POTTER. (For such information about the Lalande-Chaperon cell, see p. 475, No. 1,036.)—R. G. (Go over the directions again, and read up the numerous replies which have appeared recently.)—MR. ARROWSMITH. (You will find diagrams illustrating the arrangements in back numbers, and in the little pamphlet advertised by Gent and Co., of Leicester. But will you not want an indicator, or how will you know from which room the signal has been sent ?)—QUÆSITOR. (Was it not described very recently ? At any rate, it has been in back volumes, and in the textbooks. The other questions are answered by "Depends on circumstances.")—POOR CLERK. (Better not experiment on your daughter with either the interrupted or the continuous current. Consult a medical man. You can apply the current to yourself if you like. You will find your questions answered in back numbers. See p. 435, No. 929, for suitable apparatus.)—T. MORRIS. (There is the Pharmacopœia, and the cyclopædias. Procure a catalogue from Messrs. Churchill, New Burlington-street. They publish several works on materia medica. 2. We do not know of a paper in which divers advertise. The addresses of competent men are to be obtained by applying to the firms who make the dresses and apparatus.)—ANXIOUS TO KNOW. (Spelter for brazing is sold at the metal-shops ; it is a brass nominally made from copper and zinc. Zinc itself in the ingot is often termed spelter.)—TONDU. (Spelter, borax, and heat are the essentials for brazing brass. See the indices or recent back numbers—pp. 370, 387, for instance.)—A YOUNG SMOKER. (The "theory" is simply that the smoke is drawn through water. You can see one at any of the large tobacconists' shops.)—TENNISSITE. (For ons for making tennis-courts see p. 111, last and the indices.)—C. O. (To fill the bath you her carry the water up or pump it up, unless n is above the level of the bath. It will be mpty it by mea [illegible])—AMATEUR

PHOTOGRAPHER. (Can you line it with black twill, or coat it with leather?)—T. F. FORDE. (He is quite correct when the expression is understood. The light is more actinic because so many of the heat rays have been absorbed or cut off by the clouds. In the arc light it is necessary to spread the beam or diffuse the light. 2. The address of Relfe Brothers is 6, Charterhouse-buildings, E.C. We do not know price of the book.)—J. DROUSFIELD. (Answered many times. It must be thoroughly sized first, and then coated with paper varnish or best pale copal.)—W. P. (Query incomprehensible. The pigments used are mixed with size.)—WILLIAM JOHNSON. (If you cannot strengthen the frame, you had better procure a set of new strings identical with those now in. Surely the lowest string is loaded? Messrs. Goddard, of Tottenham-court-road, or Messrs. Hughes, of Drury-lane, can probably supply a suitable set of strings.)—SILKE. (You can see one on any railway waggon. 2. Drawings for engraving should preferably be about twice the size they are intended to appear, and so far as our columns are concerned, should be either one, two, or three columns wide.)—W. (Some of them have. The French are just commencing theirs. The distance is generally taken as 92,700,000 miles.)—E. O. W. (We do not know. Most probably of Stanford, Charing-cross.)—PARCLE. (How much time would it take?)—J. (We know nothing more about it than we have given; it was described on p. 551, No. 1,013.)—J. G. (Have you read the papers in, say, Nos. 834, 836, 840, 846, and so on? See the indices, too, as far back as Vol. IX.)—FREDERICK THOMAS. (To dye the ivory red, clean with solution of washing soda and drop into a basin containing water with a little nitric acid—just enough to "bite" the tongue. Then immerse in an infusion of cochineal in liquor ammoniæ; or steep in tin mordant, and then immerse in decoction of brazil wood. For black, wash as before, and steep in weak solution of nitrate of silver, and then expose to light, or dry and dip into weak solution of sulphide of ammonium. Cheaper black can be obtained by boiling in decoction of logwood or nutgalls, and then steeping in solution of acetate of iron.)—BEGINNER, G. T. (See p. 394, No. 1,032, and look through indices.)—EONAC. (Damp thoroughly, and then dip into linseed-oil. Paper canoe fully dealt with in back volumes. There is something about them even in the previous number—p. 478.)—ONE IN TROUBLE. (Suppose you try with brazing-tongs—that is, tongs with heavy beaks, which are raised nearly to a white heat. Scarf the two ends, smear with borax paste and spelter, and bind with a bit of wire. Pinch with hot tongs until spelter runs, and then dip tongs and all into water.)—BRUSH MAKER. (Such ovals can be drawn with a pencil and a loop of string; but perhaps you would prefer an elliptograph, for which see catalogues of instrument-makers or back numbers.)—ENGRAVER. (Copper 9, tin 1.)—JUMBO. (When not real they are made of compositions—xylonite being one very useful substance. 2. You can easily reckon by remembering that the depth of the thread is equal to the pitch of the screw; but in drilling holes it is well to have the tap to measure from.)—JAMES BOTTOMLEY. (If you cannot refer to back volumes, procure the Syllabus of the London University. You would certainly have to pass a preliminary and an intermediate. The degree of D.Sc. represents a great deal more than you think.)—S. S. S. (A speed gauge is useful; but its value depends on what it will do, and how it does it.)—A READER. (Hydraulic accumulator described in No. 1,039, p. 5?8.)—SILKE. (Answered above. Too late for last week. 2. An ant-hill is said to be an excellent temporary tomb for small animals, the skeletons of which it is desired to preserve; but the simplest plan is to boil in solution of caustic soda and bleach, as described many times. 3. Yes, it will make good metal. See indices.)—A. B. (You cannot recover the rent from the receiver, we fear.)—EMERY. (Most of your queries are surely answered in "Sand-Rat's" paper, which appears this week, or in his previous articles?)—URANIUM. GLATTON. (In type.)

Valuable Chemical Works.—For Sale, as a going concern, very compact chemical works, standing in nearly an acre of ground, completely surrounded by brick walls. The works contain excellent engine and boiler, and a large quantity of plant for distilling processes, direct or secondary, and for making and turning out aniline colours in large quantities. There are numerous brick-built and tiled-roofed sheds. In close contiguity to the river. Also five-roomed foreman's Cottage inside walls.—Address, MANUFACTURER, 332, Strand, London.

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Every Workman connected with the Building Trades requiring a Situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 332, Strand, London, W.C.

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First-class **Lantern Transparencies**, direct photographs, in exchange for Photographic Apparatus, Lenses, Microscopes, Microscopic Accessories and Slides, or other Lantern Slides—Apply, PIGGOTT, Chemist, Huddersfield.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Wanted, new or second-hand **Microscopical Apparatus**, by good makers, also Scientific Books, in exchange for first-class Micro. Slides.—C. COLLINS, Bristol House, Harlesden, N.W.

Half-Horse **Engine**, double oscillating cylinders, on horizontal bed, in good condition, complete, with governors. What offers?—JOURNET, 194, Gt. Portland-street.

Capital 3½-horse **Vertical Engine**, with throttle-valve, governors and guard complete, splendid condition, cost £35; good exchange to value £15 accepted.—S. GORTON, Coventry.

Lathe Wheel and Crank, single speed, Taylor, maker, Birmingham; 3½in. Leg Vice and Bench, 5ft.; 14 Chasing Tools. Exchange.—W. SMITH, Bilston-road, Wolverhampton.

Water Motors. Exchange. What offers? Bailey's Thirlmere Motor, cost £5; Empress Motor, cost £4. Lathe heads or slide-rest wanted.—THOMAS WHEELER, Preston.

Congo Free State — To Steam Launch Owners, Foreign Traders, &c.—See advertisement under Situations column re trading in above State.

Wanted at once, **Boiler**, 2ft. 6in. or 3ft. high, vertical, suitable for double cylinder engine, 2in. bore, 4in. stroke, to work at 40 or 50lb. pressure, and pump to suit same, to work from crosshead, second-hand. Exchange Silver Watch, &c.—A. W. NURSE, 38, High-street, Lewes, Sussex.

Tuerk's **Turbine**, new, only once used, three-quarter-inch supply; also Water Engine (Haags pattern), cost £10, in good order, 1in. connection. Exchange for small Paper-Cutting Machine, or one-man Gas Engine. Would give balance cash.—J. PURVES, Printer, Elie, Fifeshire.

Wanted, **Lathe**, in exchange for Bicycle or Model Engine, value £4.—A. GRICE, 76, Church-street, Runcorn, Cheshire.

Fan, by Aland, 22in., suit foundry, or smith's forges; offer wanted.—RODGERS, 16, Riley-street, Bermondsey.

Stocks and Dies, Ratchet Brace and a few American Drills.—As above.

Hydraulic Jack, 4 tons, by Tangye. Offer.—As above.

Show Case, magnificently carved walnut, cost over £30; eminently suitable for coming exhibition. Wanted, portable 12 by 10 Photo Apparatus. Companion Case can be had.—Address, C. MURRAY, 50, George-street, Richmond, Surrey.

Instruments or cash offers for "**Engineering**," any volumes: "Ewart's Agriculturist's Assistant," "Rivington's Building Construction," any volumes.—Z. C., 62, Loddige's-road, Hackney, London.

Vertical Exhibition Iron **Tubular Boiler**, height, 31½ inches; diameter, 20in.; fitted with injector, whistle, steam and water gauges, made to gentleman's order, everything best make, only used a few times, stand 100lb. pressure; cost over £20. Offers.—DUCKWORTH, 10, Cedar-road, Leicester.

Achromatic Object Glass, 4¼in. aperture, 10ft. focus, in brass cell, complete. Exchange good Microscope, pair Telephones. What offers?—BROWN, 79, Victoria-road, Clapham, London.

Amateur **Drilling Machine**, made by a mechanic in spare time from Dorrington's Castings, fitted with feed motion, nearly new, and in thorough working order. Offers.—J. FULWELL, Craven-street, Coventry.

American Journals.—Tremendous variety for exchange. Humorous, scientific, &c. Wanted, any books written by Thomas Miller. Write for list.—CEDRIC BONNELL, Spring-gardens, Gainsborough.

Camera, highly finished, 5 by 4, 3 double dark slides, tripod, &c., by Hare, London, 5 by 4 rapid symmetrical lens. Useful hints and instructions free. Exchange for good Dynamo. No rubbish.—MCCLELLAN, Clock House, Sidcup.

Wanted, **Electric Bell Indicator**, about te holes, imperfect order. Offer 70 c.p. Dynamo, Electro Motor, or cash.—HERVEY, Hartley Rectory, Alton, Hants.

50in. **Bicycle**, in perfect condition, ball bearings front wheel, cones to back, hollow forks, cradle spring, long distance saddle, bent handles. Will exchange for "Kangaroo," or Safety.—S. ARMSTRONG, Belleek, Co. Fermanagh.

Oxycalcium Lamp, for lantern, with spirit in exchange for various Slides, Batteries, or Electrical, value—D. PORTEOUS, 22, Junction-street, Leith.

Wanted, Vols. II. and III. "**Design and Work**" published by George Purkuss, in 1877. Exchange.—A. CAMERON, Mearns-street, Greenock.

Strong **Copper Boiler**, horizontal, almost new, 12 by 7, with stand and lamp. What offers in Lathe way?—61, Falls-road, Belfast.

Edison's Electric Pen, with Press, and 4-cell Bichromate Battery, complete, in good working order. What offers in exchange?—WORTHY, Railway Station, Redbridge, Southampton.

"**English Mechanic**," Vols. XVIII., XIX., What cash offers?—T. C. R., 27, Albert-street, Shrewsbury.

Dynamo Electric Light Machine, with seven incandescent lamps, price £7 10s. Take part exchange. Anything useful.—194, Commercial-road, Landport.

Cottage Piano offered in exchange for Foot Lathe with back gear, slide-rest, and chucks.—T. F., 31, Mellish-street, Millwall, London, E.

Lancaster's half-plate **Instanto Lens**, with shutter, for half or whole-plate strong bellows camera.—JOHN EMERSON, 85, Lower Salt-hill, Galway.

Aquarium, octagon slate bottom, 20 by 15, good order; "Cassell's Science for All," unbound; last Volume ENGLISH MECHANIC, unbound. What offers? All or part. Aviary, good canaries, or other singing birds, &c., (no fowls or pigeons)—AQUARIUM, 24, Park-road, Clapham.

Horizontal **Slide-Valve Engine**, on bed-plate, bore, 2in. stroke, brass fittings, good working order. Exchange for Orguinette. What offers?—Address, KNOTT, 45, Chaversham-road, Reading.

Large Iron **Lathe**, ditto one 4½in. centres, large Emery wheel, 6in. slide-rest; tricycle; 16in. fan. Wanted, Gas Engine.—Bridge-terrace, Pitlake, Croydon.

Good **Shocking Coil**, remainder chemical apparatus, books, &c. Must part with, going abroad. Any offers considered.—PORTER, 30, Aden-grove, Stoke Newington.

Small **Donkey Pump**, new (seen by appointment). Exchange for 4in. back-geared headstock and slide-rest.—F. G. 72, Albert-road, Kilburn, London.

Microscopic.—Fine, healthy specimens of the beautiful rotifer, Melicerta ringens, &c., in tube. Exchange.—S. View, Ayr, Scotland.

Flute, in case, eight German silver keys, ferrules and mouth plate, wants replating; good Microscope, three powers, suitable for a beginner, and lot of slides; Box, with chess board drawer, contains chessmen, draughts, and dominoes; Scrap Book by 11, about 70 leaves, filled both sides with various Christmas and other cards, useful for studies. Want 2 to 4 c.p. electric lamp, and batteries, complete; small electric bell, batteries, wire, push switch; telescope; box, with few good carpenter's smaller tools; chest of drawers (small), with fall-down flap for desk, and pigeon holes, or other desk.—Letters only Mr. VINER, 51, grove, London, W.

Ventriloquism.—Two Ventriloquial Figures, sacrifice for 15s., carriage free. "Art of Thought Reading." Will exchange for Conjuring Apparatus, Magic Lantern Slides, or Watch.—GODSELL, Anne-street, Limerick.

Wanted, **Lantern**, 4in. condensers, in exchange for 5 by 5 Mahogany Camera and Portrait Lens.—ROTHWELL, tenham-street, C.-on-M., Manchester.

Wanted, half H.P. **Engine and Boiler**. Exchange Electric Apparatus.—A., 21, Westbourne Park-crescent, Paddington, W.

Model gunmetal **Force Pump**, new. Exchange for Water Gauge, or other Boiler, or Engine Fittings.—BURCH, Pershore, Worcestershire.

Electro-Magnetic Machine, in mahogany lock-up box. 1 ditto ditto superior Machine, with all appliances, nut box; 2 powerful Motors, Siemens armatures.—Address

Electro Motor, by Cuttriss, Leeds; Medical Coil, nickel-plated; 2½in. Induction Coils, duction Coil, 2 pairs of Telephones, 2 Electric Bells.

Half H.P. **Horizontal Engine**, very superior ½-gall. Bichromate Bottle Battery, strong double offers for any of the above articles.—T. A. CARTER, Uttoxeter.

Wanted, **Book or Lecture** on the Telephone, with experiments.—J. J. HAMMOND, 42, William-street, Norwich.

Wanted, **Dynamo Castings** and Wire, or in exchange for Pediment Barometer, in perfect order.—Castle Cary, Somerset.

Offers for **Incandescent Lamps**, 5, 10, 20 c.p. holder. Wanted, Magic Lantern or anything useful.—Wilton.

Tait's **Air Pump and Apparatus**, pair of Bell Telephones, 12 Engraving Tools, 12 Turning Tools. Exchange Lantern Slides.—J. TURPIN, Drighlington, Yorkshire.

Smith's wrought **Tue Iron** and a lot of Tools. What offers?—RIGBY SMITH, Fazackerley-street, Chorley.

Modern **Book on Plating**, Bronzing, and Lacquering, in exchange for E. Beckett's "Clocks, Watches, and Bells."—78, Viaduct-street, E.

Sewing Machine, on polished walnut, treadle, value £4 10s., or exchange Engine and Boiler, 1in. bore, See advertisement in sale column.—P. B. WARWICK, Hampton-hill, Mid.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

Electric Depot, 10, Deansgate, Manchester.— Breast Pins, 25s. Electric Bells, 4s. Induction Coils, Proprietor.

New Illustrated Price List of **Screws, Bolts**, NUTS for Model Work, drawn to actual size, stamp.—MORRIS COHEN, 132, Kirkgate, Leeds.

Fretwork.—Catalogue of illustrations, free for 6 stamps.—HARGER

Solgraph Plates are the Slides, post free, 1 doz., 1s. 6d.; 2 doz., slides, microscopes, list free.—SOLGRAPH street, Guisboro.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, FEBRUARY 19, 1886.

ONE OR TWO ARTICLES FOR SOFT-WOOD TURNING.

THAT an ornamental lathe is a very costly affair goes without saying, and so absolute is the necessity of accuracy in every part and every appliance connected with it, that it appears quite impossible to cheapen it. All attempts to do so have, at any rate, failed, for although slight defects are invisible on examination, they at once become apparent upon the work executed. And of ornamental turning that is true which is by no means necessarily so upon plain work—viz., that the slightest defect in our incised pattern renders it worthless. Take up a box with an eccentric pattern cut upon it, and if you can detect one lozenge or other figure larger or smaller than the rest, the whole ceases to command your interest, and what is almost worse, the chuck that produced such defective work stands condemned, unless, which is sometimes the case, the cause of that defect is a deeper cut than the rest. The reason of this utter condemnation of defective ornamental work is that it always stands forth as a specimen of perfect work carried out by apparatus equally perfect, which is not the case with specimens of soft-wood turning done by hand, in which any slight unevenness of outline, though a defect, is felt to be excusable—a defect, moreover, which will not necessarily be repeated in a subsequent article. The stimulus, moreover, to good hand-turning lies in its being a matter of skill alone. If a beautiful object is produced, the entire merit belongs to the workman, and has not to be shared by the appliances which have enabled him to execute it. The perfection of hand-turning is shown in a billiard ball, and I think it may be said without possibility of denial that such an article does the workman far more credit, and should cause him far more satisfaction, than if he had produced it by the costly means of a spherical rest. For a person of limited means, therefore, to hanker after those elaborate mechanical appliances which are to be found in the workshops of rich amateurs and professionals, is a decided mistake, and is merely reaching after the unattainable, while all the time the despised lathe of meaner pretensions is capable of many novel uses interesting in themselves, as well as satisfactory in the results. Among other articles capable of being executed by hand, picture-frames for photographs may be made with speed and facility, and, executed in oak, look also extremely well. If a simple oval chuck is also at hand — not the elaborate £20 affair, but such as wood-turners use — a still better job can be made, as the elliptic opening always looks better than the circular, although the latter is by no means to be despised. Even the ellipse can be marked with a loop of string, and a couple of tacks by a pencil in the well-known manner, and when thus set out, it can be cut with a keyhole saw or fret-saw, and finished carefully to line by a half-round cabinet file. It will be found handy to cut out a few ellipses in tin or card as patterns to draw round with a pencil if several frames of equal size are to be made, as this will keep the ellipses uniform. To return, however, to the oak frame to be made in the lathe, all that is needed is to cu[illegible] an oblong piece of wainscot. I get [illegible]

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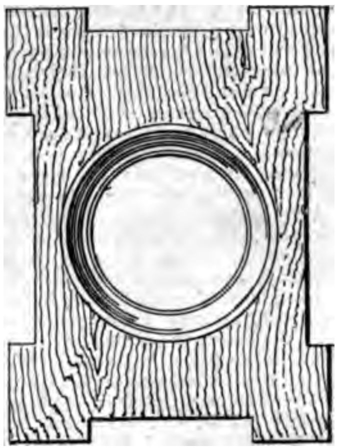
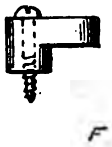


FIG. 1.

FIG. 5



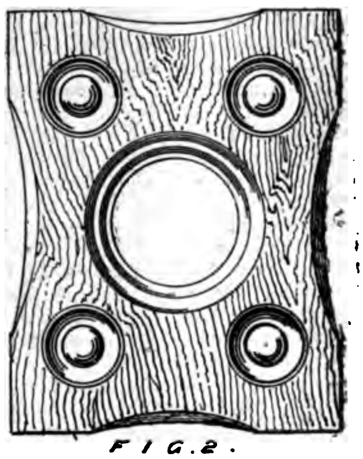
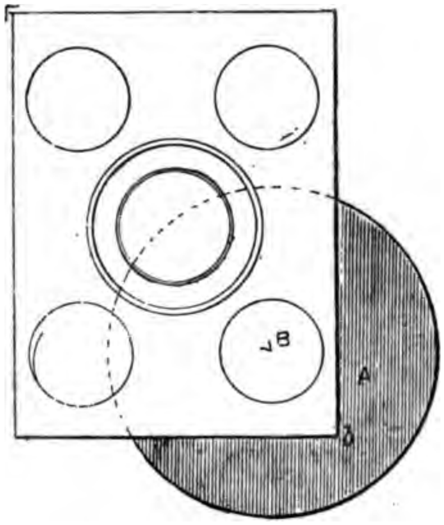


FIG. 2.

FIG 3.



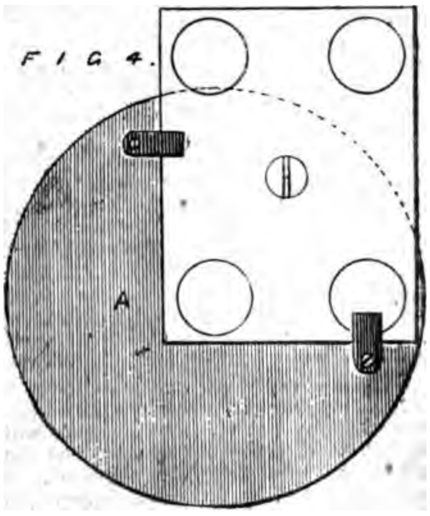


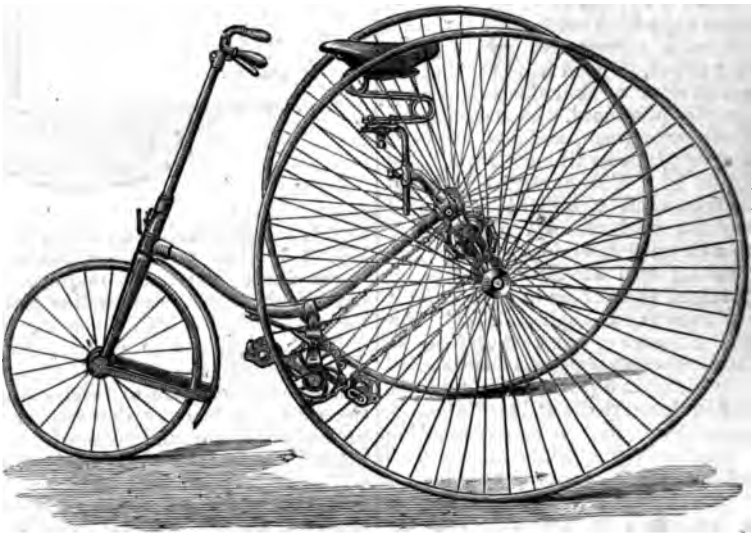
Fig. 1, and also the bosses, Fig 2, if required. Fig. 1 is then to be mounted on a taper screw chuck, and the mouldings neatly cut with gouge, chisel, and beading tool, leaving the central cut till last, which will penetrate quite through, and so far as turning is concerned, complete a frame as No. 1. This frame is not intended to receive a glass, and the card is to be cut rather smaller than the back of the frame, and gummed or glued on. the back being then neatly covered with thin white paper, which still further secures the card, and makes a neat finish. If a glass is, however, needed, nothing is easier than to cut a rebate (circular, of course) at the back first of all, mounting the work face downwards. It can then be reversed and moulded, care being taken not to cut the moulding too deep after having thus thinned the wood. In setting out Fig. 2 I have found it best to draw diagonals to get the centre, and then parallels, whose intersections shall mark the centres of the bosses. Mark these on the back as well as on the front; but on the latter draw the bosses, also with compasses, in pencil, to insure perfect similarity in size and shape. Bore five holes at the back to take the taper screw chuck, but do not let them come through the bosses, as these are to remain solid and globular. If the taper screw is too long, screw on a piece of thin board, so as to occupy some of its length. Many such chucks are made with far too coarse a screw. Those of Holtzapffel's make are cut beautifully with a finer thread, made sharp so as to cut its own way. The form of the screw should also not be a short, quick [illegible]ne, as it will often split the board. The [illegible]tter may be centred first in the middle to [illegible] or [illegible]d form the mouldings. It m[illegible]ted on each of the other [illegible]s, and the bosses or medallions cut. While turning these it must be remembered that far greater height of centre will be needed to allow the work to swing free. Fig. 3 represents it in process of turning the lower boss B. A being the disc of the taper screw chuck. To allow it to swing free of the bed, the height of centre in this case must be 6in., although a 3in. lathe would suffice to turn the central opening. If the work is bedded well down upon the chuck face or bit of plank-wood that is put on to shorten the screw, it will be held quite firmly enough for such light work as turning the bosses. I have, in fact, done this job with perfect ease in the way described. Oak is rather apt to chip, if the circular beads are too small; but a beading tool of Holtzapffels of $\frac{1}{8}$ to $\frac{1}{4}$ will make a neat circular bead if used carefully, and the boss in the centre can be done with a small gouge and chisel. If a gap bed is used there is some difficulty in getting the T of the rest sufficiently near; and for this and other jobs a goose-necked rest will be found convenient—made by having a long bent tenon to the T to go into the socket of the sole plate. There is another plan illustrated in Fig. 4, by which the centres of the bosses may be brought concentric with the mandrel in succession, and secured quickly without need of having any holes bored in the backs of them: and this is an advantage, because it not unfrequently happens that the bosses are bored a little too deeply, and when turned there is a central hole visible. When this accident happens, it is the best plan to bore such hole larger and very neatly, and to insert a turned bit of ebony. Thus the accident will appear to have been designedly incurred. For this second mode of turning, a disc of dry wood, $\frac{3}{4}$in. thick, is to be mounted on the screw-chuck, and carefully faced to form a surface chuck. This being done, measure with compasses the distance between the centre of the frame and that of one of its bosses, and make a hole in the disc at that distance from its own centre to take a screw — preferably one with the under side of its head flat. Make a hole through the middle of the frame, and, passing the screw through it, screw it down pretty tightly, but not so much so as to prevent it from turning round. Cause it to rotate on this screw until the centre of the boss is true with the mandrel. It is now in position, and needs only to be further held by two little blocks or buttons, like Fig. 5. These are put in place and held while a bradawl is passed through the hole in the head, and a hole bored in the wooden face-plate for the screw. An extra turn to the big screw on which the frame is centred secures the whole, and the boss can be turned with ease. The other bosses will evidently each in turn pass through the centre of the chuck when the buttons are removed, and the frame turned upon its central screw. Each is thus brought into position in succession. The work is then removed, and the hole in which the screw has been hitherto now serves for mounting the frame upon a taper screw-chuck, upon which the mouldings are now cut and the centre removed as before. It makes a very neat finish to gild by means of Bessemer gold paint the inside of the circular or oval hollow, merely covering with the gilding the inner circular bead. The outside of the second frame is shown chamfered, and it is easy to raise the outline of this part. If it is preferred to cut out an oval or rather elliptic hole, it will be found the best plan to mark out two concentric ellipses about ¼in or ⅜in. distant from each other. The inner one will then join the line for the saw-cut, and the outer one will accurately define the bevel. It is essential to cut very clean and very true to line, as the least defect of outline becomes painfully visible. The sharper, too, the edge of the bevel on the face of the work the better it will look. A rounded, uncertain outline never appears satisfactory. In sawing out the oval, do not, therefore, efface the accurately-marked outline by which any irregularity of saw-cut may be subsequently effaced with the file. Those sold for touching up fretwork are the best to use.

O. J. L.

THE STANLEY SHOW.

THE ninth annual exhibition of cycles, popularly known as the Stanley Show, was opened at the Westminster Aquarium on Saturday last, and will remain open until the end of this week. Judged by the number of exhibitors, and by the variety of the machines, it is the best show of the kind that has been held, though novelties are few and far between. The visitor who has always gone to the Stanley will notice the almost complete absence of some old patterns, and will be surprised at some of the changes which have taken place in the general build of the machines. Sociables are nearly gone, and the direct-action machines, the principle of which was discussed not very long ago in these columns, are apparently not made now. At one time exhibitors pointed with pride to the number of spokes they put in their wheels; now the wheels of the best machines have tangent spokes, as few as possible, and "laced," as it is called, to gain strength. The resistance of the wind has been found to be an important factor in the construction of "racers," and now all the chief makers reduce the number of spokes. At one time safety bicycles were almost scorned, now they are a leading feature of the show; but Ellis and Co., with their Facile, hold the position they have gained by the sterling merit of their machines as roadsters which can be ridden at high speed in safety. Amongst the novelties in the "safety" type we notice the "Acme" of Bayliss, Thomas, and Co., in which the pedals are brought closer together by dispensing with the ordinary hubs. The spokes unite the rim of the wheel with a couple of rings, so that when the gear and axle are removed we have a wheel with annular hubs, which take their bearings on the axle by means of five radial arms. By this arrangement the gear can be placed in the centre plane of the wheel, and the feet are kept comparatively close together—as close as in an ordinary bicycle. Humber and Co. show a tandem bicycle of the "safety" type, in which both riders drive on to one crank. The pedals for each are pivoted on a horizontal bar attached to the crank. Another maker shows this device applied in a tandem tricycle. Mr. Scantlebury has a novelty in the Rocket Safety Bicycle, in which, by means of links connecting the pedal with the crank, he gets an elliptical or oval motion with 6in. rise and fall. The down stroke is nearly perpendicular, the return describes the arc of a circle, and the rider being directly over his pedals, can exert his full power during the best part of the revolution. The pedals can be adjusted within a range of 4in. Another maker has applied what he terms the Pentograph Patent Rotary Motion, by which a "perfect circular motion" is obtained, the pedal being connected to the crank by a system of three links and five pins. The Whippet is a machine with two small steering wheels in front, and a driver behind for which it is claimed that it is the only tricycle in which the rider is "perfectly insulated from vibration." A T-shaped frame connects the wheels, and the rider, with his handle-bar, is supported on a system of toggle levers, which certainly give a free up and down motion.

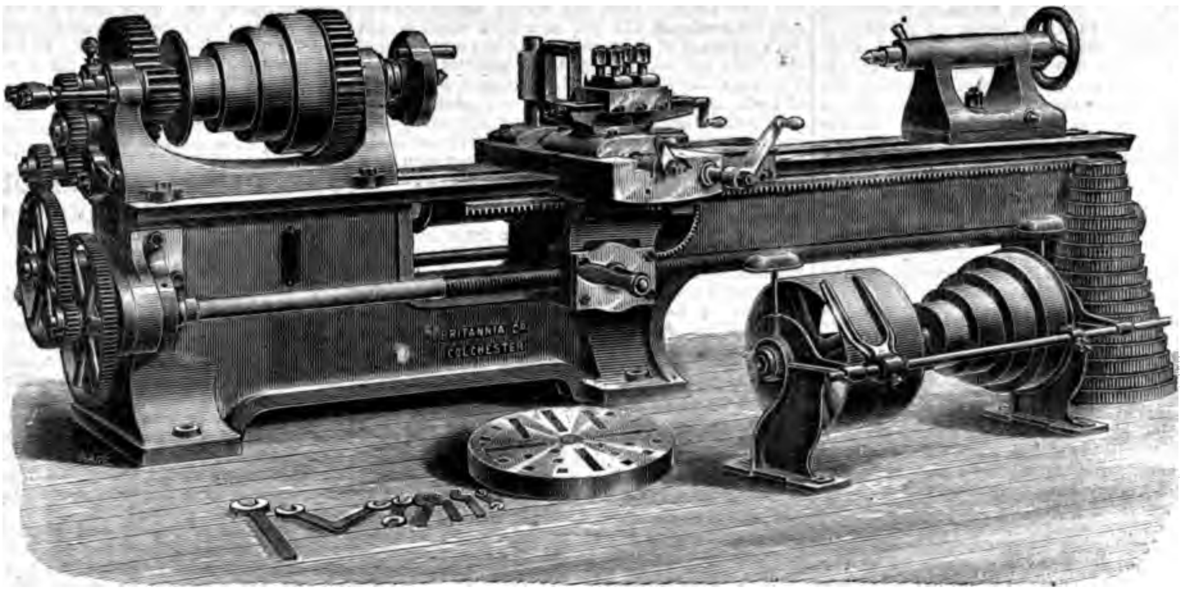
Automatic steering is a notable feature in this year's exhibition, most of the principal makers having front-steering tricycles in which the front wheel is induced to keep a straight course by means of a helical spring—an undoubted advantage, especially in the case of learners. As an example of a good pattern tricycle containing all the latest improvements, we illustrate the "Moorgate" No. 4, made by Cooper, Kitchen, and Co., of 4, Finsbury Pavement, E.C. This machine is a front-steering double driver, with a coil spring fitted between bottom of head and the fork, and another coil spring between top of head and a movable collar on the steering tube, which remove nearly all the vibration. The steering, too, is improved by placing a row of balls at the top and the bottom of the socket, and is automatic, with arrangements for increasing the tension of the spring when desired. The price of the machine is an indication of the tendency of the trade all round, for it is probably the cheapest in the market; but prices have been lowered universally. The wheels, as will be seen, have tangent spokes, laced at two points, thus combining the maximum of strength with the least weight. Mr. Devey, of Wolverhampton, as the earliest maker of cheap bicycles, deserves a special note, and his exhibits will bear the most scrutinising examination, from the 52in. Express bicycle at £4 10s. to his convertible tandem tricycle at £25. He shows an efficient and simple brake, which is applied by the pressure of the thumb on a lever.



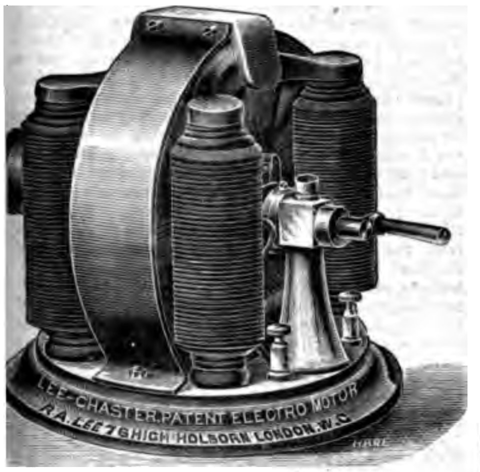
Two-speed gearing seems to be coming into favour, the Crypto-dynamic taking a prominent place in this "show," while another we noticed in an unfinished state, at the time of our visit, appears to have been devised on the model of the back-gear arrangement of the lathe, but as it was not in working order, we can form no idea of its merits. Both are fitted to bicycles. A compressed air motor for tricycles—"the only successful motive power of the future"—was present only in the shape of handbills, from which we gather that it is some scheme for utilising the momentum while running down hill to store up air in a reservoir, and then utilise it as an auxiliary motive-power when ascending hills. The patentee says that "air may also be pumped in on level roads when found necessary." Cycling accessories are shown in excellent collections, and two or three new cyclometers will attract attention, that manufactured under Boys' and Rucker's patent ringing a bell at the completion of each mile, can be read whilst riding, and is said to be perfectly correct. Horne and Thornthwaite, of the Strand, exhibit cyclists' photographic appliances which will interest riders who are also "knights of the camera." Altogether the Stanley Show of 1886 is the best that has been held—there are 110 exhibitors,—and gives lively evidence of the fact that the cycling industry is a growing one, especially in connection with tricycles, tandems, and carriers.

THE LEE-CHASTER MOTOR AND BATTERY.

THE Lee-Chaster patent electro-motor, illustrated by the annexed engraving, is made by Mr. R. A. Lee, of 76, High Holborn, W.C., and can be seen at his works applied to one of his ingenious shaping machines. Although occupying a space of 8in. by 8in. only, it is said to be capable of developing energy equal to 5[illegible] watts, and can be started, stopped, or reversed by the simple movement of a switch. The great efficiency of this motor is due to the fact that the armature runs between north and south field-magnets on both sides, and can be driven either by a primary or secondary battery, or by a dynamo. The device is more especially worthy of notice because it is driven by a battery which involves the minimum of trouble, which will run for about 20 hours without recharging, and then can be restarted with fresh solution in a very short time. The cells are charged with Lee's new double bichromate, which is soluble in its own weight of cold water, and which does not deposit crystals in the pores of the carbons or in the cells. Moulded corrugated carbons are used, and the zincs are so cut as to economise the metal as much as possible. The cells rest on a tray in a box, which tray can be raised by means of a treadle until the elements are fully immersed in the solution. The [illegible]rangements of this battery have been [illegible] thought out, and leave nothing t [illegible] desired. Both zincs and carbons are sus[illegible] from a board, which forms a lid, so t



and the connections are made by means of brass plates, thus avoiding the use of wires. Two wing nuts hold this board to the mechanism of levers, and by removing them the whole battery of elements can be lifted out, leaving the cells exposed. The zincs and carbons are automatically removed from the solutions when the treadle is released, and the amount of immersion can be regulated to a nicety. We understand that preparations are being made for fitting a Lee-Chaster motor to a launch—work to which both motor and battery are well adapted.


LEE-CHASTER PATENT ELECTRO MOTOR
R. A. LEE 76 HIGH HOLBORN LONDON, W.C.

A MODERN ENGINEER'S LATHE.

AS a specimen of a high-class engineer's lathe we illustrate the 12in. self-acting, sliding, surfacing, and screw-cutting gap-bed lathe in the Royal Ordnance Factory at Enfield. This lathe, which has great strength for its weight (about 4 tons), is one of those made for the Government by the Britannia Company, and has all modern improvements in details. The bed is 19in. wide by 13in. deep; the gap is 19½in. wide by 11½in. deep, swinging 47in. diameter. The extreme length between centres is 6ft. 8in., and the headstock is double geared, with steel spindle, conical necks, and gun-metal bearings, while the loose headstock is fitted with cylinder mandrel and left-hand square traverse-screw. The cone pulley has four speeds, the largest being 16in., and the smallest 6¾in. diameter; the leading-screw is 2¼in. diameter by ½in. pitch. The saddle has a flush top and grooves for [illegible] for boring, while the compo[illegible] to swivel to any angle [illegible] graduated for conica[illegible] gun-metal nut, ac[illegible] ment, engages an [illegible] has a quick hand-traverse by means of a rack-and-pinion and double-purchase gearing. This specimen is a good example of a complete engineer's lathe, and is fitted with every detail that can help to make it thoroughly efficient.

THE CREATION PROEM OF GENESIS.*

THE unexpected appearance of men so eminent as an ex-Premier, a President of the Royal Society, and an Oxford Professor of Hebrew as controversialists in respect of the meaning of the sublime Proem of Genesis is not only a remarkable phenomenon, but a sure indication that no satisfactory solution of the difficulties in question had hitherto been suggested. Of the latter fact I (and, no doubt, others besides myself) have been long convinced; but, as very many of my theological colleagues appeared to think otherwise, I judged that it was wiser not to interfere with a popular fallacy, and to let the subject sleep.

The case is now altered, and I propose to lay before the Church of God such considerations as have occurred to, and have entirely satisfied, my own mind, after meditations on the questions at issue extending at intervals now through half a century. Perhaps also the opportunities which have, in natural sequence, presented themselves during a long professional career both as a divine and a student and expositor of nature, may furnish a sufficient reason why I should now speak, and possibly receive some audience. In what I am about to say I desire to use great plainness of speech, and I hope also simplicity and sincerity in the mode of inquiry for truth. I shall aim at introducing no *finesse* or economies into the argument, but I will take the wonderful poem, for poem it is in a sublime sense, in its literal and grammatical and apparent meaning, such as it may be presumed a plain man on reading it would understand it to be.

Taken, then, in this plain and grammatical sense, this majestic Proem, if regarded as an account of creation in fact, contains statements which, to my apprehension, are irreconcilable with what we at present know of the constitution of nature, and there is offered no appreciable hope, that I can discern, of a reconciliation from future discoveries. I limit this statement to my own mind and my own apprehension alone: if other divines, other astronomers, other naturalists think otherwise, I can only bow to their sincerity and look to them for a candid interpretation of my want of insight. I give what I regard as unimpeachable reasons why I cannot accept the Proem as being, or even as intended to be, an exact and scientific account of creation; nevertheless, I shall also state why I am satisfied that it had originally a different intention and a far higher scope, and moreover contains within it elements of that same sort of superhuman aid or superintendence which is generally understood by the undefined term of inspiration.

That it could not originally have been intended to give [illegible] scientific account of creation in its precise ord[illegible] method, or limitation of time, I am convi[illegible] n (1) I read of the existence of waters before the appea[illegible] of the sun; (2) the clothing [illegible] ees and grass, each bear-[illegible] ation of the sun; (3) the successive periods or stages of creation, occupying each one single day.

There are two other difficulties regarding palaeontological morphology, on which I forbear to speak; it is enough for me that a man of Dr. Huxley's responsibility and deep knowledge of the subject and general fairness of mind states distinctly that the Mosaic account therein, as he interprets, is at variance with the facts of nature so far as is at present known. Further, it will be observed that I interpret the periods of time, expressed again and again by the words, "There was evening, there was morning, one day," in the sense in which any plain man would understand them—namely, as being intended to represent the interval of time ordinarily represented by twenty-four hours. Moreover, I am unable sincerely to avail myself of what, with some tinge of irony, Dr. Huxley calls the flexibility of the Hebrew language, and draw fine distinctions between the words made and created, as if the document were that of a lawyer or a glossary of scientific definitions. To all intents and purposes there is a representation of the creation of the sun and moon, after the representation of that of the fruit-bearing trees and the grass. There is also a distinct representation of each of these creations occupying a space of time limited by evening and morning, one day. These three representations (including that respecting the pre-existence of water) if, intended to be a statement of fact, are, to my apprehension, in direct antagonism with our present knowledge of nature and the operations therein.

Nevertheless, and in the face of these, to me, insurmountable difficulties, I feel as fully convinced also of the existence of a superhuman element running throughout the Proem from its beginning to its end. It is not, and it cannot be, simply a mere tradition from antecedent generations. For the record in Genesis is *sui generis* in the world's history: in all the annals of literature there is nothing that approaches it: not all the poets and philosophers that have ever lived could have combined their genius to compose the like of it in its succinctness, its concinnity, its majesty. The myths of Plato on the origin and destiny of things, wonderful as they are for their exquisite beauty, are utter childish babble when placed by the side of the Mosaic Proem. All other cosmogonies add grossness to infantine senility.

What, then, are we to say of these two apparently antagonistic elements contained in the same narrative, one of which is contradictory to the facts of nature, so far as we know them, and the other introduces therein the suggestion of a superhuman element, implying more or less of Divine aid or control? For my own part, I fail to see any inconsistency here, which I do not also see, in kind at least, repeated throughout the entire scheme of Providence, whether as revealed in the Scriptures, or as observed in nature. For the Eternal Father unquestionably does teach His children, at sundry times, in multifarious manners. Moreover, things are so constituted that the whole truth, in its absoluteness, is never taught and is never attained: the light is sufficient for the day, and often for that day only; and more light is generally attainable by a more diligent and skilful use of existing faculties and natural endowments. Further still, the object of the Proem seems to be to impress on [illegible] nd primæval age, in a clear and emphatic [illegible] the Fatherhood of God over the whole [illegible] ; but its object was not to teach the order [illegible] the method, or the times in which that creation proceeded. Accordingly, a series of pictures is presented to the mind, in each of which some portions of the Divine creative power are successively displayed, in respect of the sun, or the moon, or the earth with its varied populations, on the land, or in the air, or in the waters. But it is a matter of entire indifference in what precise order the creative energy is depicted; and, as a matter of fact, we find that order does occur, which is best suited to impress the emotion and the intelligence of the mind. I hold that the distinction implied in this remark is of supreme importance, as removing all objections drawn from the fact that the order of the creations detailed in the Proem is not the order of natural fact.

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* [illegible] Guardian.

Again, if we seek for the origin of this sublime Proem, it seems natural to assign it, as many writers have assigned it, to some ancient tradition handed down from previous generations, until, like the poems of Homer, it became committed to writing. But in this case, where lay the original source of the tradition itself? That source, I hold, as I have already stated, could not have been entirely human; for, as we have also seen, experience and history have taught us that nothing like it, in respect of sublimity of conception, and gravity of diction, and perspicuity of statement, has appeared among the nations of the earth since the remote age of its first appearance up to the time when the philosophical astronomer of Slough constructed his wonderful instruments and applied his genius to the scrutiny of the heavens, so pregnant and so suggestive.

But if the Proem be not entirely of human origin, we are then to ask in what way it is alleged or supposed that this superhuman aid was accorded to the mind of a man. Now, without entering upon the profound or inscrutable question as to the mode or extent of what we term Divine inspiration, a mere cursory search into the sacred record soon discloses that the general agency is recorded to have been through visions in the night, or a trance by day. It is true that no such origin is actually assigned in the sacred record to the Proem in question; on the contrary, it is introduced without a preface, and with a majestic abruptness, befitting (as it seems to me) what professes to be the commencement of God's written word to man. Independently of this, omissions of matter, subsequently appearing to be of importance, are in constant occurrence in Scripture. We may, therefore, I contend, assume the same sort of origin to this beginning of Genesis, which in so many other instances is stated to have been the mode of communication between man and the Powers unseen, even the Spirit of God, dividing unto every man severally as He will, and as the occasion serves. We may assume (without violation of probability) that in some remote stage of the world's history, remote beyond our knowledge, some holy seer, a man of God, after long and reverential pondering on the things around him, animate and inanimate, and on his own existence, fell asleep, either in the gloom of evening or in the light of noon-day, and in his sleep visions of creative processes pass before him. In his waking hours of meditation, something akin to what is now disclosed in the vision had gradually dawned with uncertain light on his imagination; but now a Power not his own has reduced it to an order more defined, and a conception more distinct. It is not, indeed, a complete panorama of the creation of things animate and inanimate, in its pure and absolute sense, that moves before the vision of his mind; but there are vivid pictures or parables of creation, enacted like the scenes of a drama before him; parables of the creation of what, in his waking hours, had excited his admiration, and such as when the vision was over he could remember and recount. Better than all, the creations were represented as the work of Him who was the God of his family of his nation, and who had commanded him to love Him with all his heart.

And so, in the dreaming mind of the ancient seer, it may be, in that undefined and darkling way, wherewith in our dreams we rather perceive than see, chaos is present: an unformed earth plunged undefinedly in many waters, dark and deep. In his dream, and with the hearing of the mind, he heard a Divine Voice, speaking with a sublime authority, unknown before or since to man, "Let there be light;" and he now sees chaos and the waters which he had only heard or half-conjectured before; but as yet there is no blaze of the noontide light. And there the first scene of the creation drama closes. To his sleeping thoughts there had passed "an evening and a morning, one day." Again the vision of the birth of things created is resumed, and he perceives an awful separation of the waters from each other at the bidding of the Divine Word. Part of these pass off beyond the firmament of heaven, now formed and disclosed at that same command, and part of them remain below. To the dreamer there has been again "an evening and a morning, a second day." During the like limitations of a third day the earth emerges from the waters, continents and seas are arranged, and the new-born earth is clad with the trees of the forest and of the orchard, and the fields are arrayed in their mantles of grass. These all, like the other things created, are blessed of God. As yet there had been no shadows flitting amidst the forests or reposing on hill and glade, such as he was wont to see at noontide or at the wane of day, for all as yet had been seen by a diffused and unconcentrated light. But now that the earth is arranged in its continents, and seas, and hills, and plains, and clothed in its glorious array of fruit-trees, bearing their fruit and their seeds each after its kind, then, and not till then, the sun in its majesty breaks forth and sheds its living light resplendent over the fair earth on the birthday of its completion. The shadows from cloud and hill and tree now vary, the scene, and add new beauty as the day declines. In the evening there is the moon, and there are "the stars also," all created and blessed by the God of his fathers. And so ends the creation drama of the fourth day.

On the fifth and sixth days the creation vision presents to the seer's mind a succession of pictures, which, after the lapse of many centuries, were embodied by the Hebrew Psalmist in almost matchless poetry, and have ever since become a great possession to devout men in the Church of God. The new-clad earth no longer remains tenantless by life, but "among the cedars of Lebanon the fowls of the heaven have made their nests, and sing among the branches;" "the high mountains are for the wild goats, and the rocks are a refuge for the conies." "By the sides of the streams the wild asses quench their thirst. Yonder is the sea, great and wide, wherein are things creeping innumerable, both small and great, the leviathan whom God hath formed to take his pastime therein." "These all wait upon God," and God pronounced them good. So sang the Psalmist, taking up his parable from the creation poem, sublimer even than his own. Meanwhile, on the sixth day, when all this fair creation is completed, where is he, its future lord and master, for whom all this wonderful array of life and beauty was called into being? And so the seer, in his trance, hears the voice which he recognises as the voice of God, "Let us make man," and the man comes forth before the prophet's gaze, fashioned as nought else that lives besides, even as in the image of Him Who created him. If we seek to realise the scene, can we doubt in what guise the new-formed man appeared? Surely erect, and in the attitude of prayer, and praise, and thanksgiving. And he, too, is blessed of God and pronounced to be "very good." Did the seer, in his dream, then also realise the picture so touchingly drawn by the Psalmist, even that the man "went forth to his work and to his labour until the evening"? Who shall say? With this vision of the new-formed man the scenes of creation close; and "there was evening, there was morning, the sixth day."

One day still remains, a day of rest, a peaceful Sabbath calm, for "the heaven and the earth were finished, and all the host of them." Was it on that Sabbath morn that, as in the ancient tradition preserved in Job, but omitted in Genesis, "the morning stars sang together, and all the sons of God shouted for joy"? If so, then there is here the sublime picture of the first consecration of a day, which henceforth has become a day of days, a season of blessedness for man.

If such, or at all approaching such, were the visions of creation, and if amid such joy, the entranced seer awoke from his dream, it could not well be otherwise than that the favoured saint would call his friends and his neighbours together, and sitting under his vine, or in the shade of his olive or his figtree, he would recount his wonderful dream again and again, and still again. Meanwhile the tale itself, after the manner of the East, would speed its rapid way from city to city, until at length the vision, as such, lost its name, and it became a tradition.

This, then, is the aspect under which I view the majestic Proem of the Book of Genesis. To me the interpretation wears the appearance of so much probability that I accept it as an approximate fact. To my mind it provides a key which fits and opens many of the locks of modern controversy. Both as an astronomer and a divine, musing on a difficult question now for half a century, it satisfies my mind, and it sets me free. Under this solution, a man may be loyal to his faith in the sacred scriptures, and faithful also in a fearless and ingenuous search for truth. Questions of development, and of protoplasm, and of the survival of the strongest, have no real place for contention in sight of this sacred panorama of the visions of creation. It bears no true and real relation to any vexatious doubts as to the priority of palæozoic or cainozoic populations. The astronomer is left in peace to take his prism, and scrutinise the materials of distant suns, and the genesis it may be of new worlds; and the naturalist is free to take his still more marvellous lens, prisms only in another form, and search for the hidden seat of the mechanism of the emotions: all this, and more than this, he may do, without the possibility of a conflict with the sacred record. The duty of both is the same, it is the search for truth in nature. The duty of the theologian is to search for truth of another order, in regions which may be collateral, but can never be conflicting.

GEOLOGICAL EXTINCTION, AND SOME OF ITS APPARENT CAUSES.

II.

By A. S. Packard.*

(*Continued from page* 486.)

A SECOND series of causes of extinction arose from the elevation or depression of extensive regions of the earth. The paroxysmal, elevatory process in the formation of the Cordillera of North, and particularly South America involved corresponding more or less rapid changes in the flora and fauna of the Pacific coast regions of those continents. In South America, particularly, during the Quaternary period, though there was no glacial period north of Patagonia, the extinction of life was widespread and marked.

As observed by Darwin and Alexander Agassiz, within historic periods there have been paroxysmal upheavals over thousands of square miles, if not over the whole extent of the Western Andean plateau. For example, in 1822, after an earthquake, the coast-line of Patagonia and Chili was suddenly elevated from two to seven feet above the level of the ocean. In 1835, Darwin, while at Valdivia, on the coast of Chili, experienced the earthquake which devastated Concepcion, and he says his "compassion for the inhabitants was almost instantly banished by the surprise in seeing a state of things produced in a moment of time which one was accustomed to attribute to a succession of ages. In a single day, Feb. 20th, this earthquake shook the coast of South America over an area of 600,000 square miles, and the whole coast line of Chili and Patagonia was elevated from two to ten feet above the sea level." Darwin, in his "Voyage of a Naturalist," remarks: "At the island of S. Maria (about thirty miles distant), the elevation was greater on one part, Captain Fitz Roy found beds of putrid mussel-shells *still adhering to the rocks*, ten feet above high-water mark; the inhabitants had formerly dived at low-water spring-tides for these shells. The elevation of this province is particularly interesting from its having been the theatre of several other violent earthquakes, and from the vast number of sea-shells scattered over the land, up to a height of certainly 600 and, I believe, of 1,000ft. At Valparaiso, as I have remarked, similar shells are found at the height of 1,300ft.; it is hardly possible to doubt that this great elevation has been effected by successive small uprisings, such as that which accompanied or caused the earthquake of this year, and likewise by an insensibly slow rise, which is certainly in progress on some parts of this coast." Darwin adds: "Two years and three-quarters afterwards Valdivia and Chiloe were again shaken, more violently than on the 20th [Feb. 20, 1835], and an island in the Chonos Archipelago was permanently elevated more than eight feet."

As observed by Mr. A. Agassiz, there are no corals of species still living in the Pacific Ocean adjacent attached to the surface of interstices in the rocks at Tilibiche, Peru, at a point about 2,900ft. above the level of the sea. This locality is situated on a ridge parallel to the coast, there being a pampa or basin between this ridge and the coast range. This basin was probably the bottom of an inland sea which afterwards became a salt lake, and was eventually drained into the Pacific by the breaking through of the mountain barriers. The extensive saline basins on the western slope of the Andes, at an elevation of over 7,000ft., may have been former ocean bottoms. In his "Andes and the Amazon," Orton says: "President Loomis, of Lewisburg University, Pa., informs the writer that in 18[illegible], after nearly a day's ride from Iquique, he came to a former sea-beach. It furnished abundant specimens of Patellæ and other shells, still perfect, and identical with others that I had that morning obtained at Iquique with the living animal inhabiting them. This beach is elevated 2,500ft. above the Pacific." (p. 116). Also, the presence of a species of Amphipod Crustacean belonging to "a truly marine family," dredged by M. Agassiz in Lake Titicaca at a depth of sixty-six fathoms, indi that this lake may be a remnant of the Pa Ocean; though it now stands at an elevati 12,500ft. above the sea.

These facts tend to prove that the A plateau during the Quaternary peri paroxysmally elevated into the air some Let us now look at the possible results of enormous upheaval on the plants and this region. Before and at the time ment began, when the land was 12,000ft.

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* From the *American Naturalist.*

Atlantic trade winds which now cross ; impinge upon the Andes, and drop their ure on the eastern slopes alone, then favoured the western slopes and Pacific coast. The tropical flora and fauna now confined to the neighbourhood of Guayaquil on the coast of Peru, then probably spread over Bolivia, Ecuador, Peru, and Chili to Patagonia. The tropical belt in Peru ends with the chinchona forests of Loja, which is 6,768ft. above the Pacific Ocean. The sugar cane grows in Banos, which is about 6,500ft. high. At Riobamba, with an elevation of 9,200ft., the climate and vegetation are temperate; here occur bones of the mastodon, horse, deer, and llama—animals which may have lived in a temperate climate. But was not there extinction, and that of the colossal sloths, armadillos, and other animals of the pampas largely due to a change of climate resulting from the elevation of the Andean plateau?

As the land gradually rose, the atmosphere would become more rarefied and insupportable to tropical life; the animals and plants would either seek lower levels or undergo extinction, or in certain cases become modified into species suited to a temperate climate. As the plateau rose still higher, the air would become too cold and rarefied for even the mastodon and horse. Gradually an Alpine zone became established, and finally the higher peaks of the Andes, at an elevation of 15,000ft., became mantled with perennial snow, and on the eastern flanks of Chimborazo, which intercepts the moisture of the Atlantic trades, glaciers established themselves. We thus see how, within Quaternary times, temperate and Alpine zones became established over the vast Andean plateau, originally, perhaps at the end of the Pliocene, a plateau of the third order, clothed with vast forests like those of Brazil and Venezuela.

In Patagonia, likewise, the elevation of the Cordillera, and the change of level of the low lands of the eastern coast, now well known to have happened, are they not sufficient to account for the extinction of the fauna of the pampas?

The same phenomena obtained in Western North America. Throughout the Tertiary period there was in the northern portion of the plateau region a secular rise of land, if not at times paroxysmal, resulting in the drainage of the plateau into the Pacific and the formation of vast inland seas and estuaries which eventually became fresh-water lakes.

During the Laramie epoch the Rocky Mountain plateau became dry land, and the elevation and drainage went on during the Eocene. The Gulf of Mexico was much larger in the Eocene epoch than now; afterwards the coast of Texas rose from 300ft. to 700ft., while further north, in Colorado and Wyoming, the Rocky Mountain plateau rose from 4,000ft. to points 10,000ft. above the ocean.

The plains east of the Rocky Mountains are underlaid by beds deposited by vast inland, fresh-water lakes. In Texas these beds dip under the Gulf of Mexico, but at the base of the Rocky Mountains in Colorado they are 7,000ft. above the sea. They have been tilted up. Gen. Warren and Mr. King have shown that after the Pliocene epoch such a tilting took place. These lakes dried up, and the marvellously abundant mammalian life which thronged about their shores became extinct as the Quaternary period opened. May not the extinction of life so widespread throughout the West, particularly at the end of the Eocene, the Miocene, and the Pliocene, have been mainly due to the great changes in the physical geography of that vast region? We see also why a semi-tropical climate and flora and fauna continued to exist around the Gulf of Mexico, but ceased to live on the elevated Rocky Mountain plateau, as well as the Sierra Nevada and Cascade plateaus. The whole western portion of the continent was carried up bodily, the lakes drained off by the Missouri, Columbia, and Colorado rivers, and the air at such an elevation becoming rarefied, dry, and cooler, the tropical life became either extinct or migrated southward to warmer and lower regions. Towards the end of the Pliocene multitudes of llamas, droves of horses, mylodons, elephants, and mastodons, with lions, cats, and dogs, flourished in Oregon, Montana, Utah, Wyoming, Colorado, and New Mexico; changes of level, and consequently of climate, were perhaps the main factors concerned in their demise.

There were throughout the Tertiary most widespread and all-pervading geological changes, culminating in the upheaval of the two
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elevation of 10,000ft., the sign and
extensive upheaval. We kno
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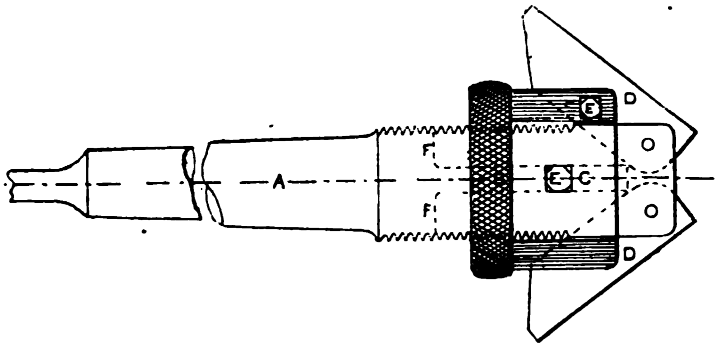
tion set in throughout the great basin between the Rocky Mountains and Sierra Nevada, and extensive rainless districts resulted. But even then there were alternate wet and dry cycles throughout the early Quaternary. Great Salt Lake, from being a vast body of fresh water, became a shallow brine pool; the sources of the Colorado, Columbia, and their tributaries likewise partially dried up.

(*To be continued.*)

FLY-MILLING CUTTER.

THE annexed sketch of a fly-milling cutter for bevelling odd jobs is contributed to the *American Machinist* by Mr. Lee C. Sharpe. It will be seen, by referring to the sketch, that it is adjustable to quite a range of angles and is very rigid. To adjust, loosen the three set-screws E E E, and move the sliding collar C (which slides over the thread) by the milled nut B. Two slots are cut in shank to receive cutters, as shown by dotted lines F. The set-screws E E should be slightly inclined so as to bed the cutters firmly on collar C. The centre set-screw holds the collar C in place, and should bed itself in a shallow key-way cut on the threaded shank. This cutter can also be used for countersinking and re-seating. I have seen nothing like this before.



LEAD-POISONING BY HOUSEHOLD UTENSILS.

THE German Parliament has now under consideration a Bill which is intended to regulate the employment of lead in the manufacture of cooking and other domestic utensils, and so to diminish the risk of poisoning by that metal. The provisions of this measure certainly do not err on the side of leniency. They forbid the use of vessels containing more than 10 per cent. of lead in their composition for the above purposes. No alloy with over 1 per cent. may be used in coating iron articles used in cookery. Solder may consist of lead to one-tenth of its amount, but no more. Enamels into which lead enters are treated with equal stringency. The effect of this Bill, if it be passed, will be to obliterate the legal existence of pewter and of soft solder as at present made, since these alloys contain from one-half to one-fourth of their weight of lead. One fact which it brings into prominence is that lead-poisoning in Germany appears to arise from other causes besides those to which it is commonly attributed in this country. Cases of this kind among ourselves are usually found in the persons of those who are actually engaged in handling lead or its compounds in their daily occupation. Plumbers, painters, glass-blowers, glaziers, potters, and enamel-card makers furnish the majority of those who suffer from plumbism. When this disorder appears in the household, new paint in the walls or the leadwork of the water service affords a clue to its detection. It is comparatively rare to find in these days that pewter pots or cooking utensils are at fault. This may be because glass is used on the whole far more frequently than pewter in the liquor trade; while in the kitchen those vessels
of which are most likely to become
with lead in the solder—such, for
pans—are usually made of
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use of lead in manufactures and in its other domestic applications. The introdutcion of these further restrictions might fitly exercise the judgment of our own as well as foreign legislators.—*Lancet.*

ENGLISH AND AMERICAN RAILROADS COMPARED.*

IN the opinion of the author, neither the English nor American railroad is perfect in itself, if the object of a railroad is to give the greatest amount of comfort to the passengers for the least amount of money, and the cheapest freight charge to the shipper. In this light, the Pennsylvania Railroad comes nearer perfection than any other, but it has the serious fault of many level road crossings. All other large American railroads have, in addition to this defect, that of the absence of the block system. With these two faults alone, they are far from being perfect, to say nothing of minor improvements required, such as good station buildings, &c.

Although the English cars are far from being as comfortable for travellers as the American, yet the English engineer can do but little now to remedy it, owing to the low and narrow cars he is obliged to run. Perhaps the most that could be done would be economising in the cost of motive power, the general introduction and use of the American baggage-check on all connecting lines, thereby increasing the comfort of passengers, and also saving a large expense to the railroads in saving the cost of many unnecessary porters; warming the cars in winter; general use of the bogie truck under passenger cars, thereby diminishing the constant jarring motion now so great in them. The English road-bed, superstructure, and block-signalling system are all that could be desired. From superficial observation, it is difficult to say what is the cause of the great additional cost in motive power in operating the English railroads, when it should be much less than that of the American railroads, as, owing to their average superior construction, with easier grades and curves, it should not be much over half, instead of being nearly double. Apparently the most prominent cause of this increased cost is the great speed and small tonnage of the freight trains, and too many passenger trains lightly loaded. Perhaps the American bogie-truck rolling stock runs with less friction than the rigid wheel-base rolling stock used on the English roads. The English railroads have cost per mile more than three times as much as the American, yet they only save 8 per cent. of the annual operating expenses. In other words, to save one-twelfth of the annual operating expenses the cost of construction has been increased more than three times. The preceding comparison would be still more striking if we brought into calculation the comparative cost in the two countries of the different items included under the heading of "Maintenance of Way," "Locomotive Charges," and "Repairs of Carriages." Probably 90 per cent. of these are made up of labour, fuel, iron, steel, &c., all of which would average, in 1883, fully one-fourth higher in the United States than in the United Kingdom. This speaks very well for the American system, that, notwithstanding it costs much less to construct, after paying higher prices for labour and materials—and for financial reasons the location is often faulty, and the superstructure of perishable materials—yet it is operated for less than the English roads are, when due allowance is made for the difference in the price of labour and materials that enter into operating exp s. Notwithstanding these disadvantages for ilar accommodation, the passenger rates an charges are much less on American
tha railroads. One of the principal

Dorsey, M.Am.Soc.C.E. From
American Society of Civil Eng

items of the greater cost of English railroad construction over the American is the necessity of having much straighter aligument or easier curves, so that it can be safely operated by the rigid and long wheel-base rolling stock in use there. The Baltimore and Ohio Railroad is a sample of what can be done with the American rolling stock. This road is built through a very difficult and rugged country, which compelled a very poor alignment, with nearly one-half of the entire length in curvature, which curves run up to 600ft. radius, and long grades running up to 120ft. per mile. The country affords no natural advantages whatever. Yet, with all these drawbacks, this road does a very large and profitable business, paying annually 10 per cent. dividend, and running passenger trains safely at very high speed. All this is done on a road that could not be operated with rolling stock built on the English system. The extra cost of enlarging these curves to adapt them to English rolling stock would be so great as to be commercially impracticable. It is not difficult to appreciate the great difference in cost of construction, in an extremely rough country, of a railroad which curves 600ft. or 2,640ft. radii.

Unquestionably the American system of construction is the best for new countries, or where cheapness of construction is desirable. The American rolling stock, with the bogie-truck, will run safely and rapidly over roads of inferior construction, or sharp curves that would be impossible for rolling stock constructed on the English type of long and rigid wheel-base. The American type is specially adapted for military purposes. During the late American war some military railroads were operated successfully, with the ordinary American rolling stock, with curves of 50ft. radii. The New York Elevated Railroad has been operated for years (it transported last year 97,000,000 passengers) without accident, and has many curves under 100ft. radius. Through an ordinary rough country, a railroad to be operated with the American type of rolling stock could be constructed in one-fourth of the time and for one-fourth of the money that one suitable for the English rolling stock could be built. It would certainly pay the management of the English railroad companies to investigate the cause of the extra cost of motive power on their roads, and, if possible, remedy it. If this can be done, they will be able to decrease their operating expenses over 8 per cent., without making any changes whatever in the present prices. This will enable most companies to increase their dividends largely—probably over 4 per cent. For what is done in the United States ought to be done in the United Kingdom.

LANTERN SLIDES ON GELATINE PLATES.*

By B. J. Edwards.

FOR contact printing from negatives of a suitable size the gelatino-chloride process will be found especially suitable; it also has the further advantage that it is extremely easy to work.

This beautiful process was first described by Dr. Eder, of Vienna, who exhibited at the Technical Exhibition held in 1881, at the Society of Arts, in London, a series of fine transparencies made by the new process.

In April of the following year I had the honour of demonstrating the process before the South London Society at the same place, and I also introduced gelatino-chloride plates commercially in this country.

Since that time many improvements have been made. Dr. Eder's formula for gelatino-chloride emulsion was published with instructions for modifying it in preparation so as to produce various tones in the transparency. Dr. Eder also published his formula for development by means of citrate of iron. Then came Captain Abney's ferrous-citro-oxalate developer, which was much more rapid in its action, but which gives only black tones in the transparency. Shortly afterwards, in the course of my experiments, I discovered that the tone or colour of the transparency could be varied at will by simply altering or increasing the time of exposure and using a weak or restrained ferrous-oxalate developer. This discovery was published at the time, and at the same time I ventured to predict that this or a similar modification of the gelatino-chloride process, applied to paper, would probably prove the quick-printing process of the future. That my prediction has already been partially fulfilled is shown by the rapid-printing papers already in the market, and more or less extensively used. I have brought with me some of the results of my earlier experiments in this direction, which may be interesting.

With regard to the development of gelatino-chloride plates for transparencies, the rule above mentioned holds good. Short exposure and powerful development give black tones, while full exposure and restrained development give warm or red tones.

The following formula will give good results with any desired range of colour:—

Stock Solution.

No. 1.

Oxalate of potash	2 oz.
Chloride of ammonium	40 grains
Bromide of potassium	20 „
Distilled water	16 oz.

No. 2.

Sulphate of iron	4 drachms.
Citric acid	2 „
Alum	2 „
Distilled water	16 oz.

The developer is made when required for use by mixing equal parts of the above solution.

To print the transparency the chloride plate is placed film side next the negative, in an ordinary pressure-frame, taking care to adjust the plate exactly in position over that part of the negative which it is desired to reproduce. The manipulations may be safely done by candle-light, or weak gas-light, as although the plates are very sensitive to daylight, they are not very sensitive to ordinary artificial or yellow light.

The time of exposure to diffused daylight, 2ft. or 3ft. from the window of an ordinary room, will vary from two to twenty seconds, according to the power of the light and the density of the negative; full exposure in a dull light usually gives the best results.

With weak or thin negatives it is better to cover the printing-frame during exposure with a piece of opal glass or white tissue paper, giving sufficient exposure to compensate for the loss of light. A convenient method of printing by artificial light consists in burning an inch or so of magnesium ribbon at a distance of 12in. from the printing-frame; several plates in separate frames can be exposed at the same time to lessen the cost, which is, however, very trifling.

To develop the transparency place the exposed plate film uppermost in a porcelain dish, mix equal parts of the above solutions, adding No. 2 to No. 1, and pour the mixture rapidly and evenly over the plate; rock the dish during the progress of development (which may be examined from time to time by yellow light). When sufficient detail and density are obtained, which will usually be in about two or three minutes, pour off the developer into a measure, and flood the plate with water, and wash well under the tap.

The above developer, with moderate exposure, will give positives of a rich black or purple colour: warmer or redder tones may be easily obtained by simply diluting the mixed solutions with an equal quantity of distilled water, or by adding to each ounce three or four drops of a sixty-grain solution of bromide of potassium, and proportionately increasing the time of exposure. In practice it will be found a good plan to make up two separate portions of developer, strong and weak, and commence with the latter. Should the plate prove to be under-exposed, the developer must be poured off, and the more concentrated solution used to bring out the picture and complete development. This method will allow considerable latitude in the time of exposure. Several plates may be developed in the same solution; but the developer gradually loses its energy, and will not keep long after being mixed.

To fix the pictures, make up the following:

Fixing Solution.

Hyposulphite of soda	1 oz.
Water	8 „

Pour sufficient of the above, when dissolved, into a separate dish kept for the purpose, and immerse the developed and washed plate for two or three minutes, or until fixed, taking care not to expose the plate to light during the operation; then wash well under the tap, and apply the following clearing solution:—

Sulphuric acid	½oz.
Saturated solution of alum	20 „

Pour a small quantity of the above repeatedly over the plate for about a minute, or until the slight deposit of oxalate of lime (caused by the washing water) is dissolved away, and the picture becomes bright and clear; as soon as cleared, wash well in repeated changes of water, and allow the film to dry spontaneously.

In working this process, great care must be taken that not the slightest trace of hyposulphite of soda comes into contract with the developing solution, or with the plate, before or during development. Separate dishes must be used for each solution; the dishes, as well as the hands of the operator, should be frequently washed and kept scrupulously clean during the various manipulations, otherwise the films are liable to become stained and discoloured.

When quite dry the transparencies may be varnished with good clear negative varnish [illegible] with heat in the usual way.

The above method of making lantern slides [illegible] contact printing from small negatives will be found all that can be desired. In cases where it is desired to obtain slides for the lantern from larger negatives by printing in the camera, the chloride plates are not found so suitable, owing to their comparative want of sensitiveness to the weaker rays of light which pass through the lens; therefore it becomes desirable to use a more sensitive film. For this purpose it is found that gelatino-bromide plates having the sensitive compound in the film in an extremely fine state of division will, with suitable development, give excellent results, and be sufficiently rapid for all purposes; in fact, plates of any rapidity may be used, provided the development be modified to suit the degree of sensitiveness in the film. Care must also be taken to avoid fogging the plates by actinic light previous to exposure, or during development; at least some portion of the highest lights in the picture should be represented by absolutely clear glass, without a trace of fog or deposit of any kind, which would detract from the brilliancy of the image. These plates are also suitable for contact printing by gas-light, and with a plate of moderate rapidity about 8 or 10 seconds' exposure to the light of a good "fish-tail" burner, at a distance of about 12in. from the flame, will be found sufficient for negatives of ordinary printing density; thinner negatives should be exposed less time or at a greater distance from the light. Exposure may also be made by diffused daylight, in the dull light of an ordinary room; it is, however, far more difficult to judge the correct time, therefore it is preferable to use artificial light.

It is important that as nearly as possible correct exposure be given, according to the density of the negative and the power of the light; under-exposed plates when developed appear hard, with black shadows and want of detail in the half-tones, while very much over-exposed pictures are usually thin and flat, without sufficient contrast.

For printing lantern slides in the camera, it will be found a convenient plan to diffuse the light which passes through the negative by means of a sheet of white tissue paper stretched on a frame, and arranged about 2in. from the back of the negative; a shallow tray or box without lid, with an open space for the negative cut in the bottom of the tray, and the other side of the tray covered with tissue paper, will answer admirably for the purpose. The space between the camera and the negative should be covered so as to exclude the light. This may be done by means of a sleeve or tube of dark cloth or velvet attached to the tray, and tied at the other end round the lens of the camera. The exposure may be made at a window by diffused daylight, or by burning a few inches of magnesium ribbon a few inches from the tissue paper screen. The flame should be moved about during combustion to insure equal distribution of the light through all parts of the negative.

The plates may be developed with any of the usual formulæ for ferrous oxalate or alkaline pyro, taking care to use sufficient bromide as a restrainer; the iron developer already given for chloride plates answers well. I have, however, obtained the best and most uniform results by means of the following form of hydrokinone developer:—

Hydrokinone	30 grains.
Sulphite of soda	2 oz.
Carbonate of soda (pure)	4 „
Carbonate of potash	2 „
Bromide of potassium	40 grains.
Distilled water	20 oz.

Dissolve the hydrokinone in the water, and add the other ingredients in the order named.

This developer will keep good for at least a month, or it may be made in two solutions to keep indefinitely; it can be used over again for several plates; it is somewhat slow in its action, but will not fog the plate under any circumstances. To develop, place the exposed plate in the developing tray, and pour over the developer, without previously wetting the film; all danger of air bubbles may be avoided by passing the finger or a brush over the surface of the plate immediately after pouring on the developer. The image should begin to appear in two or three minutes, and grow gradually in detail and density. The development should be completed in from seven to eight minutes; rapid development does not gives such good results. The plate may be examined by looking through it from time to time, taking care not to expose it too much to the light, which should be well shielded by ruby glass or non-actinic paper. As soon as the picture is sufficiently dense in shadows the plate should be well washed under the tap; it is then ready for fixing.

Should the details appear too quickly it is
of over-exposure, and if the develo
tinued the picture will probab
high lights before sufficient de

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* A paper read before the Photographic Society of Great Britain.

any long list of medallists will come to the conclusion that it does not satisfactorily mark out the history of the science with which the medals are connected. Many of the Copley medallists are quite unknown names.

Mr. Howlett: Do your remarks refer only to the Royal Society medal, or do you make the same suggestion with regard to our own?

Mr. Ranyard: I took the Royal Society medal as an instance, in order to avoid anything which might lead to a discussion of personal merits, and because it extends back into the last century, and we are better able to judge fairly after a lapse of time; but my remarks apply to all long lists of medals. No guide is better than a bad guide, and if such medals have not picked out and marked the best men, we had better have been without them. Efforts have been made recently in the newspapers to point out the hundred best books for people to read—(laughter)—but I think it seems to be pretty generally agreed that such efforts have not been very successful, and if the best books cannot be picked out with advantage, how can the best workers be picked out by their contemporaries; Each man must judge for himself with regard to the books he will read. It is part of our education to make such judgments for ourselves, and it is better that we should not fall into a stereotyped plan of following others. With regard to giving medals to specialists, no council, however able, will be able to judge rightly of the work of specialists; they must rely on the estimation of other specialists working in the same line, and any committee puts itself in a false position if it attempts to sit in judgment on specialists. The members of the committee must either rely entirely on the judgment of a few specialists in the same line, or they must pretend to give awards on their own responsibility outside their own line. I think we had better avoid all such false positions. The awarding of medals always necessarily involves personal questions with regard to contemporaries, and sometimes with regard to co-workers, and such discussions always have a tendency to lower the scientific spirit. (Cries of "No.") The question is one of great importance, and deserves serious consideration. We ought to avoid anything that may injure the scientific *morale*.

Mr. Esdaile seconded the motion.

Mr. De la Rue: I stopped here specially to hear Mr. Ranyard's proposal, and to hear his reasons for depriving the society of a graceful recognition of the merits of astronomers. I must say that I have not heard one argument which has in any way altered my opinion, or which should justify us in depriving ourselves of what is a very great privilege. He is perfectly eight in saying that medals do not promote work for the sake of obtaining them. No man who has ever received a medal would, I am sure, say that he had the medal in his mind when he commenced his work. The work is done simply for the love of it—for the sake of the work, and not for any possible reward. (Hear, hear.) I think it would be a very great pity, even in these revolutionary times, to do away with what I feel to be one of the greatest privileges the society possesses.

Mr. Ranyard: I wish that some of those who believe in medals would say what they can to meet the particular arguments I have adduced. (Laughter.) To say that it is a privilege to give medals is not meeting the arguments I have brought forward as to the influence of medal-giving.

Mr. De la Rue: It is very difficult to meet a shadow.

Mr. Ranyard: I hope that the arguments I have brought forward will not be avoided, but that somebody will try fairly to meet them. (Cries of "Vote.")

The President: I will take that as your reply, Mr. Ranyard. I will now put the resolution. On a show of hands there was a decided majority against the resolution, a considerably minority abstaining from voting, and only three hands being held up in favour of the motion.

The scrutineers declared the following list of council and officers to have been elected for the ensuing year: As president, J. W. L. Glaisher, Esq. As vice-presidents, J. C. Adams, Esq, W. H. M. Christie, Esq., Astronomer Royal; the Earl of Crawford and Balcarres, and Edwin Dunkin, Esq. As treasurer, A. A. Common, Esq. As secretaries, E. B. Knobel, Esq., and Lieut.-Col. G. L. Tupman. As foreign secretary, W. Huggins, Esq. As council, J. R. Capron, Esq., A. Cayley, Esq., G. F. Chambers, Esq., A. M. W. Downing, Esq., J. R. Hind, Esq., G. Knott, Esq., E. W. Maunder, Esq., Capt. W. Noble, the Rev. C. Pritchard, A. Cowper Ranyard, Esq., E. J. Stone, Esq., and Lieut.-Gen. J. F. Tennant.

LIVERPOOL ASTRONOMICAL SOCIETY.

THE fifth meeting of the session was held on Tuesday, Feb. 9, in the Association Hall, the president, Mr. Isaac Roberts, F.R.A.S., F.G.S., in the chair.

The Rev. S. J. Perry, in an interesting address, said that the great work to which astronomers were now directing their attention was photographing the stars—stars of even the 16th and 17th magnitude are being photographed. While several eminent men were doing this in different parts of the world, our president (Mr. Roberts) was engaged in doing a portion of the same work, and that very successfully. His own work was especially to devote himself to observations of the sun, and he had a careful drawing made of it every day. The spots on the sun are past their maxima and are passing away. He finds the markings on photographs of the sun not at all equal to a good drawing with a fine pencil.

The secretary read a paper contributed by Mr. Thomas Radmore on "The Occultations of Aldebaran, α Tauri, and Other Stars on 16th Jan." Clouds seem to have covered large districts; but he was more fortunately situated at Portsmouth. Inst. 3½ Achro., power 80. α Tauri found first at 3.45 p.m. θ^1 θ^2 not seen at time of disappearance, 4.54, both easy; at 6.35 sky mottled between the clouds, and during a clear opening, at 7.47, the disappearance *sudden, startlingly* so. Reappearance at 8.46. Several occultations of α Tauri and other stars in Hyades being about to occur, it may possibly interest possessors of small telescopes to test thereby their light-grasping power, definition, &c. The secretary read a paper sent by Mr. Edwin Holmes on "Telescopic Vision and Definition," dealing with the relationship between the size of the aperture of a telescope and its capabilities for celestial observation; and also a paper from M. A. Gunziger, entitled, "A New Form of Cross Wires for the Finder of an Astronomical Telescope." He says that it is often quite difficult, where high powers are used, to bring a small star by means of the finder into the field of the telescope, since the star may happen to be behind the wires, or even behind the cross itself, and be thus hidden; and he suggests that the wires be four separate threads, and a little space be allowed where they usually cross. This space should be quite small, and the wires thicker than usual. The secretary also read a paper sent by Rev. J. Perkins, M.A., F.R.A.S., on "The Best Use for a Small Telescope." He says that a telescope may be used for two different purposes—first, for self-education; and, secondly, for the advancement of astronomy. Whilst nebulæ and coloured stars are best seen by large telescopes, variable stars are useful objects for small instruments. He goes on very clearly to describe how amateurs may most successfully study the sun and moon. Very interesting discussions followed each paper. Two new members were elected, making already 24 since the commencement of the session

USEFUL AND SCIENTIFIC NOTES.

Prizes of the Paris Academy of Sciences.—The following are among the prizes offered this year by the Paris Academy of Sciences:—Geometry: A study of the surfaces admitting all the symmetrical planes of one of the regular polyhedrons, 3,000f.; Francœur prize, the work most conducive to the progress of the pure and applied mathematical sciences, 1,000f. Mechanics: Extraordinary prize of 6,000f. for any work tending most to increase the efficiency of the French naval forces; Montyon, 2,500f. invention or improvement of instruments useful to the progress of agriculture, of the mechanical arts or sciences; Plumey, 2,500f., improvement of steam engines or any other invention contributing most to the progress of steam navigation; Dalmont, 3,000f., the best work by any of the Ingénieurs des Ponts et Chaussées in connection with any section of the Academy. Astronomy: Laland prize, gold medal worth 540f., for the most interesting observation on work most conducive to the progress of astronomy; Damoiseau: 10,000f., best work on the theory of Jupiter's satellites, discussing the observations and deducing the constants contained in it, especially that which furnishes a direct determination of the velocity of light; Valz, 460f., for the most interesting astronomical observation made during the course of the year. Physics: Grand prize of the mathematical sciences, 3,000f. for any important improvement in the theory of the application of electricity to the transmission of force. Statistics: A prize of 500f. for the best work on the statistics of France. Chemistry: Jecker prize, 5,000f., for the work most conducive to the progress of organic chemistry. Geology: Vaillant prize, on the influence exercised on earthquakes by the geological constitution of a country by the action of water or of any other physical causes.

IN no part of the Southern Hemisphere is population increasing so rapidly as in Sydney. In 1870 the population of the city and its suburbs was about 140,000; at the close of 1885 it was estimated at 290,000, having more than doubled in fifteen years.

SCIENTIFIC NEWS.

THE death is announced of M. Jules Janin, the permanent secretary of the Paris Academy of Sciences in the Section of Physics and Natural History. M. Janin, who was born at Ternes, Ardennes, on May 30, 1813, was admitted to the Normal School, and commenced his career as one of the masters of the Collège Bourbon, now called the Condorcet Lyceum. Thence he removed to the Polytechnic School to the chair of physics, and in 1863 was appointed Professor of Physics to the Faculty of Sciences, Paris, entering the Academy of Sciences five years later. He was the author of a large number of valuable articles and papers on scientific subjects, published in the Transactions of different societies. The subjects to which he devoted his chief attention during the last years of his life were electromagnetism and the electric light. He was appointed permanent secretary in succession to the late J. B. Dumas, a post in which he had frequently occasion to display his talents as a literary man. He made a touching speech on the occasion of the anniversary of the admission of J. B. Dumas to the Academy, and delivered the *éloge* of Arago, which received high praise as a thoughtful and eloquent study.

Hofrath Fischer, the well-known mineralogist of Freiburg, died recently.

The death is also announced of Dr. Arnold Konstantin Peter Franz von Lasaulx, the professor of mineralogy and geology at Bonn. He was only forty-six.

Although no further special announcements of observations of the comets Fabry and Barnard have been made, there is no doubt that towards the end of April both will be easily visible to the naked eye, and will, moreover, be in a good position all night. Fabry's will be the brighter, and will be in Perseus, while Barnard's will be in Andromeda.

The small planet No. 250, which was discovered by Dr. J. Palisa at Vienna on the 3rd of September, has been named Bettina.

M. Faye has been appointed president of the Bureau des Longitudes for 1886.

The Publication Agency of the Johns Hopkins University, Baltimore, have nearly ready for issue to subscribers a series of photographic plates of the normal solar spectrum, made by Prof. H. A. Rowland. The plates are seven in number, and may be bought separately. They are 3ft. long by 1ft. wide; and all but one of them contains two strips of the spectrum. Together, they give a complete map of the solar spectrum from wave-length 3,100 to wave-length 5,790. The price for the set is a little more than £2.

At the recent meeting of the Institution of Mechanical Engineers a paper, by Mr. J. H. Wicksteed, was read, descriptive of an autographic test-recording apparatus. Prof. Kennedy expressed the opinion that Mr. Wicksteed's device was the first in which a trustworthy diagram had been obtained, and Profs. Unwin and Smith also spoke in favourable terms of the machine, which should prove of much advantage to the users of steel—a metal which is gradually supplanting iron in constructive works, but which requires careful testing. A paper by Mr. Alfred A. Langley, of Derby, was also read. It described a form of "hydraulic buffer-stop for railways." The buffer consists of a pair of parallel hydraulic cylinders fitted with pistons, and having rods passing through both covers. The front-rods carry the buffer-heads to meet those on the locomotive, and the rear rods are connected by chains to counter-weights, which return the pistons. A 4ft. stroke is allowed, and is deemed amply sufficient, as a train travelling at eight miles an hour can be brought to a stand before the stroke is completed, and that without damage to the train or buffer. What should have been an interesting paper, judging by its title—"Distribution of the Wheel Load in Cycles,"—was postponed until the next meeting.

The Otto patents, which have been twice upheld in English courts, have been invalidated in Germany by a recent decision of the Reichsgericht—the highest court. The first, second, third, and fourth claims of the 1876 patent have been invalidated, and the result is that gas-engines can be made in Germany by anyone who can devise other methods of applying the general principles without copying the details described in the Otto patents.

At a recent meeting of the Engineers' Club of Philadelphia, Mr. H. Constable gave an account of the system of supplying hydraulic power to warehouses, &c., in London, and afterwards described a novel rubber spring for tram-cars, railway draw-bars, buffers, and the like. It consists of cylindrical pieces of rubber with a hole through the axis, and capped at both ends with bearing-plates; the draw-bar or location-bolt, of course, passes through the bearing-plates and rubber spring. The peculiar feature is that a steel spring encircles the rubber, so that as the rubber is compressed it is reinforced by an increasing resistance on the part of the steel spring, which tends to hug it back to its original form. It presents some excellent features for long range, endurance, uniformity or gradation of resistance, freedom from danger in collapse as well as in economy. These springs, said Mr. Constable, are being extensively used in England, and one that has been under test by the Chief Engineer of the North-Eastern Railway has withstood up to the present time over 1,000,000 depressions of 5 tons. A model was shown, and it should be noted that the steel ring is not solid but laps over itself, so that the ends slide over each other as the rubber presses the spring outward; also that the section of the spring can be U, W, or other shape.

For the coming Colonial Exhibition at South Kensington the colonies will be divided into four groups, and four handbooks are being written, each dealing with a group. They will be published at a shilling each, and bound together in cloth in one volume at six shillings. As there is little doubt that the exhibits will form the nucleus of a great permanent colonial museum, these books will be of great value. Instead of this year's exhibition being a collection of tradesmen simply anxious to sell their goods, the exhibits will be divided into sections systematically arranged, with a central office at which inquiries can be made of a commission who will give information without considering the probability of business following.

At a recent meeting of the Royal Horticultural Society Mr. Smee read a note of his observations on the relative amount of dew deposited on the leaves of different plants. The observations were made in his garden at Wallington, during nineteen days last summer. The plants selected were quince, syringa, Brussels sprouts, peach, rose, mulberry, evening primrose, and dahlia, at seven in the evening and again at nine in the morning. It appeared that the leaves of the quince and mulberry are always the last to be coated with dew, and are never very wet at any time. Dahlias and Brussel sprouts become coated with dew sooner than any other plants; while in the former, drops of dew hang from the points of every leaf. The leaves of the peach, rose, and evening primrose were never so wet as those of the dahlia, but always had more moisture deposited on them than had those of the quince and mulberry.

A petition has been presented to her Majesty in Council praying that a charter of incorporation may be granted to the Statistical Society. The petition will be considered on March 17.

MM. Ferran and Pauli have a memoir in a recent issue of *Comptes Rendus*, in which they contend that the comma bacillus, when dead, confers an immunity enabling animals to resist the effects of the living bacillus. Their experiments were made on guinea-pigs.

The London Stereoscopic Company's second annual International Amateur Photographic Exhibition will be held at the Art Galleries, 103, New Bond-street, W., from April 15 to May 24. At the first of these exhibitions of the work of amateurs some 4,000 subjects were exhibited, and as photography is now so fashionable an amusement, readers would act wisely by making early application for space if they intend to exhibit. All particulars as to classes, prizes, date of entry, rules, &c., can be obtained on application to "the Manager, International Amateur Photographic Exhibition, London Stereoscopic and Photographic Company, Limited, 108 and 110, Regent-street, W." We may mention that the entrance fee is 10s., which entitles the exhibitor to a wall-space of 10 square feet and a free season ticket.

Next Thursday Prof. W. Boyd Dawkins will commence a course of four lectures on the "Ancient Geography of Britain," at the Royal Institution. The lectures will be continued on the three following Thursdays, March 4, 11, and 18.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

All Cheques and Post-office Orders to be made payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

> "I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks, a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

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Σ 848.—SATURN AND NEW DOUBLE STARS. — MAGNITUDE OF STARS NEAR NOVA ANDROMEDÆ. — ERRATUM.

[25349.]—THE faint companion of Σ 848, of which Mr. Hunt writes in letter 25303, p. 468, appears to have been first mentioned by Dunér. He gives 296·55° : 15·160″ : 1872·19, 12·0 magnitude in Struve's scale (approximately), and observes: "A ce que je sais cette étoile excessivement faible n'a été mesuré par aucun autre astronome." Burnham measured it on one night in 1878, giving 295·4° : 15·55″, the magnitudes being assumed from Σ and Dunér, and these are the only results I can remember at present. Sir W. Herschel remarks of the close pair, "Among the rest are none near enough to belong to the 2nd class, but several of the 3rd, 4th, &c." In the "Catalogus Novus," Σ only mentions the close pair, and that as being "Lucida acervi"; but in the "Mensuræ" he speaks of the object as "quadruplex." There must, by the way, be many of Dawes's unpublished measures in existence.

I hardly know whether to consider letter 25304 as a joke, after the manner of that Mr. Nixon who some years ago wrote an edifying letter to these columns, or as embodying the results of bona-fide observations by an unskilled and somewhat imaginative observer. Mr. Edward Clark seems to have secured such a view of Saturn as has seldom been accorded to observers with the largest instruments, including an observation of Enceladus standing where he ought not, which must, as he remarks, have been a never-to-be-forgotten sight. It is almost unnecessary to say that I cannot confirm his observations of new companions to the double stars his mentions. His 6″ companion to Σ 698 may possibly exist, and one of the stars of Σ 1106 may be a close equal pair—neither of these two objects have been measured very recently; but surely a little elementary knowledge would have shown him that no 6½in. could by any possibility exhibit a 12th magnitude star only 0·5″ from a 5th magnitude, as the smaller star would actually fall within the disc of the larger with that aperture. 56 Aurigæ, being one of the stars proposed by O Σ for comparison of measures, has been recently observed by many astronomers, including Prof. Hall with the 26in. on ten nights. Σ 572 has been measured during the last six years at Washington, Nice, Leipzig, and Plonsk. 118 Tauri has also been observed with the 26in., but none of Mr. Clark's companions have been noticed; in fact, it would severely tax the power of the 26in. to show a 12th mag. at 0·5″ from a 5th magnitude. I hope Mr. Clark's next letter will be accompanied by his address. The magnitudes assigned by the Radcliffe observers to the stars mentioned by Mr. Numsen (letter 25305) seem to be expressed in Argelander's scale for the brighter stars, and possibly in some extension of this for the fainter ones. The following observations of the magnitude of the Nova on October 12th will show Mr. Numsen the discrepancy between the Radcliffe results and the others:—

Un.	Mü.	Ra.
9·8	10·0	11·2

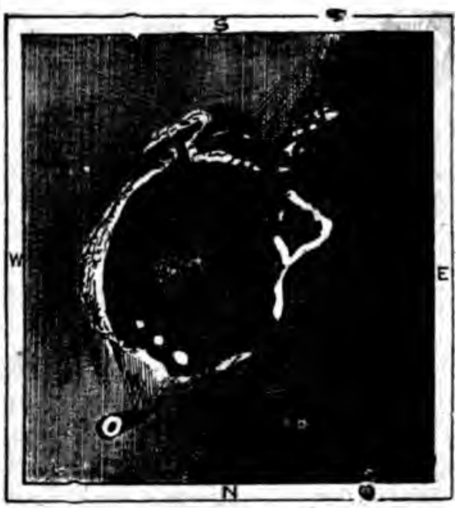
"Un" stands for the Oxford University Observatory results, "Mü" for Dr. Müller's at the Physical Observatory at Potsdam, "Ra" for Mr. Bellamy's at the Radcliffe Observatory. I should have called the star γ about 10·8 Σ at the beginning of September.

In the third line of the last paragraph of letter 25302, for "observations" read "observatories."

Feb. 9. **H. Sadler.**

SELENOGRAPHICAL—FRACASTORIUS.

[25350.]—THE accompanying sketch was made on the evening of the 8th February, from 6 p.m. to 7 p.m. The definition at the beginning was exquisite; but towards the end it became very poor. Power used was 200, on 12in. Calver mirror. Two wide and obvious depressions, or passes, through the walls of this interesting formation were observed—one at the N.E., and the other almost due S., and a further break in the continuity of the wall was seen in the S.E.



Clouds coming up prevented further observation, and I was unable to watch long enough to see if the ring became complete, as it has been said to have been seen on rare occasions by several observers.

Three small hills, on a line running N. to W., were seen standing out clearly from the darkness which filled the interior; the central mountain was seen to be of a crescent shape, with the horns turned N. Shortly after this became visible two other fainter points, apparently the summits of two smaller hills towards the N.W., were seen, and a little later the slopes of the central mountain became dimly descried through the gloom. No breaks or passes were to be seen in the W. wall or in the E. wall, so far as it was seen. There appear, however, to be two openings into the peculiar, triangular formation to the E. of Fracastorius.

W. Goodacre.

Forest Gate, February 11th.

MAGNIFICENT DISPLAY OF THE AURORA BOREALIS.

[25351.]—AT 8.30 p.m. on 9th January I witnessed at this place a display of the aurora of surpassing beauty. When I first noticed a light amongst the broken clouds, which I have frequently seen at this season of the year (the aurora being far from uncommon in this latitude), I equipped myself with a Browning pocket-spectroscope and awaited results. As I anticipated, I was soon rewarded: the clouds overhead dispersed, and an auroral arch was formed from the diffused light, which had been visible over the whole expanse of the heavens. Each end of the arch appeared to rest on a bank of snow-clouds. Its position was E.N.E. and W.S.W., and its altitude was about 30°.

After retaining the form of an arch for the space of about five minutes, it suddenly began to quiver along its whole length, and appeared for a few seconds more, like a huge snake writhing and wriggling about; then, as it were, with a tremendous bound one end was projected towards the zenith, the other almost simultaneously whirling round and round like a "flaming" scroll. At this moment the lines of Sir Walter Scott's beautiful "Hymn for the Dead"—

"When shrivelling like a parchéd scroll,
The flaming heavens together roll,"

flashed across my mind, and never during my life did poetry appear more forcible and expressive the scene presented to my awe-stricken gaze.

"The scene was changed." This time I be a spectacle which baffles all description. Suff to say that a boreal crown was formed of scribable brilliancy and of every shade o

The moment I saw the display I directed my spectroscope to it, but when it became so transcendently beautiful I was electrified. As soon as I recovered myself, however, I began to take observations.

From first to last Angström's line was bright; during occasional coruscations it was brilliant, and at these times I saw, at the lowest estimate, upwards of *a dozen* other lines extending from the green to the violet of the spectrum. Some of these lines were broad, all appeared dark, and similar in appearance to absorption bands.

The fact of the bands appearing broad could not, in this instance, be due to the slit being widely opened, as, when focussing Angström's line, I had nearly closed the slit; and yet, that line appeared almost as sharp and bright as the D (sodium) line. After the display I directed the instrument to all parts of the sky, and in every instance I saw Angström's line, even the snow-clad ground on which I stood reflected the auroral light sufficiently to show the line almost distinctly as the sky itself.

On this, as on several previous occasions when using the spectroscope, I noticed what appears to me to be a peculiar feature. When the light was coruscant, Angström's line presented a different appearance from that exhibited when the light was steady. Under the first-named condition, globules of light alternately rising and falling in quick succession, occupied the place of the sharply-defined bright line. I first noticed this phenomenon on the 22nd of December, 1884. Since that time every display that I have seen has had the same peculiar feature. I tried to account for this by supposing that moisture had condensed on the jaws of the slit, and that when they were *nearly* closed the moisture would be so compressed that the superfluous molecules would be thrown down the sides of the jaws, whilst a single row of molecules filled the minute space between the jaws.

Now, as far as I am aware, the most powerful microscope yet invented has failed to show the molecules of which water is said to be composed. This fact, therefore, in my opinion, administers the death blow to my "moisture theory," as the jaws of the slit could not be so *nearly closed* as to contain between them only a single row of molecules, and yet, at the same time, be opened sufficiently wide to allow the passage of such a light as that which the aurora generally diffuses. I am unable to advance a theory sufficiently tenable to account for the phenomenon.

If, therefore, any other reader of the "E.M." has observed the aurora with the spectroscope, I shall be interested to hear whether such observations have anything in common with my own.

In conclusion, I may state that during any observation of the aurora made by me I haver heard a sound.

I trust, Mr. Editor, you may find this of sufficient interest to insert, and apologise for using so much valuable space. **John W. Fleming.**

Kirkwall, Orkneys, Feb. 12.

NORWEGIAN GIMLETS.

[25352.]—These are not peculiar to Norway. I constantly buy them in Paris, where they say they come from Germany. They have the point in addition to the cutting scroll shown in Fred. Carre's diagram on page 495. This correspondent will be pleased to learn that he can replenish his tool chest with them at Addis's, in Leicester-street (under the name of French gimlets); but they, curiously enough, are supplied with them for sale to the French theatrical scene constructors in London, who use them as handscrews to fasten their temporary constructions together. There is no question, however, that for gimlet uses they are very superior to any pattern gimlet known to the trade in England, as they will go through the hardest or the thinnest woods without splitting them.

Montmartre.

LOCOMOTIVES, &c.

[25353.]—May I be permitted to ask, through your columns, the particular value of the running number of an English locomotive? and why the number originally given should so often not be adhered to?

An engine began running express work on the North-Eastern some four years ago as Number 19. Mr. McDonnell soon rechristened it 1463. Now it is again at work as 19. Another engine, built about the same time, was for long 1477, but now is known as 1325. Another, built in 1882, came out as 489; then became 1473, and is now, I believe, something else quite different.

Take a glance, then, at the L. N. W. A good many people will remember that in the "Inventions" last year this company was represented by a compound, "Marchioness of Stafford, 2798." This engine is now running as 507.

In last month's set of big compounds Mr. Webb has robbed a 6ft. 6in. Ramsbottom engine of the name "Dunrobin," and the Metropolitan bogie engines belonging to L. N. W. of their numbers, which he has put on to these latest productions. A little while ago an engine was called "Caliban," in order that its old name, "Cyclops," might appear on a compound, and so on, *ad nauseam*.

Now, Sir, would some one let me know whether all this is simply the amusement of responsible officials, or whether there really is any sane reason for so much change?—for really so much has been going on lately that one is bound to be slightly curious.

By the way, a good deal can be said against compounds; but only a few such performances as the following reach the public:—

Jan. 16th. 10 a.m. down from Euston.

	Rugby	arr.	time	507, 10 on.
		dep.	,,	
	Crewe............	arr.	1.32	503, 10 on.
		dep.	1.40	
(Blocked outside)	Preston	arr.	2.44	
		dep.	3.12	
	Shap Summit	pass	4.36	
	Penrith.........	,,	4.53	
	Carlisle.........	arr.	5.17	

Had the train run the average pace down the Shap Fells to Carlisle, it could easily have arrived some 12 or 13 minutes before time. After all, by running some miles without steam, and taking matters fairly easy, "Dreadnought" only gained five minutes on time—a very respectable performance on paper; but 2h. 10min. *does* seem rather long to allow between Preston and Carlisle, even for a big compound on a light train.

W. H. Thompson.

TRAIN SERVICE (OLD AND NEW) GREAT NORTHERN.

[25354.]—The Act for the incorporation of the Great Northern Railway was obtained in June, 1846; it was an amalgamation of the London and York and Direct Northern. The original plan was a line from London, viâ Peterborough, Newark, and Retford, with a loop from Peterborough, through Boston and Lincoln, rejoining the main line at Retford.

The line was opened from Maiden-lane to Peterborough in August, 1850, and King's-cross Station was opened in October, 1852.

Though small in extent, compared with its rivals, the Great Northern has always ranked as a first-class line, both from the importance of the traffic which it serves, and from the spirit and enterprise which mark its management. Railways, like schools and individuals, soon get a character which generally sticks to them, and the Great Northern nas been noted from the first for speed and punctuality, and for the courtesy and intelligence of its officials of every grade.

There is no need now to enlarge on the development of express-running on this line, as it has been fully illustrated in the English Mechanic for the last ten years or so. But we may refer to a significant table which appeared on page 432 of the last volume (July 17), where it is shown that the Great Northern had 42 trains last summer with a speed of 50 miles an hour and upwards, against 53 such trains contributed by all the other companies together.

The annexed tables show a noteworthy improvement every decade, culminating in tue splendid services of July, 1885.

A.—London and Peterborough (76¼ miles).

Down Trains.

	1854.	1864.	1874.	1885.
No. of Trains from King's Cross to Peterboro'	8*	15	17	19
Average time of	h. m.	h. m.	h. m.	h. m.
journey	2 85	2 15	1 58	1 54
Fastest train ...	1 40	1 37	1 30 (2)	1 28 (2)
Slowest train ...	3 25	3 10	2 52	3 27

Up Trains.

	1854.	1864.	1874.	1885.
No. of Trains from Peterboro' to King's Cross	8*	12*	17	28
Average time of	h. m.	h. m.	h. m.	h. m.
journey	2 41	2 8	2 9	1 56
Fastest train ...	2 0	1 45 (2)	1 40	1 30 (2)
Slowest train ...	3 55	2 50 (2)	3 19	3 22

Notes.—In 1854 the morning express left King's Cross at 9.30, and was due at Hitchin at 10.10. Our valued correspondent, Mr. C. R. Marten, has borne witness that this time was actually kept, or even beaten by a minute or two, which, considering the brakes then in use, was a wonderful performance. In 1856 there were two trains to Hitchin in 40 minutes, and Peterborough in 1 hour 40 minutes.

The table for 1885 takes no account of the expresses, five down and three up, which do not stop between Grantham and King's Cross; but these trains must be remembered in an estimate of the total advance.

B.—London and York.

Down Trains.

	1854.	1864.	1874.	1885.
No. of trains from King's Cross to York..	5*	7*	10*	15*
Average time of	h. m.	h. m.	h. m.	h. m.
journey	6 16	5 33	5 6	4 25
Fastest train ...	4 50	4 35	4 15	3.55
Slowest train ...	8 55	8 5	8 0	5 5

Up Trains.

	1854.	1864.	1874.	1885.
No. of trains from York to King's Cross...	6*	6*	12*	12*
Average time of	h. m.	h. m.	h. m.	h. m.
journey	6 56	6 13	5 18	4 23
Fastest train ...	5 20	5 10	4 15	3 55
Slowest train ...	10 0	7 40	7 35	5 25

Note.—The trains in 1854 and 1864 ran via Milford Junction, 191 miles. The route by Selby, now taken by most fast trains, is about 3 miles shorter. The distance from King's Cross to the new station at York, opened in 1878, is 188 miles 1 chain, according to the gradient map.

C.—London and Leeds.

Down Trains.

	1854	1864	1874	1885
No. of trains from King's Cross to Leeds	5*	7*	9*	9*
Average time of	h. m.	h. m.	h. m.	h. m.
journey	6 15	5 39	5 13	4 20
Fastest train ...	4 50	4 45	4 20	4 0(2)
Slowest train ...	8 50	8 10	8 2	4 49

Up Trains.

	1854	1864	1874	1885
No. of trains from Leeds to King's Cross...	6*	8*	9*	10*
Average time of	h. m.	h. m.	h. m.	h. m.
journey	6 50	6 16	5 49	4 30
Fastest train......	5 20	5 10	4 40	3 55
Slowest train ...	10 0	8 40	8 5	5 0

Note.—By the route at present followed, the distance from King's Cross to Leeds (Central Station), according to the gradient range, is just over 185½ miles.

In 1864 train travelled by Knottingley, 19[illegible] miles. In 1854 the distance is called 186½ miles, and it stands so in Bradshaw for some years following, but I do not know how it is recorded.

The 3¾ hours service between Leeds and London in 1880 is now a matter of history. It involved the fastest piece of express timing in modern days—viz., from Grantham to Wakefield (70¼ miles) in 77 minutes = 54¾ miles an hour. This was the time in July. In August 78 minutes were allowed, giving a speed of 54.

D.—London and Cambridge via Hitchin (58 Miles).

Down Trains.

	1854.	1864.	1874.	1885.
No. of trains from King's Cross to Cambridge	3	4	7*	8*
Average time	h. m.	h. m.	h. m.	h. m.
of journey...	2 55	2 40	1 45	1 31
Fastest train...	2 50 (2)	2 15	1 25	1 20 (2)
Slowest train..	3 5	3 0	2 5	1 56

Up Trains.

	1854.	1864.	1874.	1885.
No. of trains from Cambridge to King's Cross	3	4	6*	7*
Average time	h. m.	h. m.	h. m.	h. m.
of journey...	3 5	2 55	1 47	1 25
Fastest train...	3 0	2 50 (2)	1 30 (2)	1 17
Slowest train..	3 10	3 0 (2)	2 24	1 47

Note.—The line from Hit
worked by the Great Ea
reverted to the Great No

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* Besides auxiliary trains.

E.—LONDON AND NOTTINGHAM, VIA GRANTHAM (128 MILES).

Down Trains.

No. of trains from King's-cross to Nottingham.	1854.	1864.	1874.	1885.
	5*	6*	10*	10*
Average time of journey	h. m. 4 37	h. m. 4 13	h. m. 3 40	h. m. 2 58
Fastest train......	3 15	3 20	3 0	2 40
Slowest train ...	5 50	5 0	5 35	3 12

Up Trains.

No. of trains from Nottingham to King's-cross	1854.	1864.	1874.	1885.
	6*	8*	9*	10*
Average time of journey	h. m. 5 3	h. m. 4 33	h. m. 4 19	h. m. 3 19
Fastest train......	3 40	3 25	3 10	2 50(2)
Slowest train ...	6 30(2)	5 30	6 0	4 25

F.—LONDON AND MANCHESTER VIA RETFORD, G.N.R. AND M.S. AND L.R. (203 MILES).

Down Trains.

No. of trains from King's Cross to Manchester	1854	1864	1874	1885
	4	7*	6*	9*
Average time of journey	h. m. 8 29	h. m. 7 24	h. m. 5 28	h. m. 5 1
Fastest train......	6 51	5 15(2)	5 0	4 15
Slowest train ...	9 21	10 35	6 0	6 15

Up Trains.

No. of trains from Manchester to King's Cross	1854	1864	1874	1885
	5	7*	6*	9*
Average time of journey	h. m. 8 33	h. m. 6 34	h. m. 5 22	h. m. 5 2
Fastest train......	6 35	5 15(2)	5 5	4 15(2)
Slowest train ...	10 55	9 35	6 0	6 35

Note.—The 4¼ hours trains between London and Manchester date from July 1884, an epoch memorable for the acceleration of several important expresses on other lines. This service is the very flower and crown of modern express running, and is conducted with an ease and punctuality which deserve the highest praise.

G.

THE WIMSHURST MACHINE.

[25355.]—I AGREE with Mr. O. Beckerlegge (25343) as to the desirability of obtaining a material equal to glass for electrical purposes, but which will not so freely break, although the cause of breakage is perhaps more the fault of the user than of the material.

Vulcanite gets out of shape, and when kept or used in the daylight, rapidly decomposes and gets useless; and it seems to me a pity that so much of this material is now made up, and offered for sale, as the purchasers of such machines must inevitably, sooner or later, be greatly disappointed. As an instance of this may be mentioned the large-plate machine in the School of Mines, which at first gave good results, but soon became quite useless.

"Dermatine" seems to be a very likely material, although at present it is made too soft for the purpose. The makers are now endeavouring to produce some of a harder character.

I wish Mr. B. every success with the silk and shellac discs, and shall be glad to read his experience with them.

J. W.

[25356.]—IN reference to letter 25343, signed by O. Beckerlegge, in your paper of 12th Feb., we venture to suggest that the discs required should be of mica, which is the most perfect insulator known, and which will not warp or undergo any chemical change.

Richard Baker and Co., Mica Brokers,
9, Mincing-lane, London.

EXPRESS SPEEDS.

[25357.]—WILL "Ghilleasbuig McTomae" say whether he knows of his own knowledge that the 12 noon from Euston once arrived at Rugby eight [illegible]inutes before time, or whether he only heard it [illegible] so? The alleged run is extremely improbable [illegible] the face of [illegible] I have heard too many [illegible] to place any faith in [illegible] on making close inquiries they generally turn out be unfounded. Two journeys I have made with the 12 noon gave 89 and 87 minutes, respectively, as the time between Willesden and Rugby.

On Dec. 24 I went to Peterborough with the 7.40 a.m. in 88¾ minutes, No. 7 and 11½ coaches. King's Cross, 7.42.30; Potter's Bar, 8.3.10; Hatfield, 8.8.44; Hitchin, 8.24.24; Huntingdon, 8.51.15; Peterborough, 9.11.0. The greatest distance run in an hour was 57¼ miles; posts 16 to 73¼. The 29 miles following post 28 were run under 29 minutes. The run, taken as a whole, was mediocre for the Great Northern.

I came up from Bedford to Kentish Town in January in 59 minutes, with "1565" and 12 coaches. The greatest speed was 67 miles an hour—St. Alban's to Radlett. Some time ago I timed a Precedent, between Rugby and Northampton, past seven consecutive mile posts in six minutes; load 7½. Three miles were run at 72, 73·4, and 72 miles an hour, respectively. The time, Rugby to Northampton, was 22 min. 25 sec.

The following run was made by a 7ft. single and nine coaches, on Dec. 24—the day I went down with the 7.40 a.m.

Miles.		h. m. s.	
	King's Cross ...	2 0 15	
12¾	Potter's Bar ...	2 19 0	
76¼	Peterborough	3 22 45	
105¼	Grantham	3 58 50 4 7 0	
120	Newark	4 24 0	M. S. and L. 7ft. 6in. single.
138½	Retford	4 43 30	
162	Sheffield.........	5 14 30	

I may also add that a friend recently timed the 10.35 a.m. S.E. mail as 93 minutes between Cannon-street and Dover; the Channel passage was 102 minutes.

Feb. 10. **Kappa.**

G.N. 7ft. SINGLES.

[25358.]—ON the 24th December, 1885, the following remarkable run was made by G.N. 215 (7ft. single, inside cylinders). The lines were crowded on that day, and the load was *nearly double* the usual weight. It will be seen from the few subjoined details that however insignificant any G.N. engine may look, it is capable of doing magnificent work.

	H. M. S.	Miles.	Speed.
King's-cross dep.	2 0 15		
Barnet pass.........	2 14 28	9¼	39
Potter's Bar „	2 19 0	3½	38
Hitchin „	2 35 30	19¼	70
Huntingdon „	3 1 5	24¼	57
Peterbro' (slack) „	3 22 45	20	55
Grantham arr.	3 58 30	29	49
	118¼min.	105¼	54

It may be well to compare the above run with the best run I have ever made on a compound constructed on Mr. Webb's system (load, 16 coaches).

Willesden	dep.	10.17½	a.m.
Bushey	pass.	10.33½	„
Watford	„	10.35½	„
Boxmoor	„	10.44½	„
Berkhampstead	„	10.49	„
Tring	„	10.54	„
Cheddington	„	10.59½	„
Bletchley	„	11.10½	„
Wolverton	„	11.17	„
Roade	„	11.26½	„
Blisworth	„	11.30½	„
Welton	„	11.45½	„
Rugby arr. and	dep.	11.56½ to 12.3½	p.m.
Brinklow	pass.	12.12	p.m.
Nuneaton	„	12.23	„
Atherstone	„	12.29	„
Tamworth	„	12.38	„
Lichfield	„	12.45½	„
Rugeley	„	12.55	„
Stafford	„	1.7	„
Whitmore	„	1.24½	„
Crewe	arr.	1.37	„

I leave your readers to compare these runs, and form their own conclusions.

I entirely agree with Mr. Rous-Marten that it is a British characteristic to cry down innovations simply because they happen to be contrary to previous practice. But I do contend that Mr. Webb's compounds have met with an amount of fair (and almost partial) treatment which is seldom accorded to innovations in general. From my own experience, I can confirm and emphasise the statements made by your correspondents against the compounds. The result of a number of observations on my part has led me to the results embodied in the following sub-heads:—

(1) They do not generally keep time, except on slow or light trains.

(2) They are specially constructed to save fuel, and they waste it (vide any L. and N. W. coal sheet).

(3) They cost far more than other N. W. engines for repairs and renewals.

(4) They are destructive to permanent way.

(5) They do not run smoothly, and the drivers have a bad time of it, and sometimes give vent to their feelings in somewhat hard language. A N. W. man, in speaking of the compound drivers, said, "Our armies swore terribly in Flanders; but nothing to this."

(6) Their initial cost is much greater than in a simple engine.

Finally, the compound system, as elaborated by Mr. Webb, is made a laughing-stock of by all those who use their eyes, and do so without prejudice.

W.

MICRO. O.G's.

[25359.]—WITH regard to the magnifying power of lenses, Fred. H. Evans is not by any means the only microscopist who is bewildered. I will try and explain. An achromatic objective called 1in. is a lens which is equivalent in power to an uncorrected lens which has 1in. of focus for parallel rays, this magnification being measured at 10in. It is said that some one has very carefully measured the magnifying power of an uncorrected lens of 1in. solar focus at 10in., and has found it to equal 10 diameters. I have not personally verified this result; but I know it is everywhere assumed to be correct. It matters very little whether it is or not; all that we want to know is that it is the accepted standard.

An achromatic 1in., therefore, is a lens which has a power of 10 diam., measured at 10in. This power is called the initial power of the lens. The power in the makers' catalogues quoted by Mr. Evans is the combined power of the o.g. and the A. or No. 1 e.p. on a certain tube length. P. and L.'s No. 1 e.p. is a 2in., and as they use a 10in. tube, the combined magnifying power of their 1in. o.g. and their 2in. e.p. is, as their catalogue states, 50 that is, 10 for the initial magnifying power of their 1in., and five from their 2in. e.p. on the standard body. Under those conditions the 1in. magnifying 50 diam. the ½in. *must* magnify 100, the ¼ 200, the ⅙ 300, the ⅛ 400, the $\frac{1}{10}$ 500, the $\frac{1}{12}$ 600, the $\frac{1}{16}$ 800, the $\frac{1}{20}$ 1,000, the $\frac{1}{25}$ 1,250, the 2in. 25, the 4in. 12½, the 3in. 15, and the 1½ 33⅓. They have made the 1½ an intermediate between the 1 and 2, and have given it a power of 37, but it is not a true 1½ with that power.

If Crouch's 1in. is 50, and ½ 100, his ¼ at 280 is really between ⅕ and ⅙, and so with the others. If Swift's 1in. is 50, his ¼ is a ⅕. If Steward's eyepiece and tube-length are such as to give his 1in. a power of 37, they ought to give his ⅛ a power of 296 instead of 420 in his catalogue; in other words, if his 1in. is a 1in., his ⅛ is a $\frac{1}{12}$, and if his ⅛ is a ⅛, his 1in. is 1½.

The magnifying power, as measured by Mr. Evans, according to the rules laid down in his text book, is quite correct. If Mr. Evans finds any difficulty with the lower powers, he should put a carpenters' rule on the stage (cut a piece off one and keep it for the purpose) and throw down the image of the $\frac{1}{10}$ or $\frac{1}{20}$ of an inch.

It is of no use to trust to the catalogues for magnifying power. This is especially true with wide-angled glasses of low power. It is a difficult thing to make ⅕ of 80°; but it is not difficult to make a ¼ of 80°, so you will find that all so-called ⅕'s of 80° are over a $\frac{1}{6}$ in power—i.e., more than 125 diam. The best I have ever seen magnifies 128 diam. I have measured one as high as 175. In the same way wide-angled ¼'s are often ⅙.

If you want to find the initial power of a lens, cast the image of the stage micrometer on the camera focussing plate, placed 10in. from the front lens of the o.g., and use no e.p.

If you want to measure the combined power of o.g. and e.p., place the camera 10in. from where the rays cross over on emerging from e.p. This spot can be found out by holding a piece of paper in front of the eye-lens, and moving it to and from the e.p. until the spot is reduced to its smallest size.

If the e.p. is a 2in., and the tube standard, then the combined power will be five times the initial power of the lens. Again, if you place the camera 50in. from the front lens of o.g., and use no e.p., you will get a magnification equal to five times the initial power of the lens. If the distance is 100in., as in Dr. Pigott's experiment (p. 417), you will get ten times the initial power of the lens; the amount of diminution being, of course, equal to the magnification.

I would advise Mr. Evans to cast the image of his stage micrometer on his camera focussing glass at a distance of 50in. from the front lens of his o.g., and then, without e.p., he will obtain a magnification which ought to equal that given in his column headed "Power as by my Measurement," if his e.p. is a 2in., and his tube standard length. He need not trouble about the diameter of his field. The following are the measurements I made with a P. and L. ⅛ of 40° ·01in. on stage. P. and L. stand with No. 1 (2in.) e.p. Beale's neutral tint 10in. from table, power = 106 diam.; camera 10in. from front of o.g., no e.p., magnification = 20 = initial power. Camera 10in. from where rays crossed outside eye lens, magnification = 105. Camera 50in. from front lens of o.g., no e.p., magnification 105.

These measurements were roughly made, and for all practical purposes show a perfect agreement. That this explanation may be of use to others as well as Mr. Evans is my excuse for its length.

Feb. 12th. **Edward M. Nelson.**

CENTRING GLASS FOR MICROSCOPE.

[25360.]—In reply to "F.R.M.S., jun." (letter 25309), the centring glass for ascertaining whether stage diaphragms and other appliances are properly adjusted in the optic axis of the microscope was invented by Andrew Ross, and acts on the principle that when suitable lenses are inserted in the body, or super-added to the eyepiece at various positions, they will cause an extended conjugate to the object-glass, so as to convert the combination into a kind of telescope, giving a view of objects more or less distant, as exemplified by the "erecting glass" of Lister.

I trust I may be excused for not giving an illustrative diagram, as other pursuits prevent me from devoting any time to microscope matters.

F. H. Wenham.

THE REV. JAMES CAMPBELL'S FINE ADJUSTMENT.—ERRATA.

[25361.]—Page 443, third column, line 15, before "halved" insert nearly. Line 16, for $\frac{1}{960}$, read $\frac{1}{950}$.

Feb. 11. **Edward M. Nelson.**

"JOURNAL OF THE ROYAL MICROSCOPICAL SOCIETY."

[25362.]—I am sorry I hurt "F.R.A.S.'s" feelings. Nothing was further from my intention. Moreover, the chaff was not meant to be "elephantine" (nor even, as in "F.R.A.S.'s" reply, ursine), but distinctly *microscopic*, as befitted the subject. Of course, my reply would have been more "telling," as he says, if I had told what he wanted to know. But it was just there that the moral of my letter came in, which I don't think "F.R.A.S." quite hits. To put it in another way, no one ought to be denounced as apparently without excuse before the denouncer has taken any trouble to ascertain whether there is not, in fact, an excellent excuse. The inquiry should be made *simpliciter*, without adjectives or expletives. In politics it has become an accepted rule to begin by stating that your opponent is "seemingly" either an inexcusable fool or a knave, and call on him to disprove it; but that is not a rule that can be conveniently transferred to scientific matters. A thirst for knowledge is, however, so essentially noble a quality that I have the editor's authority to say that if "F.R.A.S." will dine with him all shall be made plain to him; only "F.R.A.S." must understand that the editor's dinners do not take place on the house-top, and that if there be any *seemingly* inexcusable delay in the arrival of any of the courses the reason is not proclaimed *ad urbem et orbem*. **One Who Knows.**

THE MUSICAL INSTRUMENTS FOR HOME.

[25363.]—I should be inclined to put it the other way, and not as Dr. Ussher does, p. 490. The details do not differ, but the reeds are voiced, and as a rule a better (acoustically) case is provided. That is all. The measurements are, I believe, identical; as he says, though, price makes it a white elephant. "C. J. S. T." on same page has a beauty; but he describes it as having nine stops and two knee swells. I suppose no one cares for more than two knee swells; but is there any reason why the instrument should not have had nineteen stops? "Stops" tell nothing; how many reeds are there? I wonder whether Mr. Fryer (p. 469) could be persuaded to describe how the celeste in the orchestral organ is "obtained by a certain method of admitting the air to one of the sets of reeds." That must be a new device, for in those I have seen all the reeds got the wind from one well, and the celeste was obtained in the usual way.

Organon.

[25364.]—I am very glad to see this subject has been revived. As yet it has been on the side of the American organs and harmoniums. There have been many queries respecting the making of pipe organs for use at home, but after the answering of many queries nothing more is heard of them. Do any get finished? It would be very interesting if those who have made pipe organs, even if the pipe work has all been made of wood, or of paper and wood, or of the more legitimate metal and wood, would give their experience as to the effect they have obtained.

Myself I prefer a pipe organ to any American organ or harmonium, even for a room. I know there are many objections to them, as tuning, the space they occupy, the difficulty of easily supplying a sufficiency of wind, &c., but I still consider them the best.

I know there are some amateurs who have built small pipe organs for themselves, one gentleman in particular, who resides in the extreme north of England, and to whom great praise is due for his perseverance, and the good finish he has given to it, for I have seen it. No doubt there are others who might give their experience.

Pipe organs, I know, are general failures when imported into a room, but this is mostly due to the utter ignorance of the builders. In this I am speaking of professional builders, and not amateurs, who cannot be expected to produce perfect models of the most difficult of instruments to build.

They are generally made up into hideous boxes, fearful to behold, and worse to listen to.

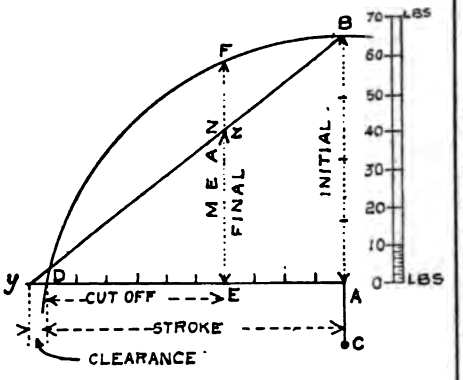
Would "Country Solicitor" kindly state the catalogue price of his instrument? I don't want to know the exact price he paid for it, but only to see what might be done with a properly made pipe organ at a similar price.

Pipe organs are not much use without pedals and pedal pipes, say, two pedal stops, a bourdon and a violoncello. Anyone can see the use of a violoncello in playing orchestral music. This is one of the principal difficulties, as you cannot very well blow and pedal a quick passage at the same time.

Uranium.

STEAM IN THE CYLINDER.

[25365.]—I inclose an improved form of the diagram originally published by Professor Rankine, which some of your readers may perhaps find useful. If the initial pressure in the cylinder is given, it will enable the mean pressure and the pressure of release (supposing expansion to be continued to the end of the stroke) to be found approximately.



Draw two lines C B and A y at right angles, and cutting in A.

Using any convenient scale of equal parts, make the length A B = the initial absolute pressure of steam.

Make A C = ¼ of A B.

With C as centre, and C B as radius, draw the circle B F D cutting A y in D.

The length of line D A will represent the stroke of engine.

In D A take E, so that $\frac{DE}{DA}$ = effective cut-off, and draw the perpendicular E F limited by the circle at F.

The length E F, measured on the same scale as A B = the mean absolute pressure.

To obtain the mean *effective* pressure, the back pressure (= 15lb. to 18lb. in non-condensing engine = 3lb. to 5lb. in condensing engines) must be deducted.

Measure off D y so that

$$\frac{Dy}{DA} = \frac{(\text{volume of clearance})}{\left(\begin{array}{c}\text{volume of cylinder swept by}\\ \text{piston in one stroke}\end{array}\right)}.$$

Join yB by a straight line cutting E F in z. Then the length E z, measured on the same scale as the other pressure, will equal the absolute pressure of release.

As an example, I will take the engine described in query 58673, page 436. Here the boiler pressure = 50lb. = 50 + 15 = 65lb. absolute.

Make A B = 65, and A C = ¼ of A B, and complete the figure.

Say cut-off is at $\frac{6}{10}$ths of the stroke, make $\frac{DE}{DA} = \frac{6}{10}$; that is, divide D A into ten parts, and mark the sixth one E. Draw E F, and, on measuring it, it is found to be 58·5lb, which is therefore, the absolute mean pressure. If back pressure is taken as 18lb., the effective mean pressure is 58·5 − 18 = 40·5lb. Supposing (the volume of one steam port + the space between piston and end of cylinder) when piston is at beginning of stroke, to be ($\frac{1}{20}$th of the stroke area of piston) make Dy = $\frac{1}{20}$th of D A. Join yB, and measure E z, which in this case is 40·5lb. absolute (the figures are *accidentally* the same as the mean effective pressure in this example), or 40·5 − 18 = 22·5lb. effective.

This last (the effective) final pressure is seldom wanted; but the *absolute* final pressure is useful in many calculations.

Of course, a line might be drawn above A D, parallel with it, and at a distance from it equal to the back pressure, so that effective pressures may be measured direct; but I have not shown this, as it would complicate the figure. The diagram shows very clearly the wastefulness of a very late cut-off.

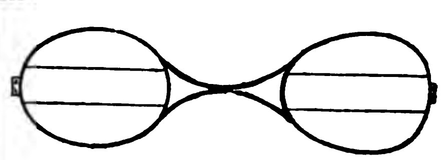
If, for example, steam were cut off at the end of stroke, the mean pressure would be 65lb. absolute = 50lb. effective, or $\frac{50}{40 \cdot 5}$ = 1·235 times as much power as when cutting off at ·6.

The expenditure of steam, however, and therefore of coal, would be $\frac{10}{6}$ = 1·67, or nearly twice as great, and horsepower per pound of coal would be $\frac{1 \cdot 235}{1 \cdot 67}$ = ·74 of what it is when steam is cut off at ·6.

Glatton.

IMPROVEMENT IN SPECTACLES.

[25366.]—Many of our readers are familiar with the spectacles in which the upper half consists of a section of a minifying lens and the lower half of a magnifying one: enabling the wearer to see distant objects clearly through the upper half and to read distinctly through the lower half; but for distances between those two ranges, where the ordinary eyesight alone can serve the wearer, he must either remove the spectacles or look over or under them.



By dividing spectacles into three instead of two divisions, so creating a blank space for ordinary eyesight between the minifying lens above and the magnifying lens below it, an instrument is produced which yields the maximum of utility with the minimum of trouble. In practice I find them give perfect satisfaction by day and night.

Montmartre.

A QUARTER OF A CENTURY'S RAILWAY TRAVELLING.

[25367.]—I have recently been making some comparisons between the present state of railway facilities and those which existed 25 years ago, and the results are somewhat startling, and ought to impose a check upon those grumblers who never seem to be satisfied with what railway companies will do for them.

The differences observed are not so much in the speed at which the trains travel, but in the number of fast trains, in the universal third-class accommodation, in the safety to travellers insured by modern mechanical appliances, and in the greater comfort of passengers.

To begin with the Great Western. This company possesses three great main roads—viz., to Exeter and Cornwall, to New Milford, and to Chester.

The "Dutchman" of 1861 started at 9.30 a.m. Ran to Reading in 45m.; to Didcot, 67m.: and to Swindon 105m.; and from this point its course was slow comparatively, as it reached Bristol at 12.25, and Exeter at 2.25. The only other fast train on this route left Paddington at 4.50, and took a quarter of an hour longer on the journey to Exeter, and the corresponding up trains, due in London at 6 p.m. and 11 p.m., were similarly timed, the former still running. The 6.30 p.m. to Oxford ran as the 4.45 p.m. does now in 78m. and up there were two trains accomplishing the distance in 85m.

It is worthy of note that at this time the G.W. route to Birmingham was a much faster one than the L. and N.W., the 6.30 down running in 2h. 50m., a time not much surpassed now.

The South-Eastern, running viâ Red
were unable to reach Dover in less than
against 1h. 38m. now; and the L. C. and
were simply "not in it" at all

The great mail
L.N.W., and thi
routes, was as co
therefore, affords a

This line ran 12 expresses daily to Rugby, against 25 running now. The fastest run was by the two limited mails, which accomplished the distance in 2h. exactly. The fastest train to Liverpool was the 9 a.m., which ran in 5½h. (and still does). Two other expresses ran in 5h. 50m. and 5h. 45m. The running time is now 4h. 25m. To Manchester there were but two express trains, taking 5h. and 5h. 25m. respectively. The two Scotch expresses left at 9 a.m. and 8.40 p.m., and took 11h. 40m., and 10h. 30m. respectively, the express time from Preston to Carlisle being 2h. 26m. both up and down. The Liverpool and Manchester service was frequent, there being 14 trains each way, of which five ran the 32 miles in one hour, and, we may add, would do so still but for the Cheshire Lines competition, which has resulted in a 40m. service. The Midland of 25 years ago only existed as a sort of link between certain towns in the Midlands, and the other trunk lines. They were too unfortunate in their approach to all their big towns. Sheffield was reached in a most circuitous manner viâ Masbro', Birmingham viâ Saltley. Nottingham lay on a branch from Derby; Northampton on a branch from Bedford; London was reached viâ Hitchin, over the G.N., a route, by the way, two miles shorter than the present one. Worcester was in complete possession of the G.W.R. and Bradford lay on a branch from Shipley; still, with all these disadvantages the Midland kept a good place.

The expresses ran the 97 miles to Leicester from K.'s Cross in 2h. 15m., including 5m. at Bedford, and this is not exceeded by their Scotchman of to-day. The express time between Leeds and Sheffield was 1h. 10m. compared with 50m. at present.

From Leeds to Derby, 1h. 55m., the same as now, and Leeds to London 5h. 50m. (4h. 25m. now). Moreover, this train enjoyed the distinction of being the only third-class express in the country.

The G.N.R. has perhaps made the most progress of any line. In 1861 there were five expresses each way between London and Peterborough, the time taken being 1h. 40m., and from London to Hitchin 40m. At present there are 42 express communications between London and the North, the time between London and Peterborough in several cases being 88m., and from Grantham to London, 105½ miles, in 118 minutes, this last being the fastest train in the world. The 9 a.m. Scotchman took 5h. 5m. to York (via Knottingley instead of Selby), 2h. 10m. York to Newcastle, with four stops, 1h. 50m. from Newcastle to Berwick, and 1½h. thence to Edinburgh, the whole journey taking 11h., as compared with 8h. 55m. now.

There is not much to say with respect to the other lines, as they so much depended on the trunks from London. As the latter were accelerated, so were the trains on the N.E.R., L.Y.R., the M.S. and L., the N.B.R., G. and S.W.R., and the Cal.R.

Of all these, perhaps, the N.E.R., with its vast monopoly, has remained the most stationary; trains from other lines certainly show an improvement; but its own trains are, in very many instances, the same now as 25 years ago.

On the other hand, this line has been abreast, if not ahead, in all other improvements. They were the first, I believe, to decide upon fitting the whole of their stock with an efficient continuous brake; their stations are handsome and commodious, and their trains numerous and well-appointed.

Increased speed is, of course, a matter of competition only, and so long as the East Coast from Berwick to Hull is at their mercy, they will stop where they are.

On the whole, then, we may say that no train of to-day runs at a very much higher speed than did the G.W. 6.30 p.m. a quarter of a century ago, or the Great Britain to Didcot even 38 years ago: but the speed is maintained for longer distances and under safer conditions. **John T. Lawrence, B.A.**

CYLINDER ESCAPEMENT.

[25368.]—As a jobber I have often met Geneva watches which would stop when the 'scape tooth was leaving the inside of cylinder, and have been frequently exercised in mind and body to remedy this defect; but have generally succeeded by some means to effect the object, although, in most cases, it has been rather by empirical alterations than by sound reasoning. I have one in hand at present which seems to defy efforts to cure; it will go for, perhaps, two or three days and then stop. Upon examination I find the tooth of 'scape wheel about half-way out of cylinder and a shake of the slightest starts it. The motion, when going, is very good; the cylinder well-sized, pivots straight, good fit, end-shake right, jewel holes all right, balance free of everything. Tried altering depth, no use; examined 'scape teeth, a[illegible] and well polished; could not, how- [illegible] "plane" be [illegible] be too great [illegible] to be not and are, troubled with stoppers of this kind, and it is possible that this may meet the eye of someone able and willing to throw light on this defect, and thereby assist many beside **Detent Click.**

PIANOFORTE-TUNING MACHINE.

[25369.]—About eight years ago this subject appeared in "Ours." One of the correspondents concluded his letter with the remark that some kind of machine ought to be invented with which it would be possible to screw the tuning-pin, without such an appliance being a fixture of the piano. Since then six inventions have been made—three in England, two in Germany, and one in Belgium; but all are an internal part of the piane, and therefore do not much benefit this generation, at least, not those who have a good piano but minus that tuning arrangement in it. The idea of our correspondent, whose name I regret I have forgotten, is the most practical one, and, adopting this idea, I have been able to invent a tuning machine which can be used to tune any piano now in existence. It requires only half the power compared with the ordinary tuning hammer, and a turn of the handle acting on cogwheel causes the tuning pin to move one-third only. This is a great gain, when we consider how tight the pins are in some of the new pianos; so much so that a good strong tuner is obliged to use sometimes two hands to turn them; and, when the pin does move, it moves too much, and the same takes place in turning it back again; it is then only by chance that one can get the pitch of the note correctly. It is, therefore, almost impossible for beginners or amateur tuners to tune with the ordinary tuning hammer. Fig. 1 will give an idea of my arrangement; *a* is inserted between the tuning pins to steady it, and *b* is the key which turns the pin. Fig. 2 is a vertical cut showing the cogwheels. Having put it to a practical test, and found it answered, we have secured the patent for it.

J. H. Schucht.

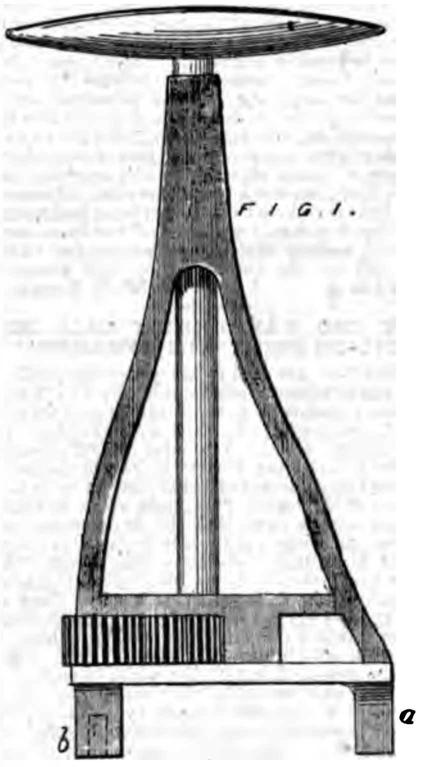


FIG. 1.

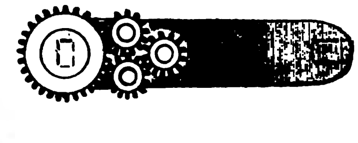


FIG. 2.

REFLECTORS v. REFRACTORS.

[25370.]—With respect to "Pen-y-van's" letter 25257, page 426, I can fully endorse all he says with regard to silver-on-glass reflectors, so far as regards the Gregorian telescope. Some years ago I constructed one, and have splendid definition with the small specula of metal; but, thinking I might obtain more light if the small specula was glass silvered, I ground several and tested them before silvering, when the definition was simply perfect, but as soon as silvered became quite useless, and only gave a blurred image. This I have experienced for the last twelvemonths, and have ground over 30 small mirrors with the same result, and in some cases have silvered and reapplied to the polisher some of them over 50 times, but with no better result after silvering. This I can only account for in the silver film altering the figure; but perhaps Mr. Calver, Mr. Linscott, or other of our optical friends can come to the rescue and help me and others out of our difficulty, and give reason of failure. **Alpha.**

SPIRAL WHEELS.

[25371.]—If Fred. Carre will send his address, or advertise in Sale Column, I will forward him a pair of spiral wheels cut in boxwood that I made for a model, and be able to tell him how they are cut to work at any angle required.

C. Sibley.

73, Westminster Bridge-road, London, S.E.

LATHE MATTERS—THE MILLING HEAD.

[25372.]—The deciphering of my last letter seems to have puzzled your compositor more than usually is the case.

A friend has told me that the illustration of "spiral gearing" I referred to appeared in "E. M." for Oct. 16, 1885; and from what is there said of them, they seem specially suited for the milling head. Their action is very smooth and noiseless, and well suited for high speed.

I do not like gearing if it can be avoided; but I don't see how we can get over the difficulty without it. There is, however, nothing to prevent the milling spindle carrying a cone pulley, as well as the bevil or spiral wheel, and occasionally being driven from the overhead; but I admit it is chiefly of heavy milling I am thinking.

I find I have very stupidly been forgetting that in milling with the cutter on the mandrel the work must advance, or be drawn up *from the back* of the lathe. Hence, what I have written about the strain on the V's of bed has been all wrong, and I give up at once my objections to the form of milling table advocated by "F. A. M." I am only surprised he did not see my mistake. I am very glad to get rid of what seemed to me the *necessity* for a special milling head. The question is—Would the arrangement on the front be worth fitting up? It certainly has several considerable advantages.

What I have written about the vertical planer has been made such hash of that it is useless to try and mend it. Of course, I have nothing to do with "Northcott's polarising arm"; what I meant was his *planing* arm or head. Also, what I advised the amateur to get (2nd line, middle column) was "a table with T *slots* on top, and planed underneath to fit the V's of his lathe-bed." Speaking of the planing of this table in 2nd paragraph, same column, what I wrote was, that it would be better to get a rough cut, taken over the top, lest when the strain was removed the table would cast, or be found to be in winding.

In my sketch of twist-drill sharpening, I had put a note that the dotted line was the proper angle at which the drill should be represented, intending that your engraver should mend my sketch. As it is, the sketch is misleading in more than one point, for the inclined plane shown would not suit the stone as shown. The angle of the incline must be suited to the size of stone and position of rest.

Fred. Carre.

LATHE MATTERS—VERTICAL PLANER, &c.

[25373.]—Although my suggestions are, of course, not to be compared with those of Fred. Carre—witness his apparatus for grinding twist drills—yet I protest against his constituting himself the inventor, to warn the readers against all suggestions of mine. The object, I apprehend, of the English Mechanic, is to enable all lovers of mechanical work to bring forward for mutual benefit any and every form of machine or apparatus which may appear to the designer or writer to be worth consideration, either as a novelty, an improvement, or an adaptation.

It is for any particular reader to consider whether such design may best serve his purpose, or whether that purpose were still better served by some other arrangement. A front slide-lathe may commend itself to one, while to another it may appear a useless or undesirable complication. "F. A. M.'s" plan of grinding drills may be preferable to Fred. Carre's, or it may not; but the English Mechanic would fail of its purpose if nothing was permitted in its columns to which F. Carre had not first affixed his "imprimatur." "F. A. M." approves the vertical plan as such, and we have no better mechanic perhaps in our pages; but if he did not, he would not take upon himself to warn all readers against it because of the source whence it originated—it did not so originate all the same!

The limit of its capabilities was fairly stated, and it was in no way thrust upon the reader as a model planer, or as the best planer, but only as a very simple one, easy of construction, cheap (the £6 was not my figure, as £1 would probably suffice), and within certain limits satisfactory. If F. Carre's is better, well and good. It has precisely the same qualification—viz., that it will do such work as it is suited for; but I suppose anyone capable of obtaining a real planing machine would despise it as a mere amateur's toy. I am preparing for publication in "E. M." a description of a screw-cutting apparatus which, to the best of my belief, will excite very wide interest, and which is wholly novel. I have also on the cards a screwing (traversing) chuck, also, I believe, quite new and effective, and in spite of F. Carre's censorship, I venture to think that both are well worth the attention of the readers, and it will rest with them whether or not they like to purchase them; as to making, it will be put out of their power by patent. Why should anyone suppress information because someone else disapproves? Even F. C.'s twist-drill grinder would be received with a smile in the workshop where such drills are made; but, like the vertical planer, it may answer where the real thing cannot be had.

O. J. L.

LATHE MATTERS, &c.

[25374.]—I WAS pleased to see "Vulcan's" remarks, and though I still incline to the split head-stock plan, I see the oil hole must be considered. I feel an objection to the long bearing "Vulcan" shows, and this was the very thing my sketch was planned to avoid. Before the discussion on Friction, I should have made my mandrel neck 1in. diam. and 1½in. long; but now I should make it about 1¼in. diam. and ¾in. long, and expect it to run as easily and be much more rigid.

I have a Northcott arm planer (fully described on pages 25 and 95 of *Amateur Mechanics* for 1885), so also has a friend of mine, and we find it very troublesome to fix up; mine also cost about £10, the top of planer head being turned (an awkward job), and a planing table and vice fitting upon saddle slide to take work. The "O. J. L." vertical planer would, in my opinion, cost little more than half the other, and be much more quickly set up. It might have a tool box which would raise the point of the tool an inch or two to enable work of 7in. long to be planed without removing the gap piece. With this vertical planer there is no chance of wearing the lathe-bed unevenly *nor the back shaft* (now I have one fitted I don't like using my arm arrangement). If power is required, it would be very easy to drive it from the back-gear shaft. Altogether, considering how convenient it would be for milling with strong drill spindle and straight line work, &c., I wish someone would take my planer and give me one of these instead.

I was very much pleased to see the section of the Robinson hot-air engine. Can "Glatton" tell us any more about it? Will it burn out? How does that governor act, and is it sensitive? Are castings to be had? But probably it is beyond the powers of an amateur with only a 5in. lathe? Where can F. Jenkins' lecture be obtained?

F. A. M.

[25375.]—THE small vertical planer proposed by "O. K. P." would be very useful for small articles, and it is hardly fair to compare its cost at £6 according to "F. A. M.," reduced to £4 by "O. K. P." if purchased from an engineer, with the cost of the competing planer of Mr. F. Carre, which is to be mainly home made. I should say that "O. K. P.'s" planer could be made with half the labour and at much less cost than the other.

The handiness of this planer must be great, and ~~its~~ rigidity has, I understand, been sufficiently tested for the work it can perform; and the fact of the cutter being ready for work in the slide-rest is a great advantage. In Mr. F. Carre's planer the rest has to be taken off the lathe-bed and fixed vertically to the arm, which is rather heavy work. Still, this contrivance does for both large and small work, and in multitude of tools there is no end, so that altogether it is preferable. I hope before long to send you particulars of one I made a year ago, which does good work up to 12in. with a stroke of 30 to 60 a minute.

M. A.

ARTIFICIAL LIGHT.

[25376.]—IT seems to me that effort is made in the wrong direction to increase the quality and quantity, and decrease the cost of the above. Too little attention has been paid to the fact that all the present means of lighting consume energy much more than sufficient for the light they give out in producing heat.

Before attempting to devise a remedy for this state of things (and the degradation of energy is a sad spectacle), various data must be obtained. Those which at present occur to me as necessary are:—

1. Proportion of energy as light to that as heat evolved by the various standards of light—viz.: (*a*) The standard sperm candle; (*b*) the pentane spirit-lamp; (*c*) the sq. cent. of fusing pt.
2. The same with regard to the various lights in common use—oil, gas, electric.
3. Whether the proportions vary with the size of any given light under identical conditions.

To one who would give us such data thanks would be due.

B. B.

APERTURE OF TELESCOPES.

[25377.]—IN reference to the letter of "Prismatique," Feb. 12th, p. 495, it may be said that it is quite impossible to determine mathematically what is the best proportion between aperture and focal length. Such a question must be left wholly to the judgment of skilled artists such as himself, among whom there seems to be a consent of opinion that a proportion of about 1 to 15 is, upon the whole, the best. One reason, of course, why the proportion cannot approach to that of a "beer-barrel" is that, owing to dispersion of light, neither the colour nor spherical aberrations can be corrected simultaneously for all rays, and as the lateral spherical aberration for a given focal length increases as the cube of the aperture, we soon come to a value of the latter beyond which aberration cannot be possibly corrected. There appear also to be other occult causes why aperture may soon become too large—e.g., in the telescope which "Prismatique" made for me, against his own recommendations, with 3¼in. to 15in., there is a small amount of glare, not traceable to aberrations, which demands a bright object with full aperture, but which disappears when we take only 3in. Of course, more light is gathered by full aperture; but, taking all things together, purchasers of telescopes may rest well assured that the proportion for which they will get the best value for their money is about 1 to 15.

W. G. Penny.

WHY DID FAHRENHEIT CALL HIS BOILING POINT "212 DEGREES"?

[25378.]—I AM glad to see your correspondent from the enlightened continent of the New World drawing attention to some of the inaccuracies in Ganot, concerning, in this case, the zero of Fahrenheit's scale. As quoted (25327) Ganot assumes this absolute zero to be the temperature produced by a mixture of equal parts of snow and muriate of ammonia. Now, most of us find this mixture more frigorific than the more common one of snow and common salt, while the latter produces a cold (according to circumstances) nearly 7° F. below zero. Ganot at one place gives this temperature as −18° C. or −·4 F., at another place as −20° C. or −4 F. But while judging by simple experiment, Ganot is evidently "out of it," your learned correspondent's "dear old friend," Prof. John William Draper, is equally far adrift in *professing* to explain what are called the "real facts." Perhaps anything that can be said by an Old-World student, especially by one that studied in benighted Scotland, will weigh little compared with the advanced science of the effulgent West; but I may be allowed to state that our "dear old friend" taught us, not as a speculation, but as an old and commonly known fact, even in this dull region, that while the freezing and boiling points of water by Fahrenheit's scale were (so far as numbers go) chance affairs, the degrees themselves were definite quantities relative to the expansion of the mercury of the instrument. In fact, Fahrenheit very properly had looked about for some easily remembered and easily manipulated fraction of the total amount of the mercury as his unit, instead of taking some purely arbitrary interval between the freezing and boiling temperatures of some fluid with which the instrument might be used, and then dividing that also in an arbitrary manner into 100, 80, or any other conventional number of parts that might strike his fancy. No doubt he found the freezing and boiling points of water very convenient test temperatures during the process of manufacture; but he quite rationally considered them as entirely outside the instrument, so to speak, just as no astronomer would take the distance between two stars at random (or let them even be conspicuous ones), and dividing that into 100, or 97, or whatever number he liked best, use that as the division scale of his circle. The number he chose as his unit was what we would call a true decimal one, being the 1-10,000th part of the total volume of the mercury at the melting point of the ice: or, what is the same, the weight of mercury filling one degree of the tube equalling 1-10,000th part of the whole mercury both in bulb and tube. Of course, a thermometer being merely an instrument of comparison, it must needs have some comparative mark relative to some assumed standard temperature, and the melting point of ice being a convenient one, he used that as his datum of comparison, but not of division; for to divide, you must have at least two points. His reason for making his zero where it is, is well enough known here at least, and needs no speculative investigations at this time of day by imaginative and ingenious professors; for with common sense, wishing his scale to read all one way, and to avoid the complicated nuisance of + and −, he took what, at his time, was the greatest *natural cold on record* [said to have been communicated to him from Iceland, from observations with older instruments], as his starting point, going from this by his increments of 1-10,000th as before mentioned; 32 *happened* to be the number of the thawing of ice, and 212 for the boiling of water.

By the way, like all physical constants, his 1-10,000th is capable of correction, and has been since found to be near 1-9994th; but with our very imperfect knowledge of the expansion of mercury in glass (the latter substance being very irregular in its behaviour under heat), the error may be as much the other way.

It may be said that being only an instrument of mere comparison, any conventional degree would do; but philosophers like to deal with quantities supposed at least to be definite, and to have some meaning. Apart from purely scientific reasons, there are many who consider the degrees of Celsius and Réaumur as too coarse without the use of fractions, which is to be avoided in all but matters of extreme delicacy; as, say, in the case of one recording the temperature of the Firth of Tay at 11·012ft. from the surface, when the moon is five days old, and stocks at 2½ per cent., in the hopes of gaining endowment from some association or other to "go and try to find out something."

Again, there are others who think C. shows more scientific culture than F., just as a sprinkling of French, or at least a few English words spelt somewhat Frenchwise and written in italics, give a finished and elegant appearance to a letter. Finally, to give authority to my statements, I will, like some of your excellent correspondents, show my credentials; but in case I may have made equally excellent errors, I will, as a cautious Scotchman, content myself with a humbler order of merit, and sign myself—

1-10000th Class Honours.

BLOWPIPE ANALYSIS.

[25379.]—PERHAPS, as this subject seems to be again attracting the attention of your readers, I may be permitted to contribute some general views as to its scope, &c., in your epistolary columns, including in them a reply to query 58820, p. 502.

Though very far from worked out, and indeed, scarcely as yet properly inaugurated—in consequence of the natural disinclination of chemists, with heaps of work on their hands, to undertake fresh labours in a new branch of their noble science—there can be no doubt that blowpipe analysis, as now laid before students, even in the imperfect state to which it has hitherto attained, is simply and really chemistry "in the dry way," and may therefore be fairly and properly termed "Anhydrous Analysis." I trust before long to contribute to the "E.M." some further proofs of this assertion, supplied by the use of pure phosphoric acid as a reagent.

Although some of its results may seem at present to run counter to those of analysis "in the wet way," the youngest student of natural philosophy—one who has only grasped and appreciated the great fact that Nature's laws are absolute and immutable—will have discerned that real divergence between the principles of the two lines of research (for final truth) is impossible; and that the seeming divergence is in reality due to the different method of routine (or routine of method) for arrival at the same goal.

This conclusion is, of course, made assuming that the empirical *facts* on both sides—or at least the more important—have been proved beyond reasonable doubt; and this, as regards the new facts brought forward in anhydrous analysis, has been allowed by some of the first English physicists and chemists now or lately living—e.g., the Lucasian Professor of Mathematics at Cambridge, the Chemical Professor of University College, the Professor of Physics, Royal School of Mines; the late Professor of Mineralogy at Cambridge, the well-known distinguished analyst, Mr. J. A. Wanklyn; the celebrated discoverer of thallium and the radiometer, and others. Abroad, the chief of the novel facts in anhydrous analysis have been admitted by such authorities as the chemical Professor of Freiberg University, the Professor of Metallurgy in the Imperial University of Berlin, and the Professor of Chemistry in the New Jersey College, America.

Assuming, therefore, that the more important *facts* of anhydrous analysis—the *proportionate* combination of certain elements to form chemically anhydrous salts—are (as, of course, they must be; susceptible of expression in mathematical formula, although the powerful aid of mathematics has hitherto been withheld from them, I would ask if it is a fair mode of scientific inquiry to sneer these results as "paradoxical," because such forms would probably differ widely from those of same elementary combinations, but obtained the wet way," and therefore containing hy as a factor?

Those who mak [illegible]

the benefit of a querist who seemed likely to be misled by a well-meant suggestion. Should the details which I give elsewhere in connection with the fitting of brakes to large coils (that is to say, coils having *large cores*), be insufficient to enable Mr. Brown to apply a platinum break to his own 8in. spark coil, I shall be happy to correct any point which remains unexplained; and if he will accept the offering, I will place at his disposal a spring properly prepared for his purpose. The important pole-piece upon the core is not mentioned by Mr. Gordon in his lengthy and elaborate account of the Apps induction coil, nor can any reference to the attachment be found in the inventor's patent specification. The action of the break may, however, be gathered from Dr. Fergusson's well-known and useful little treatise upon "Electricity," in which a sketch of one of Ladd's coils is shown. In Ladd's coils the hammer or vibrator was exceedingly small, and was arranged to work upon the edge of the core. The Apps break seems to be an outgrowth of this earlier form, and is an immense improvement upon it. I may here remark that many, if not most, of the excellent coils which were constructed by Mr. Ladd have gradually broken down and become useless, owing to the action of the generated ozone upon the guttapercha tissue with which they were insulated. The same remark applies to the famous instruments made by Ruhmkorff. Apropos of Mr. Brown's analysis of the comparative efficiency of various coils, I think I may head the list with my own last attempt at coil-building. A little coil which I lately made for a friend gives from 4½in. to 5in. of spark from a secondary 2¼ miles long. It is provided with a break of the Apps form, and has a core only 7in. in length.—Ernest Baugh.

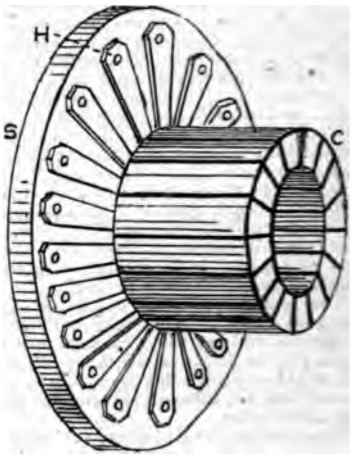
[58623.]—**Induction Coil.**—Before recording the various experiments suggested by Messrs. Baugh, Brown, and Ward to enable me to get my coil to work properly, I wish to thank them for their great kindness and the interest that they have taken in the matter. I first constructed an automatic mercury break, worked by a small bichromate battery, as I found I could not make and break contact fast enough by hand. The results obtained were certainly much better, sparks being produced with two Bunsen cells, 1¾in. long; after a short period, however, the mercury formed into globules, and the break did not give satisfaction. Next I wound on the new primary, as recommended by Mr. Baugh, of two layers No. 14 cotton-covered copper wire, which I happened to have by me, then Mr. Ward's instruction of only winding it on 10in. of the core; these two features seem to have made a very great improvement. (Will Mr. Brown please note the following?) The ordinary contact breaker, which I could not get before to work satisfactorily, now worked with continued steadiness, and gave results quite equal to mercury break. I suppose this to be on account of the core projecting some distance beyond primary; of course, this may not be the cause of Mr. Brown's break not working properly. Sparks now obtained were as follows, with half condenser, which appeared sufficient:—One pint Bunsen cell, 1¾in.; two ditto, 2¾in., and occasionally 3in.; after this the three remaining pint cells were connected, and, to my surprise, I could not obtain more than 2¼in., although every connection was perfectly clean and bright; the solutions used were all out of the same bottle. Each cell was next separately tested, when I found that only two gave a proper current; in fact, either of the first two used would give a better result than the other three together. The porous cells were tested by putting them in the place of the other two, and the fault discovered. I have since received three new ones from another London firm, and, strange to say, not with any better result; therefore, the coil has not been properly tested beyond two cells. Can anyone explain the fault of porous cells, and if they can be rectified? (Carbons all tested and perfect.) Mr. Ward very clearly gives dimensions of length of primary in proportion to diameter, also ebonite tube and secondary; but what rule is there for deciding diameter of core, size wire, and number of layers for primary, also diameter of ebonite discs for coils, to give, say, from 4in. to 10in. spark? He says that core should have a projection of ⅝in. for contact breaker. Does he mean beyond primary wire, or tube? Should core project beyond primary at other end? In building skeleton is it necessary to use shellac varnish to fasten washers to discs and tube. I now intend constructing a coil to give sparks from 8in. to 10in. long, and should feel obliged by dimensions of various parts, quantity and size of wires required. Would $\frac{1}{16}$in. be thick enough for ebonite tube, and would thickness of washers for skeleton be right as before stated? I notice that Mr. Brown, in speaking of the gigantic coils constructed for the Polytechnic and the late Mr. Spottiswoode, thinks that there must be error in dimensions and insulation as compared with amateur coils; but I am under an impression that when a coil gets beyond a certain size that for every pound of secondary wire used you cannot under any circumstances obtain anything like, say, ¾in. spark; also, if the wire in being wound into the sections is passed through melted paraffin wax, the excess sometimes adheres to side of sections, and takes up valuable space.—W. J.

[58623.]—**Induction Coil.**—The various dimensions and proportions supplied by Mr. Paul Ward in last week's issue are of great value, seeing that they are understood to be given upon the authority of Mr. Alfred Apps, the king of coil-makers, whose knowledge of the subject is probably more extensive than that of any other man living. There is, however, one point upon which I should like to ask Mr. Ward for a little further information. I notice that he advocates the use of a very large number of sections in the secondary. Now, the results of a series of careful experiments which I made about two years ago, with the object of learning the most advantageous distribution of the secondary wire in any coil, point exactly in the opposite direction; and although I do not presume to put forward my own humble results as authoritative, I have practical proof of their reliability in connection with the construction of coils giving up to 8in. of spark. I have found that down to a certain point, when the minimum of efficient insulation is approached, both the length and the quality of the spark are improved by reducing the number of compartments; and if the secondary wire is specially prepared (for example, by covering it with three or more coatings of pure silk), the central sections of the coil, where the tension is least, may each be made upwards of half an inch wide with advantage. Under these circumstances, the thickness of the ebonite partitions must be augmented, and such other alterations must be made in what Mr. Ward terms the "skeleton" of the instrument as the necessities of the case suggest. My strong impression has hitherto been that this use of specially-covered wire in a comparatively small number of wide sections or divisions was one of the features of all large coils of Mr. Apps's construction. Whether this is the fact or not, I have proved for myself, and for any readers of "Ours" who will make the experiment, that the cutting up of the secondary of, say, a 6in. spark coil, into "at least 60 sections" is wholly unnecessary. My present 8in. coil contains only 21 sections, and I do not consider that in this instrument the safe minimum is reached. I may add, for the benefit of "W. J." and others that the quality of the spark from any coil may be improved without detriment to its length, by using two gauges of secondary wire (say 36 and 35), and by winding them in regular alternation throughout. The compartments containing the finer gauge may be somewhat narrower than those in which the coarser gauge is wound. It seems hardly kind, after what Mr. Ward has said about his connection with the Polytechnic coil, to inquire of him whether this ponderous piece of apparatus was not regarded by the public as a partial failure, and whether it did not eventually break down? Certainly, the spark of 29in. was far enough away from equalling in length "the body of the secondary." Perhaps, now that he is to the fore again in these columns, our friend Mr. Ward will tell us something more about his "Electric Valve," in which many readers were deeply interested. Mr. J. Brown will find an account of Apps's patent break upon page 376, of Vol. XXXIX. of the "E. M.," where I quoted it from Gordon's book ("A Physical Treatise upon Electricity") in answer to a correspondent. In the sketch which accompanies the description, the cylindrical projection from the core is clearly shown; and it is upon the suitable adjustment of this attachment, in relation to the magnetic power of the core, and to the size and position of the hammer or vibrator, that the successful application of the break entirely depends. When all the adjustments are perfect, the working of the break will be smooth, and nearly silent, and it will become possible by tightening the screw which regulates the tension of the spring, to reduce, if necessary, the rate of the vibrations until their number does not exceed about one hundred per minute. The utmost power of the coil will then be readily obtained, and a spark will generally follow each movement of the hammer. It is necessary to mount the coil very rigidly upon the stand, and the spring carrying the vibrator must be extremely strong and elastic. The contact-points must be broad and massive, and should be composed of pure platinum, to prevent undue sticking and burning. Better results are got when the iron projection and the hammer are thrown slightly out of line, than when the latter works upon the exact centre of the former; and, in fact, the projection may, in small coils, be dispensed with altogether by causing the hammer to work upon the edge of the coil, as was done in Ladd's coils. The mastery of the details of these adjustments, after I had arrived, by slow stages, at the principle, cost me much time and labour; and in respect of the proper shape of the pole-piece or attachment, and the correct tension of the spring, I am indebted to Mr. Apps himself for some hints which he was kind enough to give me in answer to my inquiries.—Ernest Baugh.

[58662.]—**Brass Founding.**—To "J. H. S."—I am much obliged to you for your kind answer t mine. Will you kindly send me a good recipe for bearings, regardless of cost, as that is nothing t me; I am not my own master at present, and hav to make a good bearing. What sort of sand fo cores? Will same as for iron do? Also, a mixture for yellow brass for binding screws for electric work.—Moulder.

[58690.]—**Refracting and Reflecting Telescopes.**—I thank "F. R. A. S." and others fo their kind replies. The telescope has an erecto composed of two lenses, and the eyepiece also ha two lenses. I do not think the fault complained of is in the object-glass, as I tried it with another object-glass, and it still gave the double image. It is one of Theobald's Combination (No. 3.—R. J. C. S.

[58695.]—**Hochhausen Commutator.**—To Mr. Bottone.—Annexed is cut representing the arrangement of the collector bars of the abov commutator. It consists of a number of L-shape pieces of copper *c*, screwed down to a disc of slate *s*. Holes are drilled in the slate to admit the passage of the wires from the armature, which ar connected to the extremities of the collector bars as shown at H. Gaps of about $\frac{1}{16}$in. are left between each bar.—S. Bottone.



[58714.]—**Mathematical.**—As "Ratio" wishe for a formula for calculating π, I may state tha my own investigations have led me to find one o the required kind which I have never seen before, but which I cannot presume to be original. The well-known series $1 - \frac{1}{3} + \frac{1}{5}$, &c., for the valu of $\frac{\pi}{4}$ is simply useless for calculation, on accoun of its very slow convergence. We can, howeve find for $\tan.^{-1} x$ equivalent series, the convergenc of which may be made to increase indefinitely by means of the formula for multiple arcs. Thu $\tan.^{-1} x = 2 \tan.^{-1}\left(\frac{\sqrt{x^2+1}-1}{x}\right)$ the tangent in the latter case is of course smaller than in th former; but then it is irrational, and if we take a greater multiple than a double arc, it will be sti more irrational, and therefore still more unmanage able. My formula, not however in its most gener form, is the following one: $\tan.^{-1}\frac{1}{x} = 2 \tan.^{-1}\frac{1}{2x} - \tan.^{-1}\frac{1}{3x+4x^3}$. By means of th $\tan.^{-1}\frac{1}{x}$ can be divided into two separate qua tities, whose tangents are rational, and have unity for their numerators. It is evident also that eac of these two quantities can themselves be divide in the same manner, and an equivalent can thus be found for $\tan.^{-1}\frac{1}{x}$ consisting of four separa quantities. This method of division can be carrie on *ad infin.* The tangent in each case will alway be a rational fraction, and (supposing x an intege will always have unity for the numerator, an therefore for the several powers of th numerator. Moreover, the greater the numbe of these quantities the more convergent the series will be; but, on the other han the greater will be the number of series to b summed. Assuming $x = 1$ in the formula, v obtain $\frac{\pi}{4} = 2 \tan.^{-1}\frac{1}{2} - \tan.^{-1}\frac{1}{7}$. Divi $\tan.^{-1}\frac{1}{2}$ into two separate quantities by t formula and substituti

$- 2 \tan.^{-1}\frac{1}{38}. - \tan.$

cable for calculation. The formula of Machin is $\frac{\pi}{4} = 4 \tan.^{-1} \frac{1}{5} - \tan.^{-1} \frac{1}{239}$. Taking this in conjunction with my own, we obtain $\frac{\pi}{4} = 8 \tan.^{-1} \frac{1}{10} - 4 \tan.^{-1} \frac{1}{515} - \tan.^{-1} \frac{1}{239}$. I may here say that I have not sufficiently investigated this matter to have found out the most practical result. —VLADIMIR.

[58714.]—**Mathematical.**—I know not how far the original sense of this word, generally forgotten, is revived by applying it to such a piece of disciplinary toil, for discipline sake alone, as calculating 690 more figures of that π ratio than can be of use for any conceivable purpose. If any reader would like to prove Shanks's figures, here is a mode by which he can save at least three-fourths of his process. The two arcs chosen by Machin, $\tan^{-1} (\frac{1}{5})$ and $\tan^{-1} (\frac{1}{239})$, are each resolvable into two much more easily reckoned. First, the $\tan^{-1} (\frac{1}{5}) = 2 \tan^{-1} (\frac{1}{10}) - \tan^{-1} (\frac{1}{515})$ Reducing thus our largest arc to about its half, not only makes the terms converge twice as quick, and thus halves the number of them (or quarters the number of figures needed) to reach a certain result, but in this case all the divisions becoming by 10^2, instead of 5^2, by 100 instead of 25, this whole process, instead of doubling each term, reduces itself to a shifting of the identical figure or figures two places to the right. All other figures than we begin with are here dispensed with, and all computation reduced to that of the small arc $\tan^{-1} (\frac{1}{515})$, whose terms dwindle so rapidly that very few comparatively are needed, and the divisor 515 reduces itself to 5 × 103, the latter involving no more labour in single-line division than 3 itself (the easiest divisor except 2 and 5). But, secondly, Machin's $\tan^{-1} (\frac{1}{239})$, which he proved to be the excess of $4 \tan^{-1} (\frac{1}{5})$ over $\tan^{-1} (1)$, is also the difference between $\tan^{-1} (\frac{1}{70})$ and $\tan^{-1} (\frac{1}{99})$; and these two you will find (though needing more terms) vastly easier than the single but very unmanageable divisor 239. In fact, as the square of 70 is 4,900, the divisions by this become reduced to cutting off two figures and dividing by (50 − 1). This divisor and (100 − 1) are precisely the two easiest of two-figure divisors, and dividing in a single line by either 49 or 99 will be found less trouble than by 7 × 7 or by 9 × 11. We compose the value of π thus: then $\pi = 32 \tan^{-1} (\frac{1}{10}) - 16 \tan^{-1} (\frac{1}{515}) + 4 \tan^{-1} (\frac{1}{99}) - 4 \tan^{-1} (\frac{1}{70})$. I will send, if you like, the whole calculation, in this method, of the famous 36 decimals that poor Van Ceulen got engraved on his monument (having probably cost him more labour than these 707 of Shanks). Every figure used will go into about a column and a half of "E. M.," I reckon. The very first terms of the four series give this approach :—

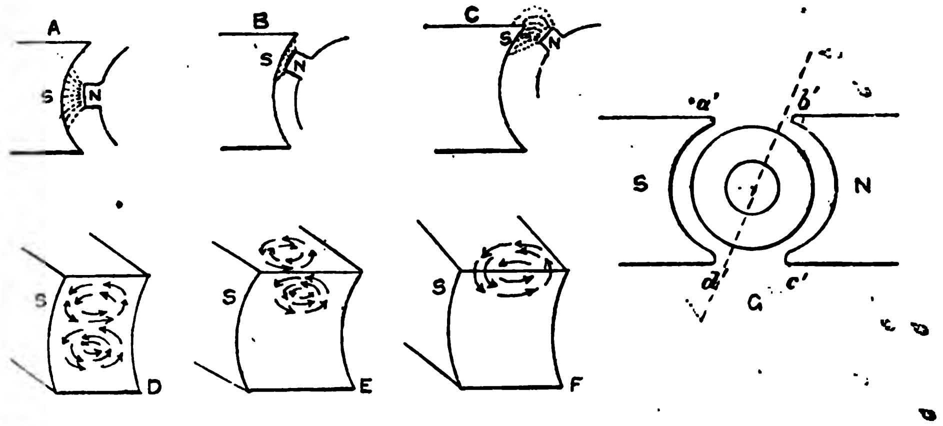
3·240404 040404 040404 040404 040404 040404
— 57142 857142 857142 857142 857142 857143
— 31067 961164 048543 689320 388349 514563
3·152, &c.

Eighteen terms complete the 36 figures. Any larger number will need half as many terms.—E. L. G.

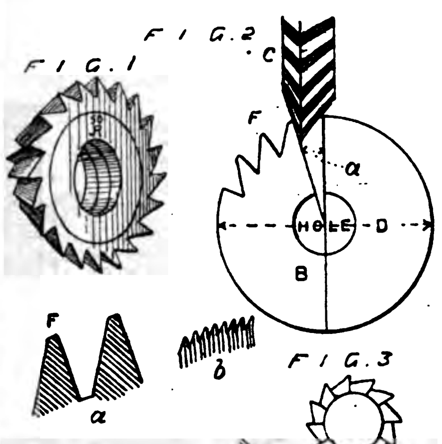
[58721.]—**Lime-Whiting.**—There is no help for him but to scrape every particle off and wash quite clean. If he does not know how to make his stuff the next time, and will write again, I will do my best to assist him; but he must send me the size of the ceiling. The best way for an unpractical man to tell the difference between lime and whitewash is to damp it with a sponge or brush. If whiting, it will immediately change colour and wash off; but if lime the water will not at first disturb it. Any practical man can tell for certain by the appearance.—T. H. W.

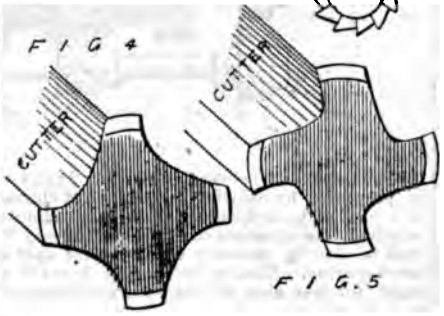
[58725.]—**Circular Milling Cutters.**—To "T. C.," Bristol.—Will he kindly say how he fixes on feed taps or other work to the under-cutting side of milling cutters fixed on mandrel to lathe centres? Particulars, with sketch, would greatly assist many amateurs and myself.—SOMERSET LAD.

[58725.]—**Circular Cutters.**—I could not tell you with any authority the speed you ought to drive cutters at. For my part, I believe in driving them slow enough that you can *see* the teeth, and not so fast that you can no more distinguish them from each other when they rotate. If I am not clear enough, say so. I also believe in few teeth with strong faces instead of many teeth with sharp ends (see Figs. *a* and *b*). The big teeth allow of sharpening with emery-wheels on the face F. For fluting taps, reamers, and such things—properly—so that the fluting gives a good cutting edge without impairing the strength of the tap or reamer, there are special cutters made, such as Fig. 4. The cutter in Fig. 5 is good for both [illegible] stronger tap, [illegible]



being dear), it would perhaps be cheaper to make fly (single) cutters the requisite shape, and drive them fast in a frame from overhead, the tap being held between centres. You do not state whether you have a vertical adjustment in your lathe-rest. Without some means of vertical adjustment, I consider milling in the lathe a very poor job indeed. Fig. 1 shows an angular cutter specially made for cutting the teeth of other cutters; Fig. 2 shows it (*c*) at work upon blank disc B. Distance *a* should be equal to $\frac{1}{10}$ of diameter D. When all the teeth are cut and cutter hardened, the faces or ends F should





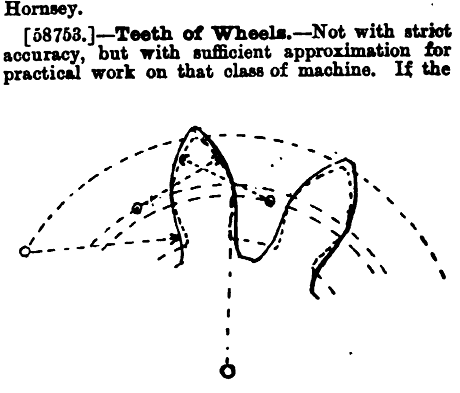
be ground with an emery-wheel with a little clearance. As you can see the cutting-face is in line with centre of disc, 12 teeth for a 1¼in. cutter ought to be quite enough. The work must go against cutter, just the same as in machine tool; otherwise the teeth are apt to ride over the work, and damage is generally the result. Another thing to show the advantage of feeding work against direction of rotation is, that by so doing, the cutting edges only come in contact with clean metal, whilst by feeding the work in the same direction as rotation of cutter, the teeth have to cut through the skin of the work, which is harder, and often contains sands from the foundry, or such things which spoil the cutter. I have not time to say more now, and wish "H. M. D." would write soon again and let me know results of his experiments, as I am much interested in the question.—BELGIAN.

[58736.]—**Hot Poles of Field-Magnets.**—I quote the following explanation from Silvanus Thompson's "Dynamo Electric Machinery":—"If the masses of iron in the armature are so disposed that as it rotates the distribution of the lines of force in the narrow field between the armature and the pole-piece is being continually altered, then, even though the total amount of magnetism of the field-magnet remains unchanged, eddy-currents [illegible] be set up in the pole-piece and will heat it. [illegible] shown by the annexed Figs. A, B, and C, represent the effect of a projecting tooth, such as that of a Pacinotti ring, in changing the distribution of the magnetism of the pole-piece. Figs. D and E (corresponding respectively to Figs. B and C) show the eddy-currents grouped in pairs of vortices. The strongest current flows between the vortices, and is situated just below the projecting tooth, where the magnetism is most intense, it moves onward following the tooth. Fig. F shows what occurs during the final retreat of the tooth from the pole-piece. These eddy-currents penetrate into the interior of the iron, although to no great depth. Clearly the greatest amount of such eddy-currents will be generated at that part of the pole-piece where the magnetic perturbations are greatest and most sudden. A glance at Figs. A B C D E F will at once tell us that this should be at the leading corner or "horn" of the pole-piece of the generating dynamo. As a matter of fact, when any dynamo which has horned pole-pieces (such as the Gramme) has been running for some time as a generator, this is found to be the case. The leading horns *a'* and *c'* of Fig. G are found to be hot, whilst the following horns *b'* and *d'* are found to be comparatively cool. When the dynamo is used as a motor, the reverse is found to be the case; the leading horns *a* and *c* are cool; the following horns *b* and *d* are hot.—S. BOTTONE.

[58740.]—**Dampness in Beehive.**—If more particulars had been given as to treatment in and after September, it would have been easier to advise. I should decidedly change them into a clean, dry hive, selecting the middle of a warm day. Keep out all frames not covered with bees, and also any containing dead bees or fermented food. Do this quickly, taking stock of the bees, food, and hive during the operation. Crowd the frames together, putting in dummy, then cover with one piece of ticking and two folds of old woven woollen carpet, or three or four folds of house flannel sold by drapers. I should begin at once to feed them with thick syrup or candy prepared with "Cheshire's solution of phenol," as per directions sent with each bottle, and to be obtained from Abbott Brothers, Fairlawn, Southall, London, for about 1s. 6d., post free. You had too many thicknesses of quilt, and closing the holes in roof was an error. Open these, and also the doorways, wide, so as to allow free ventilation. Try this and report result in a month.—J. I. S.

[58749.]—**Accumulator.**—"C. D. R." is mistaken in thinking a nitrate of soda battery unsuitable in charging accumulators. He will find them as good as Bunsens, and cost far less in using. Of course to obtain a large number of ampères you must have large cells. I have often used them for charging with the greatest success.—P. C., Hornsey.

[58753.]—**Teeth of Wheels.**—Not with strict accuracy, but with sufficient approximation for practical work on that class of machine. If the



wheels were large in diameter you could have long teeth and true cycloidal curves. Being small in diameter, you must either make the teeth very much undercut, and therefore weak below the pitch circle, or put up with a little judging. The amount of judging will, however, be so slight that none but a practised eye would detect the error. To illustrate my meaning I have drawn a couple of wheel teeth (to dotted lines) to their correct shape, as obtained by rolling circles, and of proportional length, and a couple more superimposed (full lines) to show the extent of the judging. The wheel is supposed to be 4in. in pitch diameter and to contain ten teeth of 1¼in. pitch. Such teeth would work decently at variable centres. I may note that the wheels are too small to permit of the use of long involute teeth.—J. H.

[58758.]—**Hooping Iron Cylinders.**—In bending iron of any thickness into hoops, find the distance round, add three times the thickness of iron to the length, it will then just reach round when turned for hoops of any size. For iron 1in. thick add 3in., and so in proportion to any other thickness.—A. E. B.

[58765.]—**Dental Query.**—"Urgent" cannot call himself a "Mechanical Dentist," or any other designation of the kind, unless he is registered under the Act 41 and 42 Vict. c. 33, and he is clearly liable to prosecution, although he confines his work to artificial teeth alone. If he does not think that is dentist's work, I wonder what he supposes it to be? For his satisfaction, here are the terms of the Act:—"From and after the 1st of August, 1879, no person will be entitled to use the name or title of dentist or of dental practitioner, or any *name*, title, &c., *implying that he is* registered or *qualified to practise dentistry* unless he is registered under this Act." The italics are put in to show the words whereby anyone calling himself a "mechanical dentist" without registration, and consequently qualification, is as much liable to prosecution as one calling himself "surgeon dentist" in the same circumstances. "Urgent" appears to have been altogether wrongly informed.—B. Sc., Plymouth (solicitor).

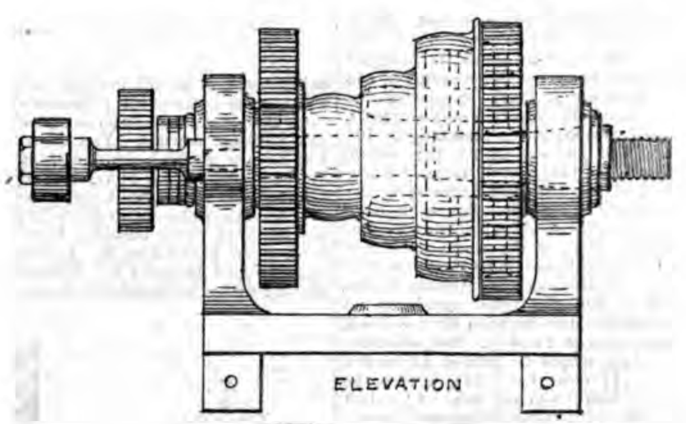
[58768.]—**Locomotive.**—The Clapham Junction and Addison-road service of the L.B. and S.C.R. is worked by their "A" and "D" class tank engine. The "A" class is a six-wheeled engine, all coupled, 4ft. diam.; cylinders, 13in. by 20in.; total wheel base, 12ft.; weight in working order, 24 tons 10cwt.; heating surface, 506 sq. ft.; grate area, 10 sq. ft.; capacity of tanks, 500 gals. The firebox, crowned, is supported by the direct stay introduced by P. Stirling, G.N.R., the results with which have been very satisfactory on this class, which have a small firebox; but for larger fireboxes Mr. Stroudley does not use this stay, as it causes the tube plate to break down at the upper flange, and produces cracks between the tube holes. This class is fitted with Mr. Stroudley's patent speed indicator, which he now applies to all his engines, both goods and passenger. The consumption of Aberdare coal with trains averaging nine coaches is rather over 20lb. per mile. The "D" class is six-wheeled; four coupled wheels in front, 5ft. 6in. diam.; cylinders, 17in. by 24in.; weight in working order, 38 tons 10cwt., of which 27 tons are on coupled wheels; heating surface, 1,036 sq. ft.; grate area, 15 sq. ft.; capacity of tanks, 860 gals.; coal bunker, 30 cwt.; boiler pressure, 140lb. sq. in. The consumption of Aberdare coal is 15·23lb. per mile with trains averaging 7 coaches, and 17·23lb. per mile with trains averaging 13 coaches. If "Young Engineer," wishes further information on L.B. and S.C.R. locomotives, I am willing to supply it.—M. R., 1675.

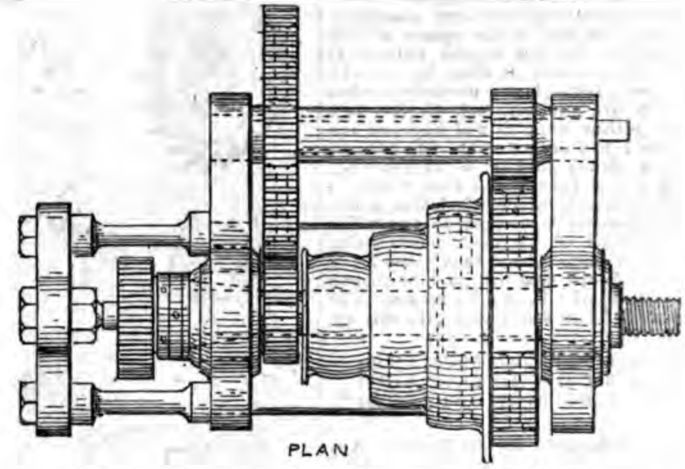
[58775.]—**Calcium Persulphide.**—I would very much like to know what "C. F. P.," in his reply to this query, means by "slaking lime water with an excess of flowers of sulphur."—Wm. John Grey, F.C.S., Analytical Chemist, Newcastle-on-Tyne.

[58776.]—**Hypochlorite of Sodium and Borax.**—Perhaps I had better explain. On making a solution of $CaOCl_2$, and precipitating the calcium as carbonate with Na_2Co_3, and then adding the solution thus obtained to a warm solution of borax, an abundant white flocky precipitate was formed.—Quinone.

[58784.]—**Silvering Incandescent Lamps.**—The following is the method employed at South Kensington, which I have used with good results:—Prepare two solutions: 1. Nitrate of silver is dissolved in distilled water, and ammonia added to the solution till the precipitate first thrown down is almost entirely redissolved. The solution is filtered and diluted, so that 100cc. may contain one gramme argentic nitrate. 2. Two grammes of argentic nitrate are dissolved in a little distilled water and poured into a litre of boiling distilled water; 1·66 gramme of Rochelle salt is added, and the mixture boiled for a short time till the precipitate contained in it becomes grey; it is then filtered hot. Any chemist will get these solutions prepared for you. See that the part of the lamp you wish to silver is thoroughly cleaned with (1) nitric acid (2) water (3) caustic potash (4) water (5) alcohol, and lastly, distilled water. Whilst still wet with the distilled water, place the bulb in a clean glass or porcelain vessel, the part to be silvered being uppermost. Equal quantities of the two solutions are then to be mixed and poured in so as to cover the glass. In about an hour the silvering will be completed. Then pour off the exhausted liquid, carefully remove the glass, wash in clean water, rub off the silver deposited where not required, allow to dry, and varnish the silvered side with any thin varnish that does not contract much in drying. Throughout the whole operation the most scrupulous cleanliness is absolutely essential.—Bangor.

[58779.]—**Headstock.**—I send sketch of headstock, showing dotted details. It is drawn uniformly to scale, and the drawings may, therefore, be measured for dimensions to suit a 4in., 5in., or 6in. lathe. Backlash is the singing backward of toothed wheels due to changes in their relative velocities, the amount of backlash being equal to the side clearance between the teeth. It can only be prevented by reducing the amount of clearance to a minimum, and by attention to steadiness of running. The clearance in screw-gearing may very well be less in quantity than that for spur and bevel-gearing. The truer gearing is made and hung, the less also is the clearance necessary.—J. H.





[58792.]—**Electric Loom.**—In reply to this querist, I can't say what book contains description of above; but the following is a short description of one from some writings I possess: This ingenious contrivance, in which the usual Jaquard cards are replaced by an electrical arrangement, worked by a pattern prepared in tinfoil with insulating varnish. A simple metal plate, perforated with holes, each of which is provided with a piston successively plays the part of each successive paper card in the usual arrangement. The pistons fill up every hole that is not required, but are withdrawn by electro-magnets from those holes which require at each beat of the loom to be kept open. When shuttles of different colours are to be used, the pattern is subdivided into insulated portions corresponding to the separate colours by removing a very thin outline of foil round each: all the parts corresponding to one colour are afterwards connected. As each shuttle is thrown, the battery in contact with the appropriate series of insulated patches of tinfoil, produces a succession of different cards, and the pattern is not shifted forward until all the colours are exhausted. After the completion of each fresh combination on the perforated plate, the battery circuit is broken by a contact breaker, and the spark is thus avoided.—Edward Duckworth.

[58800.]—**Amorphous Phosphorus.**—Many thanks to W. S. Smith for his kind answer *re* the above; but he does not indicate a solution to my difficulty—viz., keeping the phos. amorph absorbing moisture. I have tried shellac to no good end. I have tried an admixture common alkali, such as pot. bicarb., but mark the slow formation of phosphoric acid, in turn, attacks the pot. bicarb., forming, sume, phosphate of soda and carbonic aci when that action is over comes the ubiquit phosphoric acid again, which attracts moistu the air. Will he, or some other subscrib sider my difficulty, and help me? I am of that the phos. amorp. gradually returns to t talline form on exposure to air, and there some specific method of preventing this, how are safety-match boxes coated with suc Phos.

[58806.]—**Soldering.**—I want to know melt the solder with which the joints and are soldered on to the best class of metal b —not the most common class of goods; t know, are merely soldered with lead, which easily removed; nor is it for the value of t but because I want to put better pins on wish to know how to remove them.—C. Ha

[58793.]—**Lifting Power.**—The tackl have to be lifted $\frac{200}{5} = 40$ times, and its would be equivalent to $\frac{8}{2} = 4$ tons raised th distance each time, ∴ total weight of tackl $= 40 \times 4 = 160$ tons, ∴ gross weight raised f mine per hour $= 160 + 200 = 360$ tons.

$$\text{H.P.} = \frac{\text{wt. in lb.} \times \text{distance moved in ft.p}}{33000}$$

$$\text{H.P.} = \frac{\overset{6}{3{*}6{*}0{*}} \times 2240{*} \times \overset{5}{1{*}5{*}0{*}0{*}}}{\underset{11}{3{*}3{*}0{*}0{*}0{*}} \times 6{*}0{*}} = 610{\cdot}\dot{9}\dot{0}$$

∴ $610{\cdot}\dot{9}\dot{0}$ is the horse-power required.—Ink

* Erased.

[58816.]—**Marking Sheep.**—Pitch melted together with a little grease, and hot, leaves a good mark; but common paint the purpose very well, and is generally u marking, care should be taken to stamp suf high so as to prevent the mark being di when the sheep rub together. If "Yes sheep have horns, he can brand them w iron.—Ipecacuanha.

[58799.]—**Continuous Electric** ward rough sketch of a contrivance will suit "Bolton." Directly the cir the electro-magne acts releasing the lev hi contact screw S.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

[illegible]. Air-pump and Condenser Combined, p. [illegible].
[illegible]. Gyroscope, [illegible].
[illegible]. [illegible], [illegible].
[illegible]. [illegible], [illegible].
[illegible]. Twine Maker's Size, [illegible].
[illegible]. Rope Driving, [illegible].
[illegible]. Bellows v. Fan, [illegible].
[illegible]. [illegible]—To Mr. Wetherfield, [illegible].
[illegible]. Stiffness of Cast-Iron Cylinders, [illegible].
[illegible]. Boiler, [illegible].
[illegible]. Barometer, [illegible].

58614. To Mr. Wetherfield, p. 232.
58625. Emigration, 232.
58629. Hot-Air Engine. To Mr. Sutcliffe, 232.
58645. Lantern, 232.
58652. Milling, 232.
58663. Drilling Machine, 233.
58664. Crypto-Dynamic Gearing, 233.

QUERIES.

[58864.]—**Cheap Non-Conductor.**—I want to coat a tin or brass cylinder with some cheap non-conducting material, something that will easily wrap round, to gum or paste on the metal. Also the best stuff for attaching it to the metal with.—NON-CONDUCTOR.

[58865.]—**Dynamo.**—To S. BOTTONE, OR W. EAVES.—Would either, or both, of these gentlemen say whether eighteen sections are sufficient for a ring armature 18in. in diam? Whether more than one coil of wire round the field magnets is necessary? Whether if the resistance of armature and coils being equal means the same weight of wire to be on each? If brushes are to be insulated from frame of machine? If not, could not, say, half a dozen or more leads be taken from any part of the frame, and what would be the best way to either wind the armature or field magnets, so as to be able, if practicable, to intermix incandescent and arc lamps on the same circuit, or whether separate machines are required for arc and incandescent lamps?—KENT.

[58866.]—**Engine.**—Would someone kindly give me the dimensions of a two-cylinder oscillating steam engine to drive a 40-c.p. Gramme dynamo? Is this the cheapest motor? If not, which is?—ELECTRIC.

[58867.]—**Damage to Adjoining Property.**—A. is pulling down his house, and B.'s property (next door, and built about same time as A.'s, both rather old) cracks and threatens to come down without pulling. Is A., or B., liable for expense of setting things right?—LEUMAS.

[58868.]—**Obstructing Ancient Lights.**—What is the limit of time for lodging a protest against premises rebuilding going up higher than before and obstructing ancient lights (1) when a narrow public thoroughfare intervenes between the buildings, (2) when a private yard belonging to the offending party intervenes? Can a window be legally put out of a gable end to overlook another man's roof, his premises being much lower than mine?—LEUMAS.

[58869.]—**Microscopic.**—I beg to tender my thanks to each of the four gentlemen who so promptly replied to my query. I may say that I have succeeded in section cutting; but after soaking in turpentine and drying in blotting paper and mounting, there seems to be small portions of the liquid running from one cell to the other. I shall be glad to be informed how to remedy this defect, and also if such objects as wings and feet of insects are prepared in the same way?—W. H. C.

[58870.]—**Engine.**—I should be very glad if some of our readers would give me some hints as to making an engine 3in. stroke, 2in. bore. What size ought the steam ports to be? What length the connecting-rod? Ought the steam-ways to be cast in, or bored afterwards? What should be the size and section of rim for flywheel? I want to drive a small lathe with the engine. What size should the boiler be?—NO SIG.

[58871.]—**Baker's Fan.**—I would feel obliged if some correspondent acquainted with Baker's fan would give a description of its construction.—T. L. V.

[58872.]—**Cutting Rack Teeth.**—Will any correspondent kindly inform me of the best means of cutting teeth in straight racks of brass, such as are used for cameras and electric lamps. I may say that I have a wheel-cutting engine, and also lathe with divided head and overhead motion.—DYNAMO.

[58873.]—**Cheap Stove.**—I want to make a cheap stove for my greenhouse, to burn cinders, &c. Will it do if I take a large earthenware drain pipe, and fit a chimney and a door to it? Would it stand the heat? If not, could I line it with fireclay?—PANTAGRAPH.

[58874.]—**Decoration.**—Would any of your readers be so kind as to inform me through your columns what is best for the internal decoration of my very old dwelling house walls, which are not straight—the plaster cracked, chipped, and crumbling away from former damp? I have tried paper, which adheres to the protuberant portions, but, on drying, leaves the receding portions. Anything which would adhere, form a surface and not rub off. Also to the new plaster of cottages, which has blistered in innumerable places since they were done, two years ago? I wish to prepare them to paint; and they are perfectly dry. Any advice would be thankfully received. I have thought something might be incorporated with plaster or whitewash.—G.

[58875.]—**Screw Cutting.**—Will any kind reader tell me what wheels to put on a lathe with change wheels up to [illegible] teeth to cut from one to twelve threads to the inch?—[illegible].

[58876.]—**Grinding Machinery.**—What kind of boiler and steam engine is considered best for grinding machinery for making cements and the like? I am about putting down boilers and engines, and should be glad of any hints from practical men.—L. M.

[58877.]—**Setting Side-rod Brasses of Loco.**—Would any of your numerous correspondents inform me as to the best method of setting and lining the side-rod brasses of a six-wheeled coupled loco., so as to keep the same from knocking when slipping? Also if there is any work on the treatment of the loco.?—BRISTOL.

[58878.]—**Electric Lighting.**—To "SIGMA," OR MR. EAVES.—I am the fortunate, so my friends tell me, possessor of plenty of water-power, and wish to light my house with electric light. I can, at least, command one horse-power, and any speed; but the work on which the wheel is employed renders it liable to stoppages and change of speed. Under these circumstances, I am advised to have accumulators. I wish to know how many cells I should require to keep ten 15-c.p. lamps going for five or six hours? Whether there is any risk or trouble in using these? How long a time they take to charge? In fact, any information from a disinterested source will be esteemed a favour. What size dynamo should I need to charge the cells and when necessary to run 10 to 15 lamps in the ordinary way?—J. T. S.

[58879.]—**Baking-powder Mill.**—I want to make one for my own use. Will some of our kind readers give a sketch, and some instructions as to fitting up the same, with the proper quantities of soda, acid, and turmeric to mix 28lb. of powder?—ANXIOUS.

[58880.]—**Algol.**—I have often looked for a minimum period of this star unsuccessfully; but fancied on the night of the 8th inst., at 10.20 p.m., it must be at a minimum. Will one of your astronomical readers say if this is correct? It clouded over almost instantly, so I could hardly be sure; but if this was its correct time, I can get a starting point for future observations, which I fail to find anywhere else. I tried to work it out from Proctor's "Half-hours" from data only reaching up as far as Jan., 1870: but did not, I fear, either work it correctly, or the period in the mean time may have changed enough to throw my calculation out.—AL FARD.

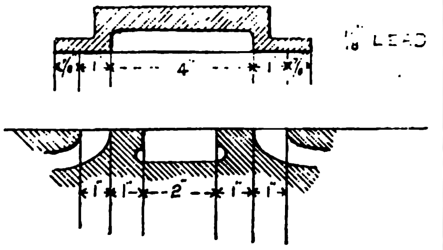
[58881.]—**Heating Apparatus.**—I intend fitting a heating apparatus into a dwelling house, three rooms each in first and second flat, with small malleable iron pipes: A 1in. malleable iron coil, 10in. dia., for boiler, and fit a 1in. pipe from it to top flat, where I mean to branch it into two ¾in. pipes, and run them along to one on top of the other through the rooms and downstairs with a gradual fall, until it goes back into the 1in. coil. An air-pipe, of course, will be at highest point in the pipes. Would any of our readers kindly inform me how to prevent in the above the rushing and cracking noise that is so often heard in this kind of heating apparatus?—PERSEVERANCE.

[58882.]—**Analysis of Steels for Wire.**—What effect has each of the following elements upon the quality of (1) Bessemer, (2) crucible steel, used for rolling rods for drawing into wire? Combined carbon, graphite, manganese, silicon, sulphur, phosphorus, and copper? What is the maximum percentage of these substances which should not be exceeded for good wire? What is meant by burnt billets, and how can this be detected by chemical analysis? What is the quickest and most satisfactory way of determining the amount of copper in a steel?—DAMASCUS.

[58883.]—**Incandescent Lamps—Resistances and Leclanches.**—I have a number of small incandescent lamps, which I wish to connect together; but as some are lower resistance than others, I find it impossible to do so without some kind of resistance being inserted. I should feel obliged if someone will inform me what number B.W.G. of German-silver wire I ought to use for this purpose? Which would take the least length of wire—thick, or thin? Also, would it be better to connect lamps in series, or in parallel arc? The power I am using is 18 of the new agglomerate Leclanchés, six-block form, quart cells. While mentioning these batteries, I should be pleased to know if the agglomerate blocks require renewing, or if only the zincs?—F. W. MUNCEY.

[58884.]—**Brass-Founding.**—To "J. H. S."—Many thanks for reply to my last query. I do not wish to sell the raw castings; but have simply to produce a good bearing metal for the dynamo journals regardless of cost, so please send me a good receipt for same. I am not my own master at present, and my orders are to make a good metal. Kindly send me a mixture for a yellow brass for turning binding screw for electrical work as well.—MOULDER.

[58885.]—**Slide Valves.**—Commencing with a single slide and port face as under, it is desired to apply a lower

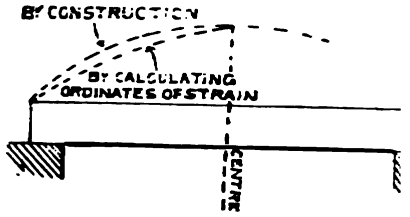


valve with expansion valve working on its back, which are to give periods of admission, expansion, release, compression, &c., of same duration as original single slide, and to give same lead of ⅛in. I presume that the eccentric for lower valve must be set ¼ rev. + lead in advance of crank? Also, given width of and distance between steam ports in back of lower valve, how is the length of expansion valve and throw of its eccentric determined, and how much in advance of crank must it be set? Kindly give it me arithmetically, as I cannot follow the algebraical solutions.—SHINY BOOTS.

[58886.]—**Reed Organ.**—I am about to co two-manual reed organ. I propose to make organ on the pressure system, like the harmon the swell organ on the exhaust system, as the organ. I do not want more than three or fo reeds on each organ, and two on the pedal organ not break the rows of reeds in the middle, as u let the stop-rod draw on the whole row, like organ. Will any reader advise me on this poi give me some hints on the selection of reeds, a and character. I can see my way clear to the m portion of the instrument, having had to repai instruments of both kinds; but have not much e with the reeds themselves. As I shall not have nor money to make more than one instrument, like it to be of the best description.—A. J. W.

[58887.]—**Coil.**—To J. BROWN, BELFAST.—I am [illegible] a spark coil as follows: iron core, 3in. long an [illegible]in. in diam.; primary, two layers of No. 20 silk wire. I am now putting on No. 40 silk-covered secondary, having put on the 6in. layer. I tried i get any length of spark; but could get nothing e actual contact. Would you kindly tell me if it is going on with it?—H. E. D.

[58888.]—**Strains on Girders.**—Can a reader give me an answer to the following—viz., and most practical method of drawing parabo uniformly distributed dead load on a girder supp each end? By construction, I get parabolic cu



high, when compared to that got by calculating or and drawing curve through extremities. I incl sketch. Also the method for ascertaining le flange-plates by means of parabola.—GYRTONA.

[58889.]—**Retort-Heating by Gas.**—I apply a continuous white heat to a vertical re diam. and 4ft. long, without bringing the fuel in contact with the retort, and will be glad if any readers will advise me as to the best arrangemen purpose. I have been thinking of fitting up an ap on the principle of Wilson's gas producer to c mixture of air and steam into nitrogen, hydro carbonic oxide, and to burn this gas with an air- the bottom of the retort. What I would lik particularly is the quantity of gas likely to be co the most effective way of arranging the pipes, and the air-blast will require to be heated or not? A mation will oblige—PHOSPHORIC.

[58890.]—**Spring Windlass.**—Is there such in the market as a small windlass, which can be le up and able to haul on a rope for a minute or t moment's notice, afterwards to be rewound at le crank or otherwise, two man-power, for two min H. L. W.

[58891.]—**Warped Harmonium Pan.**—W of our able correspondents help me out of my d anent my harmonium, a two-row one, which I bui six years ago? Last winter the pan got warped c out a ¼in. at the treble end. However, I let a sm of iron into frame of pan and got it down perfectly leve and pasted paper over all the joints, and the palle to close properly, as no reeds speak; but the strang is, at the beginning of the 8ft. treble the sound is and muffled however much I blow, and it loses fast when any of the stops are drawn. I may say I the pan, and, I think, from a good house. Shoul necessary to have a new one, which are best—the built ones?—ZETETIC.

[58892.]—**Legal.**—To MR. WETHERFIELD, OR —B. dying in India, 1869, leaves widow, son, and da both minors (intestate). The widow gives a fri power of attorney, who acts for her. After all effe sold and debts paid there is a surplus of £500 left The friend after marries the widow. Does it enti to claim for the keeping of the widow's children, they attain their majority, are they entitled to a s the £500 and interest thereon?—H. R. SIMMONDS, B

[58893.]—**Sand- and Glass-Paper Maki** What would be the probable cost of plant, &c., fo factory? There are no factories here, and an en consumption of sandpaper, which all comes from There would, therefore, be a very good sale here. I be obliged also for references to authors describ process.—LIEGE.

[58894.]—**Gramme Dynamo.**—Would Mr. or Mr. Eaves, give particulars as to size of a Gramme dynamo? Also amount and size (B.W wire? A sketch would much oblige—F. H. N.

[58895.]—**Chloride Battery.**—To MR. BOT I have put up a 4-celled chloride battery to work lamp. Elements: thick, well-amalgamated zinc porous cell, with ammonic chloride, and carbon b outer, packed with broken C in bichromate soluti parts; muriatic acid, one part. It worked well, 6·4 volts for a few days, then rapidly fell off. On ex tion, I find the zincs coated with a viscous paste, of them, the third one, too hot to hold in the ha which the paste came away readily. I was led to longer action without attention. Will Mr. [illegible] whom I have read in your paper that he [illegible] kinds of batteries, give his experience of th where I have erred in co[illegible]tion?—S[illegible]

[58896.]—**Wall Ti** [illegible] ve a wrought-iron wall tie [illegible] with the ends drawn do reader tell me a good plan of splitting and open- t is very tedious to do it on the anvil, besides being job? Also, I am charged 6s. per cwt. for having lvanised. Can I do it cheaper than this, or shall I ny fingers" if I try?—F. H.

.]—**Leyden Jars.**—To Mr. Wimshurst.— ou be so kind as to tell me how to test uncovered jars, as to proper quality glass? Would stoneware or Leyden jars? They would be much stronger.—

.]—**Me l Sifter.**—Will any reader give me a nake a simple meal sifter? I have a grist mill. with a 4-horse engine, and can produce splendid eal for whole-meal bread; but sometimes want a ite flour. The information of a machine for the ould be useful to many readers, as well as—A. E. B.

.]—**Grinding Lawn Mowers.**—I have been grinding lawn-mower knives by simply reversing ion and using emery and oil. I want to grind by fixing them in lathe (worked by steam), and a g grindstone on same, lathe working in reverse I also want to move grindstone along the whole of knives; but do not know how to proceed to do any reader enlighten me?—Lawn Mower.

.]—**Problem.**—Will some correspondent kindly a solution of following? Required to describe ouching given straight line at given point, and g circumference of given circle.—H. G. S.

l.]—**Double Electric Bells.**—From the ions given by Mr. R. T. Lewis, "Electrician," and n the last two volumes, I fitted up two bells in e arc. They do not ring at all well—that is, the re has to be set so close to the cores that the r is prevented striking the gong with a low. Can any of these gentlemen suggest a for this? Each bell rings perfectly when con- by itself to one cell; but when the two bells are d in multiple arc, and three cells are used, the roduced is not nearly what it should be, for the before mentioned—i.e., the armature having to be ghtly the distance it moves through upon attrac- very small. One bell has 10 ohms resistance, and er 16. The bell nearest to the push and battery s) rings worst. Would it be well to put in a coil close to the 10 ohms, one to make the current equally between the two? Any suggestions will oblige—Mem.Soc.Eng.

2.]—**Accumulators.**—To "P. C., Hornsey."— you in anticipation for the following information: always soldered the connections of my accumula- ith ordinary solder, not knowing they could be any other way, until I saw your letter in the " of this week, and, as you say, I find they corrode; s always the connection to the positive plate that e negative always remaining sound. Can you tell reason of this, and explain to me the process of ng," as mentioned by you?—Star.

3.]—**Turning.**—I have a small iron collar, about ., the inside of which has a hole bored through it. explain how I must chuck it to turn it so that an uantity of metal will be left all round. The hole at is not exactly in the centre of collar.—Chuck.

4.]—**Scraping.**—As I do not exactly understand meant by scraping the surface on metal, I shall be some kind reader will explain the modus operandi —Chuck.

5.]—**Centring.**—I shall be glad if some reader ase explain to me the best way of centring a round re bar of metal for the lathe. The name of a book fully explains to an amateur, who does not under- he way to go about such things as above, and other s connected with iron turning, will oblige—Chuck.

6.]—**Legal.**—Will some legal friend kindly reply rs" to the following queries? In front of a row of was made by the builder an ordinary passenger flagged ent, and at the end of the pavement he built a wall 4ft. nd as wide as the pavement, reaching from the end ast house to the high road, so that foot-passengers, traversed the length of the pavement are obliged s to the pavement on the other side of the high road. al authorities have never paved nor compensated ner for this footpath. Has the owner of the y a legal right to block the whole or part of this h during the day by exposing his goods for sale? strangers utilise this pavement, has the owner a o request them to desist, and that request failing to y effect, can he legally remove their goods off the ent into the high road? Also, if anyone stumbled rt themselves against the goods of the owner of the ty exposed whilst on the pavement, could an action for es be successfully prosecuted, or would they not be trespassers, and as such fail?—H. Ingham.

7.]—**Catgut.**—The best means of bleaching ntestines in the preparation of catgut, clock-gut, may say, by preparing them from fresh gut, either easts or sheep wraps, and by exposing them to SO_2 (by burning sulphur), we get a fair coloured gut; the intestines have remained exposed to the air ime before we get them, they go a rather bad colour, y a dark brown, instead of being a bright trans- gut, as racket-strings, &c. We also have to oil the trings, the oil we use at present being cotton-seed ich seems also to darken them. Could anyone nend a better bleaching oil?—F. E. Taylor.

8.]—**Cherry-Brandy Cordial.**—Will any kindly give me a good recipe for making the above ?—G. F. Neale.

9.]—**Storage Batteries.**—Will "Sigma," please here is any means of testing these batteries as to of time the charge in them will last after ave been used, or when they have only been partly d, so that one can say: I have so much charge in t will last so many hours? If there is any way, ny how.—[illegible] to Know.

machine, and to what extent? I may say the machine gives satisfactory results so far.—J. O. E.

[58911.]—**China Painting.**—Some time ago, I received a set of Mr. Chas. Neville's overglaze china colours. Will anyone kindly inform me if they can be fired in any ordinary china kiln? I understand that Mr. Neville only fires the work of his pupils.—Amateur.

[58912.]—**Microscope.**—Will any reader kindly give me a few hints how to use the polariser, selenites, &c., in conjunction with the microscope, as I think it would be very useful to others as well as myself.—Amateur Microscopist.

[58913.]—**Electrical Machine.**—I have a 12in. cylinder electric machine, and have been using a strip of oil silk attached to rubber; but after giving the cylinder about twenty turns, the oil silk so clings to the cylinder that it becomes almost impossible to move it. I replaced the oil silk with a strip of black silk, the result of which is that I get no spark at all; but on turning back the silk flap, I get about 1½ spark directly. Also, what should be the size of conductor for such a cylinder?—One Puzzled.

[58914.]—**Cataracts.**—Will some able correspondents kindly give me their opinion? I have just been discharged as an out-patient from the Leicester infirmary, being told I have peculiar sort of cataracts forming on the back of the eye; that an operation may be necessary, but not yet. What I wish to know is how long may this be first? I cannot see to read this when printed with such glasses as I have. Is it necessary that I should become still more dark before they can be removed? Could I, in the mean time obtain more powerful glasses to help me along, and would they be very expensive? I fear the operation will be a very painful one. Can it be safely performed under the influence of chloroform, or any other like agency? I should say I have used glasses to read with for about five years, and to work with about two years. Now I cannot do either; age, 59. Will anyone who has undergone such operation, kindly say with what result? Any other information will be very thankfully received by—Hinckley Man.

[58915.]—**Automatic Oil Feed.**—Will some friend give me the description of an automatic oil feeder for slides and cylinders of a high- and low-pressure steam engine?—Recent Subscriber.

[58916.]—**Splicing Wire Ropes.**—Can any reader give me some information on the splicing of wire ropes, and what length splice should be for ⅝in., ⅜in., and ¾in. diam.? I have tools for the purpose.—W. D. Hamilton.

[58917.]—**Silver Soldering.**—I have been trying to melt and cause to run soft silver solder, but have failed. I used a small spirit lamp and mouth blowpipe, with borax, or Baker's fluid. Is it that my heat is not sufficient, or what? Will "Os," or some other friend kindly assist me?—Mark.

[58918.]—**Tinning Small Brass Springs.**—Could anyone inform me a method of tinning small brass articles? I have heard of some method of boiling things, such as pins, &c., in some kind of salts and making them look almost like silver.—J. S.

[58919.]—**Discoloured Negatives.**—On looking over some old negatives, I found several that were stained yellow, which colour had, in some cases, deepened into brown. This, I believe, was due to imperfect fixing in the hypo. bath. The milder cases were cured by another submersion in hypo.; but this seemed to have no effect on the bad brown stains. I, therefore, tried a strong solution of cyanide of potassium, which has acted very satisfactorily, so far as clearing the negatives, several of which are now quite bright and clear, though they were at one time nearly useless. The plates were Pall Mall. I shall be much obliged if some of your readers, who are experts in photographic chemistry, will tell me whether the use of cyanide with gelatine plates is objectionable, and, if so, on what grounds? I am aware of its effect in reducing density. May plates be intensified with mercury after using it?—Bex.

[58920.]—**Frilling.**—There is one practical objection that I have found to the use of cyanide for cleaning off yellow stains, as above described, which is that the films are very likely to frill. This in the part of India where I am living is very objectionable, as we have often difficulty enough on that score with an average temperature of about 88°. I have lost several negatives from frilling, and shall be much obliged for any hints how it may be avoided. The only cure I have found so far is to put a coating of plain collodion over the plate before developing in very hot weather, as recommended by Capt. Abney. This effectually prevents frilling.—Bex.

[58921.]—**Tinted Paper.**—Is it possible to restore to original whiteness paper which has been tinted green or yellow?—Papyrus.

[58922.]—**Lap and Lead of Valve.**—I am making a small engine, 4in. dia. of cylinder, 8in. stroke, to drive a cupola fan. The ports are 2½in. by 5-16in. I have put ⅝in. lap, 1-16in. inside lap, and 1-16in. lead. Steam at 50lb. pressure, I calculate the cut-off at half the stroke. Will someone please inform me if I am right as to lap and lead?—A Young Beginner.

[58923.]—**Heating-Surface of Boilers.**—How is the heating surface of boilers known? Also the heating surface of a boiler 15ft. long, 5ft. dia., internal tube 2½ft. dia., with return flue; grate, size 48in. by 28in.—Ticker.

[58924.]—**Mersey Tunnel Engines.**—Can any of our railway correspondents kindly give dimensions and sketch of the locos. used for the Mersey tunnel traffic? I understand they are 8-wheeled tank engines and fitted with condensing apparatus.—W. H. Thurlow.

[58925.]—"**Half-hours with the Telescope.**"—I should be glad if some correspondent would kindly give his opinion on the following passage from the above work. In speaking of the object-glass it says: "But it is well to examine the quality of the glass as respects transparency and uniformity of texture. Bubbles, scratches, and other such defects are not very important, since they [illegible] not affect the distinctness of the field as they would in a [illegible] telescope—a little light is lost, and that is all." [illegible] in error? I always have understood that an [illegible] be of any use, must be free from all imper- [illegible] C. S.

[58926.]—**Gelatine for Plaster Casts.**—Could you inform me what the makers use to keep the gelatine moulds from softening on the face through the use of the plaster-of-Paris?—Melton.

[58927.]—**Astronomical.**—I have often observed, at times when both sun and moon have been visible, that the lighted side of the moon has not been turned directly towards the sun. Drawing a straight line across the sky between the two bodies, I always find that it strikes the illuminated portion of the moon, not centrally, but upon the lower quarter. Why is the lighted side of the moon not turned directly to the source of its illumination?—W. E. C.

[58928.]—**Dyeing Horn and Whalebone.**—How can I dye horn and whalebone black? Boiling in logwood and steeping in acetate of iron does not produce a permanent stain, as it comes off when polishing is done.—A. Cuter.

[58929.]—**Occultation of a Fixed Star.**—I observed the occultation of a fixed star by the moon on Feb. 14, 8.55 p.m., G.M.T., with 2¼in., power 60. It is not given in the list on p. 440. Can anyone give the name and magnitude?—G. B.

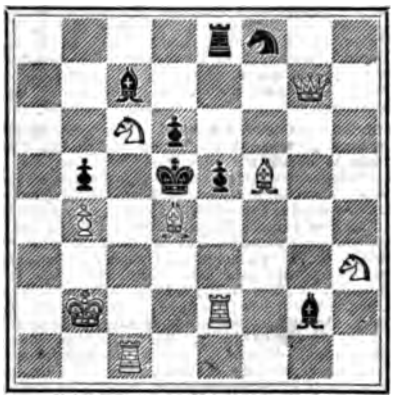
CHESS.

◆

All Communications for this department must be addressed to J. Pierce, Langley House, Dorking.

PROBLEM DCCCCLXXIX.—By W. Coates.

Black.



White. [9 + 8

White to play and mate in two moves.

Solution to 977.

White.	*Black.*
1. P takes P	1. Anything
2. Q, R, or P mates, or discovers mate	

(Three variations.)

NOTICES TO CORRESPONDENTS.

Correct solutions to 976, by T. H. Billington, J. J. Spence, G. T. Stringfellow, Hensing, Louis Morris, Isca; to 977, by Hensing, G. T. Stringfellow, Constance E. Younger, J. Ough, V. S. Pochin, E. J. Barnes, Harold, A. W. Orr, P. I., Isca, C. F., Schönewald, Louis Morris, L. S. N. O., A. W. Fisher, Avon, W. J. Carpenter, James Gillan and G. W. Middleton; to 978, by C. F. Schönewald, A Bolus, and Tommy Atkins.

J. P. T.—Thanks for the problem.

J. Hepworth Shaw.—A second solution to you problem by 1. Kt-Kt 6 (ch).

V. S. P.—P cannot Queen in 978, as K is at K 8.

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ANSWERS TO CORRESPONDENTS.

. *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand*, W.C.

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

. Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 17, and unacknowledged elsewhere:—

A. S. JONES.—W. A. Smith.—Gilford Mills Reading Society.—Anxious.—Russell Judd.—A Boy at Hastings.—Electric.—Tadpole.—Bit of Glass.—W. A. Farmer.—R. I. J.—Amateur.—Plumber.—W. F. Denning.—A. J. T.—Paper.—A. S.—Country Solicitor.—C. D. R.—J. C.—Doctor Medicinal.—E. P.—Fifer.—Alpha.—A Fellow of the Royal Astronomical Society.—Paul Ward.—W. G.—W. G. Thurlow.—W.—F. H. Wenham.—C. L.—C. C. Vevers.

OLDHAM, STEAMSHIP CAPTAIN. (Ten years at least, as he must go through the grades and pass the examinations to obtain the requisite certificates.)—A. KING. (Dissolve with spirit or acetic acid, and dilute with water.)—DUBLIN. (Better try some of the special preparations, or mix required colours with best hard copal varnish instead of oil and turps.)—INSTRUCTOR. (We do not know. Should apply to the publishers, Messrs. Spon, 125, Strand, W.C.)—R. R. (A solution of rubber in bisulphide of carbon; but the joint is not safe. When new, they are moulded in rings—not jointed.)—A SUBSCRIBER. (A sunspot, we suppose; they are not uncommon.)—OPHIUCUS. (Lampblack mixed with turpentine and just a little gold size to bind it. See p. 401, this volume, and the indices.)—PHOTOS. (They are used for different purposes. See any textbook—Abney's "Treatise on Photography," Longmans—for instance.)—AFFLICTED. (We do not know. Such a remark might have been put into the mouth of many of the characters delineated by Dickens.)—WONDERER. (If no will is left, the property must be divided equally amongst all the children.)—WILCOX. (Much depends on the work to be done. See indices. A one-horse gas-engine would do.)—IGNORANT. (270° to 300° Fahr. 2. Properly only sulphur or sulphide of antimony; but French chalk and other substances, including old vulcanised rubber, are frequently mixed with it. 3. There is petroleum naphtha and the mineral naphtha proper obtained from shale, &c.)—R. G. LEIGH. (Forwarded to Messrs. Taylor and Francis, Red Lion-court, Fleet-street, E.C., the publishers.)—R. A. P. (We have no tables for conversion at so high a temperature. Possibly some of the makers can oblige you.)—S. P. JACKSON. (The principles have been described many times. You want moulds and the prepared rubber, and then a vulcaniser. The rubber is cut out and mounted on suitable stems, which may be of wood, but preferably of metal.)—J. O. R. J. (Benzol is benzene, prepared from coal-tar, and its composition is C_6H_6. Its specific gravity is 89. Benzoline is obtained from crude petroleum, distilling off at 90 to 110° C. Its specific gravity is about 65, and it contains more H than benzene.)—H. W. S. (Several have been described in back numbers. Full details in No. 961, p. 567.)—X. Y. Z. (See p. 330, No. 1,029, for an answer to your queries about brass casting. 2. We answered the question about the stamps recently. Experience is the only guide.)—ORION. (Nobody knows. Sirius is not. Alpha Centauri is the nearest *fixed* star.)—E. (There is only one method. Apply the burnisher until you obtain the requisite polish.)—MANUFACTURER. (The best refined.)—HYDROSTATICS. (The head is the height of the column of water, and that is reckoned from both ends of the column. There are works which might be useful. Look in Spon's list, or in that issued by Crosby Lockwood and Co.)—T. J. STEVENS. (London is sufficient; but the full address of E. and F. N. Spon is 125, Strand, W.C.)—GRATIA. (All sorts of ways. Some take the wires through the gas-pipes. No practical work giving such details as you appear to want.)—ALLEY MARBLE. (Is it not explained in any textbook, and for special purposes hundreds of times in back volumes?)—E. A. M. (Cannot you refer to the *Nautical Almanac* of that date?)—LEARNER. (Spohr's School, Kayser's Studies, and then Hermann, all of Augener.)—AMATEUR ORGAN BUILDER. (Try Nos. 834, 836, 840, and look through the indices.)—VOLO NON VALEO. (Is there not sufficient information for you on p. 315? See the indices also.)—A. W. NURSE. (Apply to the Civil Service Commissioners, Cannon-row, S.W. Cassells publish a useful guide.)—LANCASHIRE. (Not for obtaining practical help, but for obtaining protection. "Inventions, and How to Patent Them," by T. Eustace Smith, London, Kelly.)—T. C. (Refer to the report of the case, as we believe the patent was not upheld, or could not be used to prevent others adopting similar devices.)—R. J. C. S. (We believe there are a few of that date, not many having been coined in that year; hence the success of the rumour or hoax.)—ANXIOUS. (Had you not better wait until the Act of Parliament is repealed before you drive your baker's cart with a gas-engine? 2. Is it not rather a simple sum; or can you not measure it with a 2ft. rule by plotting the diagram on a sheet of paper to a scale of one-tenth of an inch to the foot.)—GRIFF. HUGHES. (Use benzene.)—AN OLD SUBSCRIBER. ("Railways and Locomotives," by Barry and Bramwell; "Railway Appliances," by Barry; both published by Longmans. Maxton's "Drawing for Engineers," Crosby Lockwood and Co.; Bourne's "Catechism of the Steam Engine," Longmans; Rose's "Complete Practical Machinist," Sampson Low and Co.)—L. COSTELLO. (Carbon prints are permanent. Photos can be unmounted and put on new cards. See indices.)—ORPHEUS. (A gas-engine is best. Electricity can be used, but you must employ power to obtain that at a cheap rate, and you might with more advantage employ the power direct.)—LIEGE. (Ocarinas of the kind were exhibited at the Inventions by A. E. Mezzetti. Some even had tuning slides. 2. For information about boomerangs see p. 17, No. 911, and p. 121, No. 417.)—ZERO. (We believe not, as very small quantities answer. 2. Where do you find the term, and in what connection?)—J. B. (You will find one of the best—the Werdermann—illustrated in No. 822, p. 383. Two dozen Bunsens or their equivalent will be required.)—ICICLE. (Because it acts the part of a blanket, and keeps it from contact with the cold air.)—AMATEUR. (Apply to any of our advertisers who deal in photographic appliances.)—PAINT. (Use raw oil for such work. One of the silicate paints might be found useful; but what is the cause of the damp? See the indices of back volumes.)—E. BROWN. (No doubt some of our advertisers keep it.)—A YOUNG MECHANIC. (The question is very much like asking what sort of a house you should build to fit a door. See indices for instructions in making coils.)—W. STIRK. (If you cannot find one in Calvert's list, we cannot help you. Maxton's is a good one.)—TRIPLE VALVE. (Rather too much, and really not of much interest to anyone. About 2¼in. is the average. Cost can be obtained from the makers.)—AMATEUR. (If you had indicated what it is you want to silver, we could have pointed to a definite recipe; but as a matter of fact, there is something about glass-silvering in every volume—probably in this number.)—ONE IN TROUBLE. (Procure one of Mr. Fletcher's catalogues. He makes the most powerful gas blowpipes we know of. We suspect that your supply pipe is not big enough, as it is more heat that you want.)—BELL METAL. (Did you never see the papers we published on Pattern-Making in numbers between 938 and 1,010? They have been republished in book form by Crosby Lockwood and Co., Stationers' Hall-court, E.C., under the title of "Pattern-Making.")—BLACKSMITH. (Query too wide. See indices or ask specific questions, not for "full instructions." There is a great deal about it in back volumes.)—AMATEUR. (Queries unsuitable, or answered in recent numbers.)—BRASS-WORK. (See indices. Clean the metal thoroughly; make it rather too hot to hold, and then go over with the lacquer and soft brush, taking care not to go over same place twice. Practise on a piece of waste.)—C. A. PALMER. (We do not remember. 2. Probably potash, but may be caustic soda.)

Railway Safety and Economy.—Mr. C. P. Sandberg has prepared for the Institution of Civil Engineers a paper on "Rail Joints and Steel Rails" which calls attention to several important defects in the present systems of railway permanent way, and offers suggestions for their improvement. The first part of the paper deals with the fractures of rail joints in the United States, which have of late been very frequent, but hitherto no similar experience has occurred on European railways using the same form of rail joints. The author believes that in the United States both the rails and the rail joints are becoming too weak for the greatly increased traffic, although they may have been sufficient at the time the roads were laid down. The second part of the paper refers to the wear of steel rails in different countries, and the author shows that the English railways, in substituting steel for iron rails, increased the weight of the rails in order to meet the requirements of a heavier traffic, whereas on the Continent of Europe as well as in the United States of America this has not been done. The practical result of this state of things is found to be that English railways, so far as the permanent way is concerned, are the best in the world, and achieve a *maximum* of safety and economy in maintenence of road and rolling stock, notwithstanding that higher speeds are employed than in any other country, not to speak of the greater comfort of travelling on good roads. On the continent of Europe the flange rail generally employed is in many localities much too weak. Some of the Continental railways have quite as heavy traffic as the English trunk lines, and even heavier engines are employed; but the permanent way has by no means been strengthened to the same extent. The needs of international through traffic as now carried on demand, in the author's opinion, the use of heavier permanent way, and he calculates that to meet such requirements the flange rails used on Continental lines should, to compare with English lines in cost and efficiency, weigh not less than 100lb. per yard, instead of 70lb. to the yard, the weight of the rails now used. The author also believes that in many cases where steel have superseded wooden sleepers they have not been sufficiently strong, and that in order to effect the increased economy anticipated from their use they should be made considerably stronger than those hitherto laid down.

THE Manchester Ship Canal Company has lodged the £20,000 it was required by its Act to deposit in respect to the undertaking of the Bridgwater Navigation.

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Holloway's Ointment and Pills.—Coughs, Influenza.—The soothing properties of these medicaments render them well worthy of trial in all such diseases. In common colds and influenza the Pills taken internally and the Ointment rubbed externally are exceedingly efficacious. When influenza is epidemic this treatment is easiest, safest, and surest.—[ADVT.]

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Half-Horse **Engine**, double oscillating cylinders on horizontal bed, in good condition, complete, with governors. What offers?—JOURNET, 194, Gt. Portland-street.

Tuerk's **Turbine**, new, only once used, three-quarter inch supply; also Water Engine, [illegible] pattern, cost [illegible], good order, 1in. connection. Exchange for small Paper-Cutting Machine or one-man Gas Engine. Would give balance cash.—J. [illegible], Printer, Elie, Fifeshire.

Strong **Copper Boiler**, horizontal, almost new, [illegible] 7, with stand and lamp. What offers in Lathe way?—[illegible], Belfast.

Smith's wrought **Tue Iron** and a lot of Tools. What offers?—RIGBY SMITH, Fazakerley-street, Chorley.

Instruments or cash offered for "**Engineering**," any volumes; "Ewart's Agriculturist's Assistant," "Rivington's Building Construction," any volumes.—Z. C., 62, Loddiges-road, Hackney, London.

28in. Iron **Driving Wheel**, treadle, and [illegible] circular saw bench; 6 Volumes "Cassell's Popular Educator," [illegible] bound. Exchange for double-barrel gun.—C. ANAKIN, [illegible], Liverpool.

Silver **English Lever**, jewelled and capped, perfect condition, hall-marked case, cost £7, for 3in. foot lathe, iron bed, and few tools.—E. SMITH, 6, Berne-terrace, Clive Vale, Hastings.

23 volumes "**Encyclopædia Britannica**," first class condition, for Microscope, old China, or small piece Artistic Furniture.—SCOTT, [illegible], Queen's-crescent, Haverstock-hill.

Electric Battery, fumeless, runs three 5 c.p. lamps; three 5-c.p. Edison Swan Lamps, switch, wire, spare set of zincs, supply of chemicals.

Induction Coil, cost 30s., 2 bichromate [illegible] vacuum tubes, includ[illegible] double do., pair of handles, large glass cylinder, [illegible]

Sundries, [illegible] Terminals, Wire, Mer[illegible] [illegible] WAY, 19, South Parade, [illegible]

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, FEBRUARY 26, 1886.

MICROSCOPICAL—CENTRAL v. OBLIQUE LIGHT.

By EDWARD M. NELSON.

IT will be acknowledged a wise plan, when seeking for the interpretation of the structure of the Diatomaceæ, to select those specimens for examination which have the coarsest structure. Some observers, working on these lines, have taken the coarse areolation of the *Isthmia nervosa*, Coscinodiscus, and the hexagonal structure of Triceratium, &c., as a basis for argument. This will not hold good, as these diatoms have a delicate membrane in their coarse areolations possessing minute structure similar in appearance to Pleurosigma, Navicula, and the like; moreover, there is no ground for believing that the delicate structure is similar to the coarse structure. Sections of diatoms have been cut, with a view to show the nature of their structure. This plan has succeeded as far as the coarse structure is concerned, but nothing has been seen of the delicate structure. As great difficulties have presented themselves with regard to the interpretation of this minute structure, we shall not gain much by cutting it in half, and making it still more minute. Not so, however, with the coarse structure, for when it is cut in half it is still, comparatively speaking, a large object.

Some diatoms have, therefore, both coarse and fine structure; but others only the fine. Of these last, those possessing the coarsest of the fine structure known are the *Pleurosigma formosum*, and the *Tryblionella punctata* (*Nitzschia punctata*). Taking the best known of these, the *P. formosum*, and looking up the literature of the subject, we shall find its structure designated as striæ, lozenges, marbles, areolæ, hemispherules, punctæ, pearls, beads, &c., which shows the amount of uncertainty which prevails as to its true structure. One observer will be confident that the so-called markings are hemispherules, and that the fracture passes between them. Another, that they are perforations, with the fracture passing through them. That there are such contrary opinions is due to the difficulty of ascertaining the correct adjustment and focus of the objective. With one adjustment and one focus, you get the hemispherules or "white dot," and fracture between. With another focus and adjustment, the perforations or "black dot," with fracture through. Hence it is that the question turns on: What is adjustment? What is focus?

Some years ago, while giving special attention to *P. formosum*, I discovered that when using the "black-dot" adjustment, I could see differences between some individual dots, which could not be seen with the "white-dot" adjustment. The difference noted, in the first instance, being that one or two of the "black dots" were paler than the rest. This conclusively proved, to my mind, that the "white dot" was a spurious image. Having carefully marked this valve, and that portion of it where the differences occurred, and having worked, off and on, at that place upwards of five years, I now see a great deal more detail in that same spot, which measures about 1-2000in. square, than formerly. The "black dot" in those days was made by using a lamp with a bull's eye, centred, and focussed to the flame, sending parallel rays on the plane mirror, thence to the condenser, which was [illegible] aphragm, with [illegible]; and, [illegible] was [illegible] was [illegible] of light produced a dark and slightly chocolate-coloured ball, with a bright dot in the centre of it. I think it has been termed a marble. These "black dots" were, as I said before, not all alike. I noticed that one or two were pale, fogged, or dim. It was some time before any further progress was made, for it was not until I recognised the value of illumination by a large axial cone, and applied it to this diatom, that any more detail became apparent. Such a change demands time. One does not readily lay aside their sharp critical picture of "black dots," and put a pale, milky one, almost drowned in light, in its place. One's pet water immersion utterly breaks down under the large axial cone. The eye requires to be trained to that pale, milky picture flooded with light; but when it has been so educated, it will see more detail in the milky picture than it could in the sharper one. Many a time have I tried the large axial cone on the *P. formosum* merely to lay it aside in disgust. It was only after I had been convinced that the large axial cone was right that I determined to accept the picture, milky or otherwise. Before long I was rewarded by seeing the marbles, "black dots," turn into perforations, the one or two dim marbles, spoken of above, being caused by the perforations being blocked up or coated over with silex (Fig. 5, A). This was a great advance; but by increasing the angle of the axial cone, I afterwards discovered a spicule of silex sticking into one of the perforations (Fig. 5, B). Things remained in this state for upwards of three years; but latterly I have been using a still larger axial cone for illumination, which has revealed a very minute bar of silex stretching across one of the perforations (Fig. 5, C). This is by far the most delicate object I have ever seen with the microscope. It is impossible to measure it by any direct method; the only way to get at its size is by estimation. The size of the perforation, which has the bar across it, as measured by a wire micrometer, is 1-45500in. The accuracy of this is doubtful, as it is difficult to see the edges of the hole on account of the wires. The perforations, however, count 24,000 per inch across the valve, and I estimate the diameter of the hole to equal that of the intervening silex. Therefore, the diameter of a single perforation would be 1-48000in. The thickness of the bar has been estimated as 1-5th of the perforation, so if this last measure is correct it would give 1-240,000in. as the thickness of the bar. If we take the largest measurement—viz., that made by the wire micrometer for the diameter of the perforation, we get 1-227000in. for the thickness of the bar. The inclosed drawing is to the scale of 9·6in. to 1-1000in., and there the bar looks a good deal thicker in proportion to the diameter of the perforation than it does under the microscope, which would indicate that the real size of the bar was less than the measurements given above.

A friend, who has considerable experience in these matters, agrees with me in fixing the size of the perforation at 1-48000in. He estimates the size of the bar as between 1-7th and 1-8th of the diam. of the hole. This gives a value of 1-360000in. for the thickness of the bar. I myself think this is near the truth.

Until I had seen this object, I was not aware of the extreme sensitiveness of the focus of the oil 1-12th N.A. 1·43. An alteration in focus, which on an ordinary object would have no appreciable effect, obliterates it. This fact is of great value, as it enables us to determine what is focus and what is adjustment. You may be certain that when that bar is visible, you are not focussing and adjusting on a spectral image.

From a brass-and-glass point of view, it is important, as assisting in testing objectives. I[illegible] o shows the immense superiority of [illegible] over oblique light.

It also refutes the statement that nothing can be known about the structure of the diatomaceæ, because all the diffraction spectra are not admitted; for it shows that something can be known of the structure of the *P. formosum*, because some of the diffraction spectra are admitted. It is curious to note how those who refuse to know anything about the structure of the diatomaceæ, because all the diffraction spectra are not taken up, affirm that a German student, who had never seen a diatom, "worked out the purely mathematical result of the interference of the six spectra of *P. angulatum*." For an account of which, with figure, see *R. M. J.*

The purely mathematical result is a very simple business. The diffraction spectra are chromatic images of the source of light arranged in a pattern similar to the pattern which causes the interference, the mathematical connection between the spectra and the pattern being in the size of the interspace and the angular divergence of the spectra from the dioptric beam. All that the German student *could* do was to say that the source of light was a disc, that the pattern causing the interference was similar to the pattern of the diffraction spectra—namely, quincunx—and that if the angular divergence of the spectra from the dioptric beam were given, the size of the interspaces could be found out. Instead of which, he drew a fantastic picture (given in *R.M.J.*), for which there was no warrant from the data given. As this picture had been drawn from purely mathematical investigation, of course the markings must be there, although no one had ever seen them. The angulatum was re-examined, but with a stop at the back of the objective (!) and the small secondary markings predicted by the German student were seen. The whole affair was given out as a microscopic edition of the discovery of the planet Neptune (!)

The explanation why the secondary markings were seen with the objective with a stop at its back is, that the stop cut out the diffraction spectra of the first order, those of the second order being admitted through the zone outside the stop: a spectral image having double markings was consequently formed. So much was made of the idea that the microscopic image could be interpreted from the diffraction spectra, that you were advised to get the eyepiece made into a telescope for the purpose of examining them. On the other hand, you were told it was perfectly useless to look at a diatom except with a homogeneous immersion objective of 140° aperture, in a medium of refractive index 5·0.

It is a great pity that so much prominence should have been given to what may be called the fanciful side of that magnificent diffraction theory, to the neglect of its more practical bearing. The great moral (if I may so say) which is to be learned from the whole thing is, to my mind, just this: that it is a highly dangerous thing to tamper with the diffraction spectra, for, if you do, you are sure to get a false image. There are two ways of tampering with the diffraction spectra. First, by what may be termed the direct method—viz., by stops at the back of the objective; secondly, by the indirect method—viz., by oblique illumination—i.e., by one or two oblique beams. If, instead of forcing on the diffraction theory fanciful interpretations, which it will not bear, attention were given to finding out how wide-spreading spectra might be compressed within the range of the object-glass, much more good would be done to the cause of microscopy.

Fig. 1 shows the diffraction spectra of *P. angulatum* of average fineness, 48,000 per inch. The inner circle represents the back of an objective of N.A. ·88, the next circle one of N.A. 1·76, the outer one of N.A. 3·52. The diffraction spectra represented [illegible] presumed to be propagated by an axial cone of infinitely small angle. The dioptric beam is marked in each case by a cross. Fig. 2 shows the diffraction spectra in section, and is the drawing I gave on p. 517, No. 986, applied to *P. angulatum*. B is a valve of *P. angulatum* on slide H H; A B an axial illuminating cone of infinitely small angle; C the dioptric beam; D D′ the diffraction spectra of the first order, making angles of 60° with the dioptric beam. You will notice that the diffraction spectra of the second order are not originated in air.

FIG. 1.

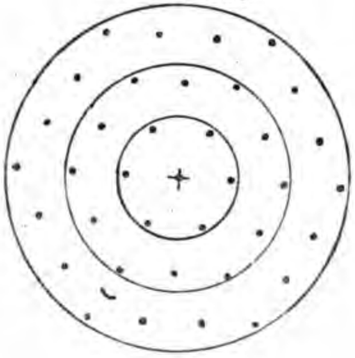
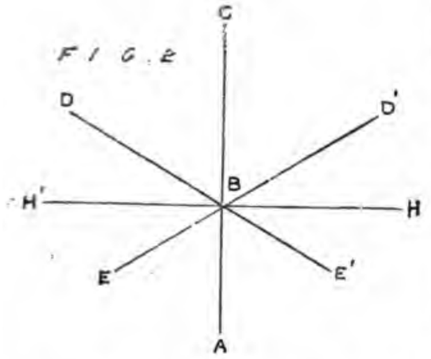
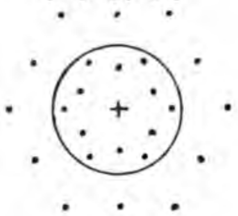


FIG. 2.



If the axial cone of infinitely small angle is now replaced by a cone E B E′ of 120°, the diffraction spectra of the first order are bent up to C, and the diffraction spectra of the second order, which were not originated before, now take the place previously occupied by those of the first order. Fig. 3 shows the same thing on plan. The circle represents the back lens of an objective of ·88 N.A. The six diffraction spectra of the first order, under the influence of the 120° axial cone, are now bent up to the cross, and the outlying diffraction spectra of the second order are brought within the grip of the lens.

FIG. 3.



There are, therefore, six of the first order at the cross, and 12 of the second order—18 in all—brought within the grip of a lens of ·88 N.A.; and mark, these are *all* symmetrically placed with regard to the dioptric beam. Compare this with the oblique method, Fig. 4. With an oblique beam, inclined 60° to the optic axis, you get six diffraction spectra, three of the first order, and three of the second, *not* symmetrically placed with regard to the dioptric beam.

FIG. 4.

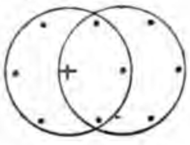
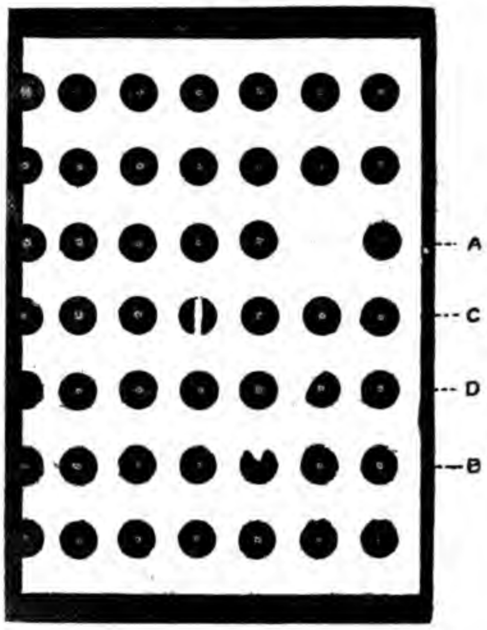


FIG. 5.



To return to the resolution of the bar in the perforation of the *P. formosum*, it is important, from a natural-history point of view, as a key to the structure of the diatomaceæ. It shows that there are no such things as markings on the diatomaceæ, and that these so-called markings are, in reality, the structure of the diatomaceæ. You cannot call the perforations in perforated cardboard the markings on the cardboard; neither, as I said at the Q.M.C. when reading a paper on this subject, can you call ribs the markings on a skeleton.

I look upon this delicate perforated silicious membrane as the essential structure of the diatomaceæ, which is intimately connected with the life of the organism.

Diatoms are naturally divided into two great groups—viz., those which have only one structure, such as Pleurosigma, Navicula, Schizonema, Nitzschia, &c.; and those which have two, such as Actinoptychus, Coscinodiscus, Isthmia, Triceratium, &c.

In Navicula, Pleurosigma, &c., I regard the median line as a girder to strengthen the delicate perforated membrane.

In the other kind, Coscinodiscus, Triceratium, I regard the coarse areolation as strengthening material to support the delicate membrane inside those areolations. The diatoms, moreover, in this latter class are, for the most part, larger than those in the other class.

Let us take a very large diatom—viz., the *Isthmia nervosa;* in this we shall find three structures: 1, the delicate perforated membrane; 2, the coarsely areolated structure supporting it; and 3, the massive girder work strengthening the whole. Look at the girder work in Arachnoidiscus and Heliopelta. In the former the perforated membrane is coarse, in the latter it is finer, and one often sees it detached from its girder work. In all these it would appear that it is the delicate perforated membrane that, somehow or other, is of primary importance to the organism, and the coarse areolation supports and protects it. In some diatoms, such as Melosira, the perforated membrane is on the edge of the disc, and not on the disc itself. I regard a diatom, such as the *A. pellucida*, as similar in structure to the *N. cuspidata*; but the resolution of it is beyond the powers of the microscope at present. I do not consider that the manufacture of striæ on the *A. pellucida* is of any service either to "microscopy" or to "diatomy." In conclusion, this subject has an important practical application. It shows one direction in which microscopy may be improved. We want less spherical aberration in our objectives, and we want condensers that will give us illuminating cones of larger angle. I am aware that condensers of large angular aperture are to be obtained; but they have so much spherical aberration, that the cones proceeding from them cannot be termed solid, and on that account they are not suitable for the kind of illumination advocated in this paper. If you focus the rays forming the sides of a large-angled cone on an object, and if the condenser from which that cone proceeds has spherical aberration, then the rays forming the central portion of the cone will not be in focus, and therefore will be, so to speak, diluted in power. I should like to see made an achromatic homogeneous immersion condenser of, say, N.A. 1·25 (we must be moderate in our demands at first) with no more spherical aberration than is found in, what we should call, a fairly well-corrected objective. In order that such a condenser should have fair play, I should like to see all slips of a uniform thickness. The condenser might, with advantage, have a correction collar to correct the aberration produced by the varying thickness of the mounting medium.

AN OLD BRASS CLOCK.

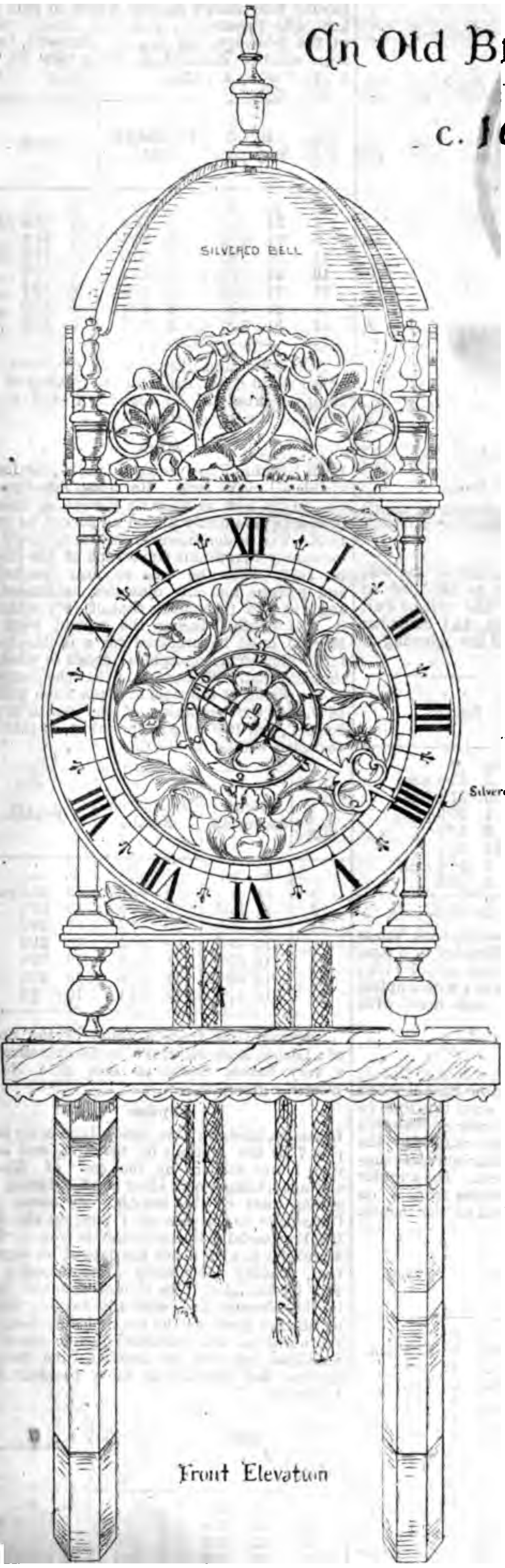
THE clock which we illustrate to-day is of that type known from its shape as a Bell Lantern, or Bird Cage clock; its date, judging from other dated examples, is between 1600 and 1650. The case is of polished and engraved brass, with the exception of the dial, hour hand, and bell, which are silvered. The works are a 30-hour movement, having originally had a vertical escapement, but now a recoil escapement with anchor pallets, driven by weights, and striking on a powerful bell. At one time an alarum was attached, but in course of time has become missing. This clock is now in the possession of Mr. G. H. Newton, of Clifton. The bracket is of simple design in oak, now black with age.

W. N.

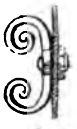
THE
Exhibiti
Rowan
Clemins

An Old Brass Clock

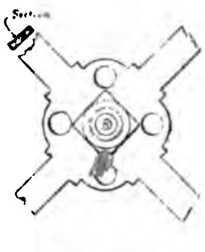
c. 1630



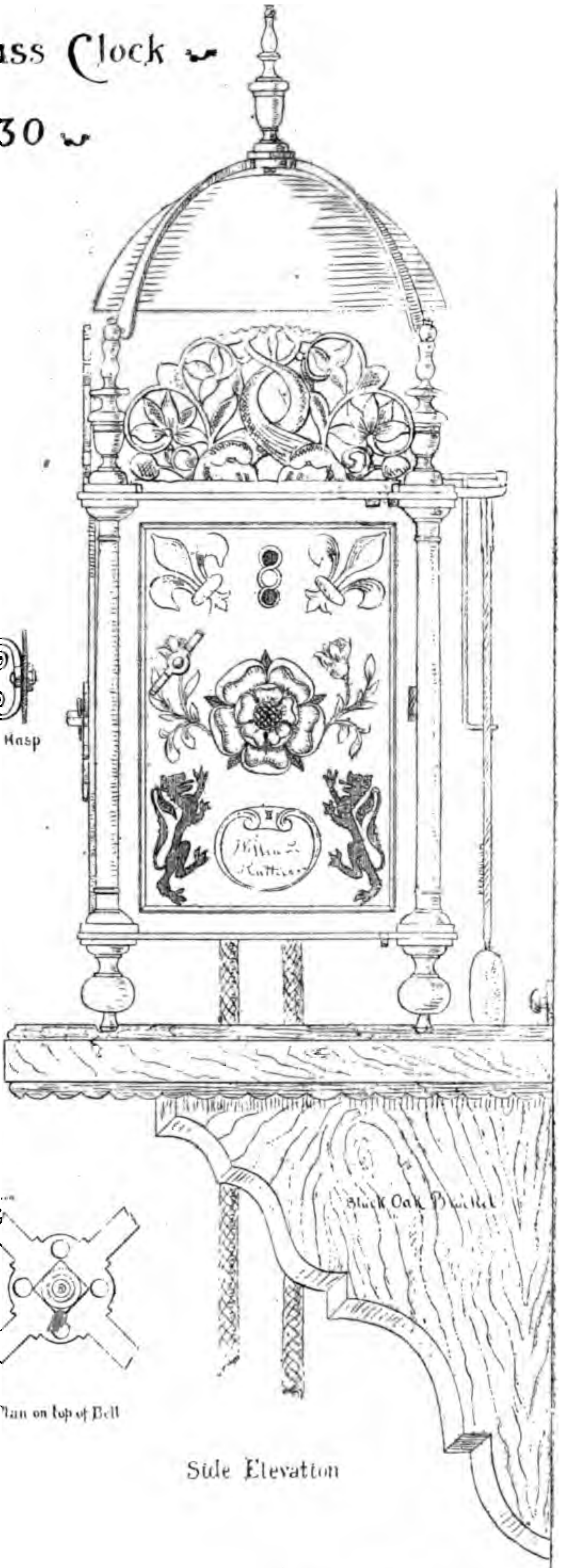
Front Elevation



The Hasp



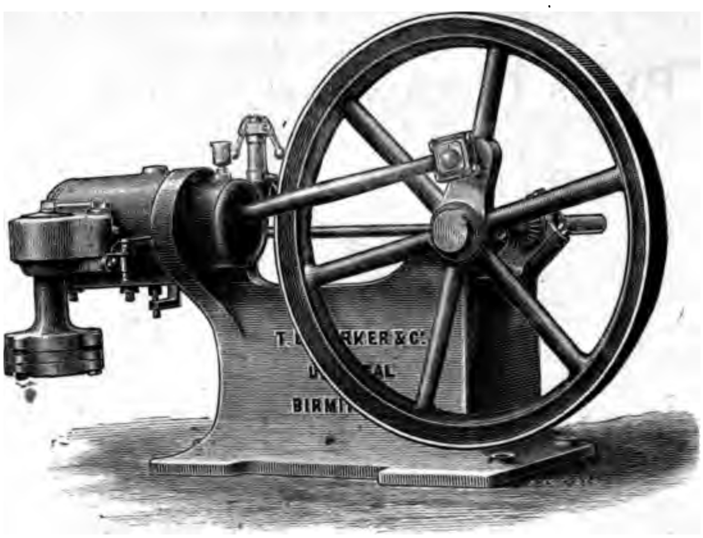
Plan on top of Bell



Side Elevation

0 1 2 3 4 5 6 Inches

MEASURED & DRAWN BY
William Newton
Jan 1886



BARKER'S PATENT "UNIVERSAL" GAS-ENGINE.

WE illustrate herewith one of the patent "Universal" gas-engines made by T. B. Barker and Co., of Scholefield-street, Birmingham, the special recommendation of which is that they are sold at a low price. It is also claimed for them that they can be trusted to run well under disadvantages of dirt, inattention, and exposure; and instances can be quoted in which they have been at work for twelve months without cleaning. They are not silent, it is true; but, as the makers point out, that is a small matter when the machines to be driven make, as a rule, considerably more noise than the engine. A one horse-power nominal costs at the works £39, and the approximate expenditure for gas is given as 1¾d. per hour, the cost for the 2-horse-power nominal being put down as 2¾d. All engines of the kind are capable of exerting more than their nominal power, and a point put prominently forward by Messrs. Barker and Co. is that it is economy to pay a little more for gas, and save a lump sum in the original cost, the interest of which will alone pay a "very considerable gas bill."

Gas engines are rapidly driving small steam-engines out of the workshop, for the simple reason that they are quite as cheap and as economical in running, while free from the risk which must always attend the use of a boiler.

ASTRONOMICAL NOTES FOR MARCH, 1886.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	0 12 29·82 PM	22 49 21	7 29 52 S.	22 36 51·44
6	0 11 24·40 „	23 7 59	5 34 34 „	22 56 34·20
11	0 10 8·70 „	23 26 26	3 37 24 „	23 16 16·96
16	0 8 44·86 „	23 44 45	1 39 11 „	23 35 59·72
21	0 7 15·39 „	0 2 58	0 19 18 N.	23 55 42·48
26	0 5 43·41 „	0 21 9	2 17 20 „	0 15 25·24
31	0 4 11·68 „	0 39 20	4 14 12 „	0 35 8·00

The Method of finding the Sidereal Time at Mean Moon at any other Station is described on p. 353.

At 4 p.m., on March 20th, the Sun is said technically to enter Aries, and Spring is supposed to begin. As is well known, he is at this instant on the intersection of the terrestrial Equator with the Ecliptic, in the Southern part of the constellation Pisces. This, too, is the theoretical date of the Equinox; but the day and night will be more nearly of equal lengths in London two days previously.

The Zodiacal Light is now visible every clear evening, in the West.

Spots, isolated and in groups, faculæ, &c., continue to appear at intervals in the Sun's face.

An Eclipse of the Sun,

Absolutely invisible in Great Britain on March 5, demands no further notice here.

The Moon

Is New at 10h. 4·3m. on the night of the 5th, and enters her First Quarter on the 13th at 1h. 17·2m. in the afternoon. She will be Full at 4h. 36·7m. a.m. on the 20th, and enter her Last Quarter at 10h. 44·2m. on the morning of the 27th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	25·4	8 53·0 a.m.
6	0·6	0 37·1 p.m.
11	5·6	4 29·3 „
16	10·6	9 10·9 „
21	15·6	*12 53·2 „
26	20·6	5 10·4 a.m.
31	25·6	9 5·6 „

*After Midnight on the 20th.

The Moon will be in Conjunction with Venus at 10 p.m. on the 3rd; with Mercury at 6 p.m. on the 6th; with Saturn at 4 a.m. on the 14th; with Mars at 2 a.m. on the 19th; with Jupiter at 8 a.m. on the 20th; and, once more with Venus at 8 p.m. on the 31st.

Mercury

Is an Evening Star during the whole of March, attaining his greatest elongation East (18° 31′) at 2 a.m. on the 22nd. At and after this time he is very fairly placed for the observer, and towards the end of the month may be caught by the naked eye glittering over the horizon after sunset, a little to the North of West. The angular diameter of the planet increases from 5″ on March the 1st to 9·8″ by the end of the month.

Day of Month.	Right Ascension.	Declination.	Souths.
	h. m.	° ′	h. m.
1	23 7·8	7 8·4 S.	0 30·8 p.m.
6	23 42·5	2 42·3 „	0 45·8 „
11	0 15·7	1 53·6 N.	0 59·3 „
16	0 45·3	6 12·1 „	1 9·1 „
21	1 8·0	9 39·7 „	1 12·1 „
26	1 21·1	11 48·1 „	1 5·4 „
31	1 23·3	12 20·7 „	0 48·0 „

Hence it will be seen that Mercury, starting from a point on the confines of Aquarius and Pisces, will travel over a good deal of the latter constellation. His path, however, lies through a barren region, and he will approach no conspicuous stars.

Venus

Is a Morning Star all through March, and is a dazzling object in the East before sunrise towards the end of the Month. She is at her greatest brilliancy on the 25th, and about this date, between 9 and 10 a.m., may be detected with ease with the naked eye in the sunlit anyone who knows exactly where to l her. She presents an exquisite cresce in the telescope, her angular diamete ever, steadily diminishing from 56·6 1st to 35·8″ by the 31st.

Day of Month.	Right Ascension.	Declination South.	Sou
	h. m.	° ′	h. m
1	21 35·3	5 32·4	10 58
6	21 30·4	6 36·1	10 34
11	21 29·5	7 30·8	10 13
16	21 32·4	8 12·1	9 56
21	21 38·8	8 37·5	9 43
26	21 48·1	8 46·1	9 33
31	21 59·7	8 38·1	9 25

This pendulum-like path is descri tween α and β Aquarii. On the last da Month Venus will be between 7° an South of the former star.

Mars

Is an Evening Star; being, in fact, pr visible all night long. He comes into tion to the Sun at Noon on the 6th, so is now as favourably placed as he can 1888. The reader, however, who remen extremely favourable Opposition of th in 1877, when he was so near p and perigee, and his diameter subte angle of 29·4″ (as against that of 16·6 it will exhibit during the second March), must be prepared for a deci ferior view of Areographical detail to then enjoyed. We have said that the of the planet at the time of Oppositio 16·6″. At the beginning of the Mont be 16·4″, and 16·0″ at the end of it, so variation will be insensible.

Day of Month.	Right Ascension.	Declination North.	Sou
	h. m.	° ′	h. m
1	11 21·1	8 40·8	12 42
6	11 13·7	9 23·8	12 15
11	11 6·3	10 4·4	11 48
16	10 59·1	10 40·5	11 21
21	10 52·5	11 10·6	10 55
26	10 46·7	11 33·6	10 29
31	10 41·9	11 49·1	10 5

Starting thus from a point to the of ι Leonis, Mars will travel backwards t a very barren region in Leo, in a Westerly direction.

Jupiter

Is also an Evening Star, rising soon aft past 7 in the evening of the first, ar two hours sooner by the end of and not setting until after sunrise dur greater part of the month. He com Opposition to the Sun at 7 p.m. on t His Equatorial diameter increases from March 1st to 41·4″ about the date of his tion, waning absolutely impercepti 41·2″ by the 31st. He is now a noble in the telescope, and with the varying of his disc produced by his rapid rotat the numerous and beautiful phenomen Satellites, presents an inexhaustible interest and pleasure to every posses telescope.

Day of Month.	Right Ascension.	Declination.	Sou
	h. m.	° ′	h. m
1	12 15·8	0 1·2 S.	1 45
6	12 13·8	0 13·0 N.	1 19
11	12 11·1	0 30·9 „	12 [illegible]
16	12 8·8	0 46·3 „	12 [illegible]
21	12 6·4	1 1·9 „	12 [illegible]
26	12 4·1	1 17·2 „	1[illegible]
31	12 1[illegible]	[illegible] „	[illegible]

It will b that Jupit

Occultations of (and a near approach to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
8	B.A.C. 408	6½	†6 11 p.m.	S. by E.	19	54				
9	64 Ceti	6	5 31 „	Dark	89	118	6 38 p.m.	Bright	306	342
9	ι Ceti	4½	6 35 „	Dark	120	156	7 39 „	Bright	272	310
13	130 Tauri	6	4 49 „	Dark	114	91	6 1 „	Bright	257	253
13	B.A.C. 1930	6½	12 40 „	Dark	112	152	1 28 a.m.	Bright	242	279
15	1 Cancri	6	10 15 „	Dark	43	70	11 12 p.m.	Bright	292	327
18	37 Sextantis	6	5 25 „	Dark	50	11	6 17 „	Bright	278	240
20	B.A.C. 4043	6½	1 38 a.m.	Dark*	101	119	2 34 a.m.	Bright	212	239
23	γ Libræ	4½	11 19 p.m.	Bright	126	93	11 58 p.m.	Dark	197	167
24	η Libræ	6	4 18 a.m.	Bright	68	75	5 34 a.m.	Dark	265	285

† A near approach. * But apparently bright

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	I	Sh I	2	50	a.m.	10	*II*	*Sh I*	7	30	p.m.	18	I	Tr E	9	55	p.m.
1	I	Tr I	3	20	„	10	II	Tr I	8	4	„	19	*I*	*Oc R*	7	8	„
1	I	Sh E	5	7	„	10	I	Ec D	8	30	17„	19	II	Oc R	7	36	„
1	I	Tr E	5	35	„	10	III	Oc R	9	58	„	20	*IV*	*Sh I*	5	44	a.m.
1	II	Ec D	10	14	7$_{PM}$	10	II	Sh E	10	18	„	23	*I*	*Oc D*	5	45	„
1	I	Ec D	12	8	28„	10	II	Tr E	10	49	„	24	I	Tr I	2	59	„
2	II	Oc R	1	56	a.m.	10	I	Oc R	10	59	„	24	I	Sh I	3	1	„
2	I	Oc R	2	49	„	11	I	Sh E	7	58	„	24	*I*	*Tr E*	5	13	„
2	I	Sh I	9	19	p.m.	11	I	Tr E	8	11	„	24	*I*	*Sh E*	5	18	„
2	I	Tr I	9	46	„	11	IV	Ec D	10	45	2„	24	I	Oc D	12	11	p.m.
2	I	Sh E	11	35	„	11	IV	Ec R	12	28	45„	24	II	Tr I	12	29	„
2	I	Tr E	12	1	„	16	II	Ec D	3	27	2$_{AM}$	24	II	Sh I	12	37	„
3	*II*	*Sh E*	7	45	„	16	I	Ec D	3	55	28„	25	III	Oc D	1	47	a.m.
3	II	Tr E	8	35	„	17	I	Sh I	1	7	„	25	I	Ec R	2	28	37„
3	I	Oc R	9	15	„	17	I	Tr I	1	15	„	25	II	Tr E	3	14	„
7	III	Sh I	3	55	a.m.	17	I	Sh E	3	23	„	25	II	Sh E	3	25	„
7	III	Tr I	5	29	„	17	I	Tr E	3	29	„	25	III	Ec R	4	53	15„
7	*II*	*Sh I*	6	13	„	17	II	Sh I	10	3	p.m.	25	I	Tr I	9	25	p.m.
8	I	Sh I	4	44	„	17	III	Ec D	10	6	43„	25	I	Sh I	9	30	„
8	I	Tr I	5	4	„	17	II	Tr I	10	16	„	25	I	Tr E	11	40	„
8	II	Ec D	12	50	30$_{PM}$	17	I	Ec D	10	23	52„	25	I	Sh E	11	46	„
9	I	Ec D	2	1	55$_{AM}$	17	I	Oc R	12	42	„	26	*I*	*Oc D*	6	37	„
9	II	Oc R	4	13	„	17	II	Sh E	12	52	„	26	*II*	*Oc D*	7	7	„
9	I	Oc R	4	33	„	18	II	Tr E	1	1	a.m.	26	I	Ec R	8	57	2„
9	I	Sh I	11	13	p.m.	18	III	Oc R	1	14	„	26	II	Ec R	10	6	9„
9	I	Tr I	11	31	„	18	I	Sh I	7	36	p.m.	28	*III*	*Sh E*	6	50	„
10	I	Sh E	1	29	a.m.	18	I	Tr I	7	40	„	31	I	Tr I	4	43	a.m.
10	I	Tr E	1	45	„	18	I	Sh E	9	52	„	31	*I*	*Sh I*	4	56	„

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight, or by Jupiter's proximity to the horizon.

Approximate Times of the Greatest Eastern Elongations of Saturn's Five Inner Satellites.

Day of Month	Name of Satellite.	Hour.	Day of Month	Name of Satellite.	Hour.	Day of Month	Name of Satellite.	Hour.
1	Tethys	9·4 p.m.	11	Mimas	12·2 p.m.	23	Rhea	1·9 a.m.
2	Dione	3·6 a.m.	13	Dione	2·4 a.m.	23	Enceladus	2·8 „
3	Tethys	6·8 p.m.	14	Rhea	1·0 „	24	Dione	1·1 „
3	Enceladus	10·0 „	15	Tethys	2·6 „	26	Dione	6·8 p.m.
4	Dione	9·1 „	16	Tethys	12·0 p.m.	27	Mimas	12·8 „
4	Rhea	12·2 „	18	Tethys	9·3 „	27	Mimas	11·4 „
7	Enceladus	12·9 „	18	Enceladus	12·0 „			
11	Mimas	1·7 a.m.	20	Tethys	6·6 „			

m a point close to η Virginis, just above
h star he will travel, and leave it to the
and South of him.

well
4

11 a.m., on the 22nd, he is in so-called "quadrature" with the Sun, and the careful observer will note how the shadow of the ball of the planet on the rings is visible only on the following side. His angular equatorial diameter diminishes slowly from 17·3" on March 1st to 16·4" by the 31st. No material change is perceptible in the aspect of his ring stem.

Saturn.

Day of Month.	Right Ascension.		Declination North.		Souths.	
	h.	m.	°	′	h.	m.
1	6	6·3	22	45·3	7	28·2 p.m.
6	6	6·3	22	46·2	7	8·6 „
11	6	6·5	22	47·0	6	49·2 „
16	6	7·0	22	47·7	6	29·9 „
21	6	7·6	22	48·5	6	10·9 „
26	6	8·5	22	49·1	5	52·1 „
31	6	9·5	22	49·7	5	33·4 „

This very short path is described towards η Geminorum, just to the North of which Star Saturn will be found on the Night of the 24th.

Uranus

In so far as his meridian passage is concerned, is a Morning Star during the first half of March, and an Evening one during the remainder of it. He is, however, in a very fair position for the observer at any time after 11 p.m.; but, as his Declination is South, it is needless to remark that the nearer the meridian he is observed, the better. He comes into Opposition to the Sun at 10 a.m. on the 26th. His angular diameter remains sensibly constant at 4" during the entire month. As the planet is in a blank region in Virgo, anyone with moderately keen sight can now detect him with the naked eye. His pale blue disc is at once recognisable in the telescope.

Day of Month.	Right Ascension.		Declination South.		Souths.	
	h.	m.	°	′	h.	m.
1	12	25·9	1	58·9	1	50·7 a.m.
6	12	25·2	1	54·3	1	30·4 „
11	12	24·5	1	49·5	1	10·0 „
16	12	23·6	1	43·5	12	45·5 p.m.
21	12	22·8	1	38·4	12	25·0 „
26	12	22·0	1	33·3	12	4·6 „
31	12	21·2	1	28·2	11	44·1 „

The short arc indicated in the above Ephemeris is described a little below a line joining γ and η Virginis, trending somewhat in the direction of the last-named star.

Neptune,

For all practical purposes, has quitted us until the late Autumn.

Shooting Stars

May be looked for on the nights 1st—4th, and again on the 16th.

Greenwich Mean Time of Southing of Fourteen of the Principal Fixed Stars on the Night of March 1st, 1886.

Star.	Souths. h.	m.	s.	
α Leporis	6	49	43·87	p.m.
α Columbæ	6	57	31·83	„
α Orionis	7	10	58·44	„
Sirius	8	1	57·71	„
Castor	8	49	2·42	„
Procyon	8	55	1·81	„
Pollux	9	0	1·42	„
β Cancri	9	31	55·85	„
ι Ursæ Majoris	10	12	53·40	„
α Hydræ	10	43	23·50	„
Regulus	11	23	35·72	„
α Ursæ Majoris	12	17	50·47	„
δ Crateris	12	34	44·78	„
λ Draconis	12	45	42·74	„

The method of finding the Greenwich Mean Time of Southing of either of the Stars in the above list for any other night in March; as also that of ascertaining the Local instant of its Transit at any other station will be found on p. 355.

PROFESSOR VIRCHOW ON PATHOLOGY AND DARWINISM.

IN an article contributed to the current number of his *Archiv*. Professor Virchow replies to some views enunciated at the Strasburg conference of German naturalists and physicians by Dr. Weismann upon Darwinism and Pathology. The question gains in interest from the facts adduced by Mr

Sutton in the first of his recent lectures before the College of Surgeons, for Professor Virchow's contention is the same as that of Mr. Sutton—viz., that variations from the animal type are largely brought about by deviations in structure strictly speaking pathological. Dr. Weismann, on the other hand, contended that such variations are the result of the law of adaptation, and it is this position which Virchow contests. He points out that Darwin himself, although not a pathologist, recognised the want of a clear line of distinction between monstrosities and mere variations. Weismann, however, went so far as to deny the inheritance of *acquired* properties; but it is difficult to see how otherwise one is to express the changes induced by adaptation to the environment. The facts of acclimatisation are, as Virchow points out, instances of such adaptation, and colonies could not be founded if it did not happen that the powers so acquired were transmissible to posterity. Weismann, on the other hand, regards acclimatisation rather as the product of selection, such individuals surviving who, by the possession of inherent qualities, are enabled to live under the changed conditions, and not that they acquire new powers. Much, however, turns upon what is meant by an acquired quality. Weismann means by it such as is imparted by some external agency, and would limit the influence of external causes to unicellular organisms, whereas variation occurs through sexual reproduction. But, as Virchow points out, external agencies ought not to be limited to those which operate outside the organism. In a multicellular organism variation may occur in some cells through the operation of other cells—i.e., strictly within the body. Indeed, the influence of the sperm-cell upon the germ-cell is an external influence, and, therefore, although we commonly speak of inherited qualities as being internal or predisposing, in strictness the qualities transmitted from the male parent are the result of an external agency when contrasted with those derived from the germ-cell. Applying these considerations to pathological processes, he shows that these are the result of external agents, and that they produce a change in the typical organisation, and thus by mere analogy the conclusion is arrived at that many racial—nay, even specific and generic—differences have been brought about by processes which may be deemed pathological. The various factors which determine the persistence of such deviations, and their transmission by inheritance, are not fully known; use and disuse explain some, adaptation accounts for others; but, however explained, the fact that acquired qualities are inheritable remains assured. —*Lancet.*

A. NEW FORM OF GOVERNOR FOR THE DRIVING-CLOCKS OF EQUATOREALS.

By A. HILGER.*

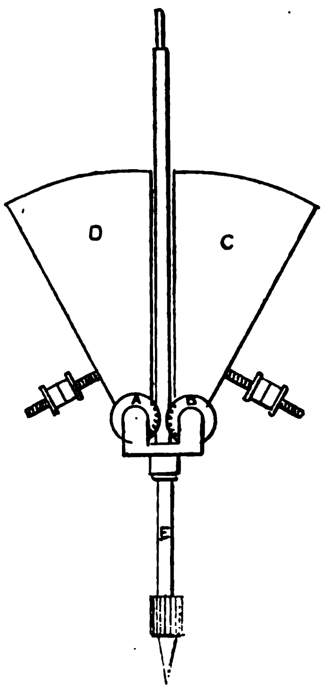
I HAVE the honour of bringing before the Royal Astronomical Society a driving governor which I believe will prove of interest to those who consider uniformity of motion an important matter for an equatoreal telescope, and especially to those engaged in the photography of the heavenly bodies. In former years I have made a great number of Foucault's clocks, with the construction of which many Fellows will be well acquainted, and which twenty years ago were considered—as perhaps they are still, especially in France—the best form of driving-clock for an equatoreal. My governor, so far as the fans are concerned, much resembles that of Foucault. A somewhat similar governor, but with three fans, was devised by the late M. Yvon Villarceau; besides these I do not know of any other fan governors, though such may undoubtedly exist.

But there were points in the Foucault governor with which I was by no means satisfied, especially the great complication of pieces and the great amount of friction, which all means error. I do not believe in any form of control which depends upon friction, and finding that, generally speaking, all driving-clocks are so controlled, I have worked out the present design, which is the result of years of experience. I do not think that any governor could have less friction while in action than this particular form, which I claim as my own invention. The friction is entirely confined to the four fine points which carry the two fans D and C. There is no other friction in the governing action whilst these are in motion.

In all forms of governors the clock is liable to go slower either when the fans or governor-balls close, or when the driving weight is reduced. It is not so with this form of clock; an addition of 140lb. more or less to the driving-weight will make no appreciable difference in the speed. The speed remains unchanged whether the fans are wide open or nearly closed; I say nearly closed, because, of course, as soon as the fans touch the spindle the control ceases.

The fans are pulled towards the spindle E by chronometer springs in box A and B, which will only allow them to open when a speed of from twenty-five to thirty revolutions a second is attained. The spring is only wound up half a revolution, so that the mean motion of the fans, which does not exceed more than thirty degrees on either side, keeps the spring perfectly free in the air. There is also another very important point in this governor: you will observe that there is no parallelogram motion to keep the fans equally inclined to the centre spindle, and yet that under every variation of position, from vertical to horizontal, the fans always open symmetrically.

When I first tried the governor I found that the rate varied appreciably with the inclination of the fans to the spindle. To overcome this defect I attached small weights to the fans on screws perpendicular to their long axes, and by adjusting the position of these weights on the screws I found it possible to obtain a quite uniform rate for a very considerable variation in the driving weight, or—what would be the same thing in actual practice—in the friction of the instrument driven.



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* From the *Monthly Notices* of the R.A.S.

GEOLOGICAL EXTINCTION, AND SOME OF ITS APPARENT CAUSES.

III.

By A. S. PACKARD.*

(*Concluded from page* 508.)

FINALLY, the Glacial epoch came in, the glaciers invaded North-eastern America; these on the one hand, and the great elevation of the western plateau, seem to have been the causes which removed the Pliocene fauna; which removal was, geologically speaking, comparatively sudden.

Either at the end of the Pliocene or the beginning of the Quaternary, as seen by the bones in the Port Kennedy cavern described by Professor Cope, there was a singular mixture of what we now regard as tropical and temperate forms living so far north as Pennsylvania; with the tapir, peccary, Mylodon, Megalonyx, Castoroides, and sabre-toothed tiger, were apparently associated the deer, bison, horse, porcupine, raccoon, dog, weasel, and smaller mammals. The fauna was in part extinguished by the glacial cold, Port Kennedy being situated a little south of the edge of the great glacier.

The result of a change of climate was a change in the nature of the forests; the tapir and peccary were forced to migrate southward; the colossal sloth and sabre-toothed tiger died outright; the Castoroides, horse, and mastodon lingered through the Glacial epoch, their remains being found at the bottom of swamps, but above the glacial and river drift; while the deer, bison, raccoon, dog, or wolf, and other forms survived with unimpaired vigour and became adapted to a lower climate, forming the typical members of the north temperate fauna of America.

Further south, in the river gravels and caves of the Middle and Southern States, are fo
bones of the great sloths, Megatherium,
onyx, and Mylodon, the American lion an
these were possibly swept out of existenc
cooler winters of the Mississippi valley.
was free from ice, but probably had fr
proximity to the great glaciers a lower
than in Pliocene times.

Professor Cope remarks: "Since the
the mammalian fauna of the northern hem
has diminished in number of species and
The Eocene fauna was richer than the
the Miocene than the Pliocene, and the
than the modern fauna." There is cert
significant parallelism between the wi
changes in the physical geography of
America, the differentiation of climates
faunal areas, and the increasing extinc
life.

The West Indies meanwhile were the
notable changes in the distribution of l
sea. From being much larger, and in so
connected perhaps with South Ameri
became submerged. Cope has described
remains found in a cave on the island of
Out of twelve species of mammals, seve
tinct and several were chinchillas of large

About the shores of the Mediterrane
were remarkable changes in the relation
and sea. The species of dwarf and other
whose bones have been discovered on the
Malta show that within recent times th
must have been connected with the main
continent.

In the old world, simultaneously
mountain-building of America, the Alp
the later Pliocene attained their present
tions; the Himalayas rose to their present
the continents of Asia, with Europe, and
assumed their present outlines.

The extent and nature of the changes wh
place late in the Pliocene in the physical g
of the globe were without doubt much
than at any previous time in the histo
planet. While the present coast lines w
established volcanic agencies were widesp
powerful, and over what were then r
intense volcanic activity are to be now
the dying embers of subterranean fires.

The long, quiet, preparatory eons of the
and early Tertiary were succeeded by a
geological history, just as the comparative
the Palæozoic age terminated in the wi
disturbances which took place at the
Coal period.

If we glance back through the geolog
we shall see that there were cases of the
tively rapid extinction of types or whol
of animals. The more remarkable were
tinction of the trilobites and ammonites.
remarks: "The extermination of whole
of ammonites toward the close of the
period, has been wonderfully sudden."

In the same manner the trilobites as w
Eurypterida ceased to exist at the en
Palæozoic age; the Silurian graptolites dis
with comparative suddenness; the crin
brachiopods mostly, and the dinosaurs and
saurs, as well as pythonomorphs wholly.
during the Cretaceous period.

The views we have presented, while o
ultra-uniformitarian ideas, have nothing in
with the Cuvierian catastrophic doctrine
wholesale extinctions and re-creatio
known facts in palæontology postulate lo
of quiet preparation, succeeded by mor
sudden crises, or radical changes in the
structure of continents, resulting in cata
both local and general, to certain faunas
of animals as well as individual species.

The biological changes were not due
and geological changes alone, but it
borne in mind that the great changes
duced but not without striking final re
ing in the addition or loss of vast areas
induced extensive migrations, the incu
prepotent types which exterminated the
The reaction of one type of life upon an
results of natural selection, were ap
through; but these secondary factors we
both during periods of quiet and periods
Here again we may quote from Darwin,
next to Lyell, of the uniformitarian sc
remarks: "We have every reason to beli
the study of the Tertiary formations, th
and groups of species gradually disappear
another, first from one spot, then from
and finally from the world. In some
however, as by the breaking of an isth
the consequent irruption of a mul
inhabitants into an adjoining sea, o
subsidence of an island, the proces
may have been rapid."

Local extinctions due to loc
the formation of deserts, salin
[illegible] and vast outpour
[illegible] Oregon and I
[illegible] bmarine [illegible]

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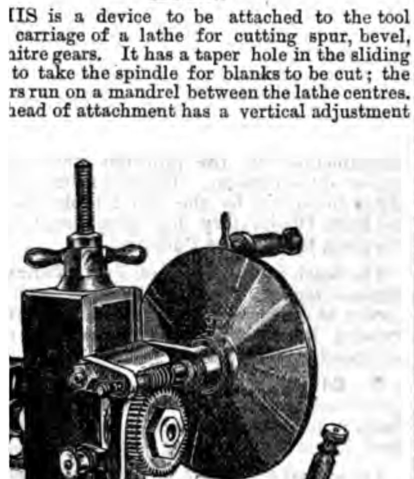
* From the *American Naturalist.*

of fishes on a vast scale, these are quite sub- ate factors.

closing this meagre sketch of a subject which ot received very much attention, we have ivoured to attract notice to what we have been tomed to regard as the main factors in the ction of species and of higher groups. That is a limit to the age of species as well as to iduals almost goes without saying. As there each individual a youth, manhood, and old age, ecies and orders rise, culminate, and decline, iations have risen, reached a maximum of opment, and decayed. The causes, however lex, are, in the case of plants and animals, ently physical; they are general and perva- in their effects, and have been in operation life began; there have been critical periods alæontological as well as geological history, periods of rapid and widespread extinction as as a continual, progressive dying-out of isolated es. Such extinction was, so to speak, a bio- al necessity, for otherwise there would have no progress, no evolution of higher types.

MER'S GEAR-CUTTING ATTACHMENT.

IIS is a device to be attached to the tool carriage of a lathe for cutting spur, bevel, itre gears. It has a taper hole in the sliding to take the spindle for blanks to be cut; the rs run on a mandrel between the lathe centres. head of attachment has a vertical adjustment



our inches, which is operated by a square- ded screw. Two index plates are furnished each machine, also an index card. It can, in ion to gear-cutting, be used for laying out rs, marking and spacing, and for various purposes. It is recommended for use in shops cannot afford an expensive gear-cutter, also ol-rooms. The manufacturer it J. C. Palmer, Union-street, Philadelphia. — *American inist.*

ranging and Fixing Diatoms.—Among nany methods of fixing diatoms and other te objects upon a slide or cover-glass, the od of M. Threlfall has been highly com- led. The diatoms are arranged upon a per- y dry surface of caoutchouc spread upon the and fixed in place by application of gentle The details may be briefly given as ws:—First prepare a solution of caoutchouc nzene, adding sufficient caoutchouc to produce y-like mass. Of this take a portion as large o peas, and dissolve it in thirty cubic centi- s of benzene. This dilute solution is the hat is used. This solution affords an easy s of attaching thin sections in series as well itoms to a glass slip. In either case the slip ited with a thin layer of caoutchouc by flowing th the solution as a photographic plate is d with collodion. The solvent rapidly eva- es, leaving the caoutchouc in a thin film on the . The sections, ordinarily included in par- are arranged in series on the caoutchouc. The is then warmed to a temperature of 56°—60° hen the caoutchouc softens, and the sections ne fixed in place. The paraffin is then re- d by petroleum spirit, and if it is desired the be stained in position. To attach ssary to arrange them rm gently.

SCIENTIFIC SOCIETIES.

◆

ROYAL MICROSCOPICAL SOCIETY.

THE annual meeting was held on the 10th inst., at King's College, Strand, W.C., the president (the Rev. Dr. Dallinger, F.R.S.) in the chair.

The President, in opening the meeting, said that some of the Fellows present might not be aware that they had just lost by death one who was well known to them—he referred to the late Mr. P. H. Lealand. His genial urbanity to all who came in contact with him, and his long connection with his firm of Powell and Lealand, to whom the science of microscopy was so largely indebted for those optical productions, the excellence of which was so well appreciated, and in which Mr. Lealand took an honourable part, justified a notice of the fact that he was no longer amongst them, and an expression of their regret at his death as well as of sympathy with his surviving relations.

Mr. Crisp said that, owing to a curious and probably unintentional operation of their by-laws, it would not be necessary to make the meeting special in order to elect Dr. Dallinger as president for a third year. While it was provided that a Fellow should not be elected for more than two years, it was also provided that at annual meetings alterations in the by-laws could be made without notice. All that was necessary, therefore, was to pass a resolution which he now proposed: "That notwithstanding By-law No. 27, or any other by-law, the Rev. Dr. Dallinger be, and he is hereby declared eligible for election as, president of the Society for a third year."

Mr. Michael having seconded the motion, it was put to the meeting, and carried unanimously.

The list of Fellows proposed as council and officers for the ensuing year was read as follows: President, Rev. W. H. Dallinger, LL.D., F.R.S.; vice-presidents, *J. William Groves, Esq.; *John Mayall, Esq., jun., F.Z.S.; Albert D. Michael, Esq., F.L.S.; *Prof. Charles Stewart, M.R.C.S., F.L.S.; Treasurer, Lionel S. Beale, Esq., M.B., F.R.C.P., F.R.S. Secretaries, Frank Crisp, Esq., LL.B., B.A., V.P. and Treas. L.S.; Prof. F. Jeffrey Bell, M.A., F.Z.S. Twelve other members of council, Joseph Beck, Esq., F.R.A.S.; A. W. Bennett, Esq., M.A., B.Sc., F.L.S.; Robert Braithwaite, Esq., M.D., M.R.C.S., F.L.S.; *Rev. Edmund Carr, M.A.; *Frank R. Cheshire, Esq., F.L.S.; *G. F. Dowdeswell, Esq., M.A.; James Glaisher, Esq., F.R.S., F.R.A.S.; John Matthews, Esq., M.D.; John Millar, Esq., L.R.C.P., F.L.S.; Urban Pritchard, Esq., M.D.; William Thomas Suffolk, Esq.; *Charles Tyler, Esq, F.L.S. (*Have not held during the preceding year the office for which they are nominated.)

Mr. Guimaraens and Mr. Powell having been appointed scrutineers, the ballot was proceeded with, and, upon the result being subsequently reported to the President, he declared that all the Fellows who had been nominated were duly elected to serve as council and officers during the ensuing year.

The Treasurer's account was read, showing that during the year £959 1s. 8d. had been received, irrespective of compositions, and that, notwithstanding an increase in several items of expenditure, the balance in hand remained substantially the same as at the beginning of the year. The treasurer (Dr. Beale, F.R.S.) said he thought the Fellows would consider this to be a most satisfactory account. He was anxious, nevertheless, to see their resources still further increased, in order that they might be able to do better still. They wanted an increased number of Fellows in order to give them the means of improving the journal, although it had already become a most valuable periodical, and had attained a very high degree of excellence, mainly through the fostering care of their friend, Mr. Crisp. What they wanted now was to see it a self-supporting enterprise, and if each Fellow would do his best to increase their numbers the journal would not only repay its cost, but they might have more plates and in other ways extend its influence.

A motion for the adoption of the Treasurer's report and for a vote of thanks to him for his services was moved by Dr. Millar, seconded by Prof. Stewart, and carried unanimously.

The report of the Council was read.

REPORT OF THE COUNCIL FOR 1885.

During the year 1885, fifty-three new Fellows were elected, a number in excess of the average of recent years; twenty-five Fellows have died or resigned (two compounders and twenty-three annual subscribers); three Honorary Fellows have also died.

The deaths of the year unfortunately include the names of three of the leading authors of works on the microscope in the English, French, and German languages. The President has already expressed the sense of the Society at the loss which microscopy has sustained in the death of the author of "The Microscope and its Revelations," Dr. W. B. Carpenter; Prof. C. Robin, the well-known French histologist, and an Honorary Fellow of the Society, was the author of the standard work on the microscope in France, which had passed through three editions; while Dr. P. Harting, another Honorary Fellow, was the author of the exhaustive and learned, historical and practical "Treatise on the Microscope," which, originally written in Dutch, is better known through its German translation.

The death of Dr. F. Ritter von Stein (the third Honorary Fellow) was referred to in last year's report. He was succeeded, as there mentioned, by Dr. Flögel, whilst the second vacancy has been filled by Prof. H. de Lecaze-Duthiers, who is well-known as one of the foremost of French zoologists. The third vacancy has not yet been filled.

The number of Fellows now stands as follows:—606 Ordinary Fellows, 49 Honorary Fellows, and 82 Ex-officio Fellows; or 737 in all.

The additions to the list of Fellows represent a net increase in the revenue of the Society for the year of £62 9s. 6d. The total income received other than for compositions was £959 1s. 8d., so that during the current year it is expected that the Society's revenue will reach £1,000, which, it will be agreed, represents a very satisfactory state of the Society's finances.

Owing to the unfortunate, and at one time serious, illness of the librarian, the catalogue of the library, which was just ready, was delayed. It is now, however, again in order for printing, and will be proceeded with forthwith, when the arrangements for lending books from the library will come into force.

The Cabinet Committee, on entering upon their labours, found that a proper revision of the cabinet would require a considerable amount of time to complete satisfactorily, and they are not at present able to present their report.

Additional shelves have been added to the library to provide for the ever-increasing number of books.

An Abbe apertometer has been placed in the library for the use of Fellows who may desire to verify the aperture of their objectives.

The principal improvement in the last volume of the *Journal* is the extension of the index. The names of the authors no longer appear alone, but are followed by the title of the paper or article of which they are the authors. Whilst this adds considerably to the length of the index, it will, it is believed, be found of great practical use. The contents, both of the separate numbers and of the whole volume also, now include the names of the authors, while the former (on the wrappers) are now classified, much facilitating reference to any particular paper. An alteration of the type has also improved the bibliographical lists.

Mr. Thurston, of King's College, kindly undertook a portion of the microscopy B section during the year; but on his leaving for India, his place has been filled by Dr. R. G. Hebb; and that of Mr. B. B. Woodward, who was obliged to resign on account of ill-health, by Mr. J. Arthur Thomson.

The Council considered and ultimately approved a proposal for publishing in the *Journal* the portraits of the Presidents of the Society. To issue the whole (21) as full-page portraits involved a greater cost than the Council saw their way to undertaking, while to spread them over a series of years did not appear to be desirable. It was therefore decided that the portraits of sixteen of the Presidents from 1840 to 1878 should be issued in two groups, with full-page portraits of the first President of the Microscopical Society of London (Sir R. Owen, K.C.B.), and the first President of the Royal Microscopical Society (Mr. Glaisher, F.R.S.). No little difficulty was experienced in collecting the photographs for the groups, the only ones obtainable in some cases being old and faded, and in others unsuitable for technical reasons. The satisfactory character of the result is due to the trouble and attention given to the matter by Mr. J. Mayall, jun., one of the members of the Council.

The adoption of the report was moved by Mr W. W. Reeves, and seconded by Mr. Spencer, and carried unanimously.

Mr. Cheshire, in eulogistic terms, moved that the thanks of the Society should be given to the Secretaries for their valuable services during the past year.

Mr. Vezey seconded the motion.

The President said that the Fellows all knew how much they were indebted to the Secretaries for their services to the society, and without being invidious he might say especially to the one on his left, and there could be no doubt as to the cordial way in which this resolution would be received. The motion was carried by hearty acclamation.

Mr. Crisp said he was sorry that Prof. Bell was unable to be with them that evening, being absent from London on account of ill-health, and he begged, therefore, to return thanks on Prof. Bell's behalf, as also for himself, so far as he was intended to be included in the resolution.

The President then read his annual Address, being a study of the origin, development, division, and ultimate function of the necleus in the lower forms of life as carried out by means of new and improved objectives of widest aperture (1·5 N.A.) specially constructed for the purpose.

Prof. Stewart proposed that the best thanks of the meeting be given to the President for his address, to which he had listened with the greatest pleasure, and which it would be contrary to precedent to discuss.

Mr. Crisp, in seconding the motion, thought it would not be out of place to point out, in reference to the President's remarks on the benefits derived from wide apertures, that what promised to be another very important advance in the construction of objectives had just been made. Prof. Abbe had for a long time been trying to obtain an optical glass which would get rid of the secondary spectrum, and he had recently succeeded in doing this. The secondary spectrum was eliminated, and nothing was now left but a small tertiary spectrum. He hoped that before long they would be able to judge of some objectives for themselves. The Fellows had already cordially approved the announcement that the President had consented to accept office for a third year, and they were aware how regularly he attended the meetings, though at considerable effort to himself, and he therefore proposed to add to Prof. Stewart's motion that their thanks be also given to the President for accepting the office for a further period.

The motion was then put to the meeting and carried unanimously.

The President said he was much gratified by the very cordial manner in which his address and this vote of thanks had been received. He could only repeat what he had said before, that he had given for many years the whole of his leisure time—and some which had not been quite leisure also—to studies of this kind. He loved the work, and should always feel it to have been a very great honour to have held the position he did in connection with a Society which made the use of the microscope its primary object.

The President moved a vote of thanks to the auditors and scrutineers for their services, and Dr. Millar having seconded the motion, it was carried unanimously.

ROYAL METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this society was held on Wednesday evening, the 17th inst. at the Institution of Civil Engineers, Mr. W. Ellis, F.R.A.S., president, in the chair.

Mr. G. Buchanan, M.Inst.C.E., Captain G. H. Leggett, Dr. H. C. Taylor, J.P., and Mr. J. Tolson were balloted for and duly elected Fellows of the Society.

The following papers were read:—

1. "General Remarks on the Naming of Clouds," by Capt. H. Toynbee, F.R.Met.Soc. The author considers it important to keep to Luke Howard's nomenclature, leaving it to the observers to express by an additional word any peculiarity they notice in a particular cloud.

2. "On the Thickness of Shower Clouds," by Mr. A. W. Clayden, M.A., F.G.S. From some measurements made by the author during the summer of 1885, he has come to the conclusion that clouds of less than 2,000ft. in thickness are not often accompanied by rain; and if they are it is only very gentle, consisting of minute drops. With a thickness of between 2,000ft. and 4,000ft. the size of the drops is moderate. As the thickness gets greater, the size of the drops increases, and at the same time their temperature becomes lower, until, when the thickness is upwards of 6,000ft., hail is produced.

3. "On the Formation of Rain, Hail, and Snow," by Mr. A. W. Clayden, M.A., F.G.S. The author points out that all observations tend to show that, except under quite abnormal conditions, the temperature of the atmosphere falls as the height above sea-level increases; and there seems no reason whatever for assuming that the law does not apply to that portion of the atmosphere which forms a cloud. Hence, if a drop were to be formed at or near the upper surface of a cloud, it would fall down into a region saturated with vapour at a temperature above its own. The result will be further condensation, producing a larger drop; and this process will continue until it leaves the cloud. If its temperature is below the dew point of the air it falls through, condensation will continue until it reaches the ground. However, it is obvious that this subsequent gain cannot bear any very large proportion to the growth while falling through the saturated cloud, from which the conclusion follows that the size of the drop must increase with the thickness of the cloud. The author suggests that condensation begins on the upper surface of the cloud by the cooling of some of the liquid cloud-particles. If this particle is cold enough it will solidify, and snow will be formed. Should it not be quite cold enough to solidify at once, owing to its minuteness, but remain still below the freezing-point, hail is formed. Finally, if the temperature is not low enough for either snow or hail, rain is produced.

4. "On Three Years' Work by the 'Chrono-barometer' and 'Chrono-thermometer,' 1882—84," by Mr. W. F. Stanley, F.R.Met.Soc. The Chrono-barometer is a clock that counts the oscillations of a pendulum formed by a suspended barometer. The upper chamber of the pendulum is a cylinder of an inch or more in diameter. By change of atmospheric pressure the mercury in the pendulum is displaced from the bottom to the top, and vice versâ. The rate of the clock is accelerated or retarded, in proportion to the displacement of the mercury. The chrono-thermometer is a similar clock to the above, and the pendulum is also a barometer, but instead of the lower chamber being exposed to pressure, the whole tube is inclosed in a second hermetically sealed tube containing air. Atmospheric pressure being thus removed, the expansion of the included air by heat alone forces the mercury up into the vacuum-chamber, and alters the period of oscillation of the pendulum.

DYEING RECIPES.

WASHING WHITE GOODS. — White goods in general are not sufficiently brushed, and blueing is often neglected. Prepare a solution of 5lb. benzine, 5lb. alcohol, and 2lb. soap, by heating it slowly until the soap is completely dissolved. With this solution brush white goods until clean; for coloured goods it cannot be used. After cleaning, blue. Mix a thimbleful aniline violet 7B with a wineglass full of benzol. Add this solution by drops to the benzine blueing bath, to which, also, some talc is added, both in proportion to the quantity of goods.

Medium Grey upon Woollens.—For 5kil.—Wash clean with soda and spirit of sal-ammonia, rinse well in cold water, and dye three-quarters of an hour upon a boiling bath containing ¼kil. glaubersalt, ¼kil. sulphuric acid, and about 20grm. indigo carmine, 10grm. fuchsine, S., and 5grm. azo yellow; lift, air, and rinse well in cold water.

Woollen or Crewel Yarn Lace.—This fashionable material wants no particular directions as regards the application of mordants and dye stuffs, which are the same as in woollen yarn dyeing; but the condition of the fabrics must be considered, and the manipulation regulated accordingly. From the start the material must be properly cleaned. If new, it is simply passed through a lukewarm solution of soap, and well washed in lukewarm water; if worn, thorough washing in soap and rinsing in lukewarm water are required. In dyeing, to prevent shrinking the lace is wound upon light wooden frames, and thus entered into the dye bath. Care must be taken, of course, not to crowd them upon the frames, else they would not be dyed through. Large quantities are best reeled up and tied in bundles, like yarn is tied in hanks, and dyed upon sticks like yarn, then rinsed or left unrinsed, as required by the dye. Finally they are centrifugated and stretched upon cushions to dry.

Garnet upon Woollens.—For five dresses.—After carefully cleaning the material, prepare a boiler of sufficient capacity with 200grm. alum, 200grm. glaubersalt, 100grm. sulphuric acid, and dye at a gentle boil with archil, some orange, acid fuchsine, and a small quantity of indigo carmine, adding the dye stuffs gradually in small quantities, to secure a uniform dye, until the shade is obtained.

Dark Green upon Woollens.—For five dresses.—Scour and wash clean from all stains, then proceed as for garnet, and dye under constant boiling with indigo carmine and fast yellow, adding the dye stuffs gradually and slowly.

Renovating Gentlemen's Faded Goods, Black, Dark Blue, Dark Grey, &c.—For three suits.—Clean well, in the usual manner, with soap and soda, rinse clean, give another hot-water bath, and proceed to dyeing. Prepare a boiler with clean water, heat to 122° F., add ¼lb. bran and half-bucketful decoction of logwood; enter goods, and raise to boiling under continual working. Let boil for 10 minutes, then lift and rinse. Goods which do not turn out dark enough are re-entered, after adding some copperas, and boiled for another 10 minutes, then rinse well without delay.—*The Dyer.*

Watch and Clock-Maker's Tools.—Mr. Morris Cohen, of Kirkgate, Leeds, has sent us his new catalogue of Watch and Clock-makers' Tools and materials, which may be of interest to amateurs who do not undertake the repair of clocks, &c., for it is a voluminous list, and contains illustrations of a variety of useful tools and appliances which may be unknown to the majority. At all [illegible] occupies more than a hundred pages, a [illegible] illustrations.

SCIENTIFIC NEWS.

AS comets Fabry and Barnard prom become conspicuous objects in the h before long, we give the ephemerides for midnight as calculated by Dr. Oppenhei Dr. Krueger. Dun Echt Circular No. 11 tains new elements of comet Fabry, com from observations on Dec. 2, 26, Jan. 22, Dr. Oppenheim: T 1886 April 5·53980 M.T.; π − ☊ 126° 50′ 27·6″; ☊ 26° 19′ 82° 11′ 15″; log. q. 9·804021.

	R.A.			N. Dec.	
March 3.	23h.	20m.	9s.	30°	11·7′
5.	23	19	52	30	45·3
7.	23	19	34	31	17·6

Dun Echt Circular No. 112 contains the meris to May 6. The comet's greatest b ness will be on April 29, when it will be reckoning its appearance on Dec. 2 as On March 3 it will be about 7. The ephem for Barnard's comet by Dr. Krueger gives

	R.A.			N. Dec.	
Feb. 26.	1h.	57m.	39s	20°	33·4′
Mar. 2	1	56	8	21	29·4

The brightness of Barnard's comet is incr slowly as compared with that of Fabry's c

The Emperor of Brazil has commissione Cruls, the director of the Observatory of R Janeiro, to procure a photographic appa similar to that devised by MM. Henry, of P in order to co-operate with those disting experimenters in the proposed photogra survey of the heavens. The new nebula ar Maia, discovered by the photographs ma the Paris Observatory, has been observed the great telescope at Pulkova.

The death is announced of Prof. Hering famous lepidopterist of Germany, and known as an historian by his "Geschichte Provinz Pommern." He died recently at advanced age in Stettin.

Mr. Edward Thomas, the well-known [illegible] numismatist and writer on the antiqui India in particular, and Asia generally, [illegible] dead, in his seventy-third year.

The appeal on behalf of the Royal S[illegible] Relief Fund has resulted so far in a [illegible] prompt response of over £2,000 [illegible] 500 guineas from Mr. Ludwig [illegible] presidents of the chartered scientific [illegible] have the right to recommend cases wh[illegible] consider suitable for relief, and an ap[illegible] accordingly be specially directed to the [illegible] of the Royal Astronomical, Geo[illegible] Chemical, Geological, Linnean, and [illegible] Societies. It is required to raise £[illegible] the present year, when Sir William [illegible] will contribute a similar amount.

The Royal Meteorological Society [illegible] hold an exhibition of barometers, &c. [illegible] 16th and 17th, at 25, Great [illegible] S.W.

The authorities of the South [illegible] Aquarium will endeavour to intro[illegible] into the collection of fish they [illegible] their control. The herring is kept [illegible] ment at places close to the sea, where [illegible] is exercised to secure a constant supply [illegible] sea-water; but no success [illegible] has hitherto been attained at [illegible]

From the zoological or natural [illegible] of view, it would be an advantage [illegible] herrings and sprats could be [illegible] in aquaria, for it would help [illegible] vexed question of the origin [illegible] Prof. Cossar Ewart read a paper [illegible] before the Royal Physical Society [illegible] in which he stated that, from an [illegible] specimens of so-called "[illegible]" [illegible] the London market from Febru[illegible] 1885, he had arrived at the [illegible] consisted of about 60 per cent. [illegible] 40 per cent. herrings. He also [illegible] were extensively preserved [illegible] Canada, and that sometimes [illegible] consignments of sprats as [illegible] returned to this country in [illegible]

The Italian Ministry of Ag[illegible] experiments in pisciculture [illegible] about half a million of fr[illegible] into the Lake of Como. [illegible] successful—the [illegible] be much—the [illegible] rapidly, and be [illegible] x years in succession, converting what should be a representative body into a close clique or corporation. Let us look forward hopefully to a more radical change still in 1887.

"Al Fard" (query 58880, p. 524), only missed the actual minimum of Algol by 38 minutes on the night of the 8th instant, as it actually occurred at 9h. 42m. There will be minima of this star on the 28th at 11h. 24m. p.m., and at 8h. 13m. p.m. on March 3rd.

"W. E. C." (query 58927, p. 525), is the victim of an optical illusion. A line joining the moon's cusps is always at right angles to a great circle passing through the centres of the sun and moon.

"G. R." puts a practically unanswerable query (58929) on p. 525. *Imprimis*, the star must have been one of a large number (none exceeding the 7th magnitude), which are scattered about in the northern part of Orion, and are, of course, wholly invisible to the naked eye; and, in the next place, he gives no hint whatever of his geographical position, albeit he must surely know that a star may be occulted at Greenwich of which the moon passes quite clear at, for example, Leicester. The proverbial finding of a needle in a bottle of hay is a task to be performed with the utmost facility in comparison with that set by your correspondent to any miserable computer!

A Fellow of the Royal Astronomical Society.

THE METEORS OF BIELA'S COMET.

[25381.]—I REGRET that your able correspondent, "F.R.A.S." (letter 25330, p. 489), does not admit the evidence (as I supposed conclusive) of observations of meteors from Biela's comet prior to 1872. It seems to me impossible to regard the great shower of meteors observed by Brandes, near Hamburg, in Germany, on Dec. 7, 1798 (when 400 meteors were counted in a few hours in half the sky), as anything but a veritable apparition of the *Andromedes*, or Bielan meteors. Another shower was seen in France early in December, 1830, and in 1838 a fine display of meteors was observed on December 6 in England (by the late Prebendary Webb, and others), and in the United States, France, and Brussels. Heis also, in 1847, early in December, recorded a conspicuous meteor shower from the point 25° + 40°; and finally, on November 30, 1867, Giuseppe Zezioli, at Bergamo, registered nine meteors, which Schiaparelli found to belong to a common radiant point at 17° + 48°.

These instances are conclusive that the meteors of Biela's comet were observed before 1872. It is true the observations are not as fully and definitely recorded as could be wished: but, such as they are, only one interpretation is to be put upon them. The meteors followed the right direction, and came at the right epoch. "F.R.A.S." will know that, owing to the rapid displacement of the node of Biela's comet, its associated meteor shower appears earlier at each return. At the end of the last century, when Brandes made his observation, the earth passed through the node on about Dec. 7, instead of on Nov. 27, as at present; hence the coincidence of date with the meteor shower of Dec. 7, 1798, is very exact. Since the disintegration of Biela's comet the displays of meteors have been far more magnificent than formerly, but the earlier showers, derived from the same origin, still possess an important significance.

Some time ago I re-examined Heis's observations in 1847, and Zezioli's in 1867, and re-read the facts relating to the other recorded displays. I was led to conclude that they absolutely demonstrated the occurrence of meteor showers from Biela's comet before 1872. But if "F.R.A.S." can adduce any strong evidence the other way, I for one shall be extremely interested if he will mention it.

Bristol, Feb. 16. **W. F. Denning.**

ELEMENTS FOR COMPUTING OCCULTATIONS OF ALDEBARAN AND THE PLANETS IN 1886—A REQUEST TO OBSERVERS.

[25382.]—I GIVE below the elements for computing all the occultations of Aldebaran and the planets occurring during the remainder of the present year. The occultations may be computed from these elements by the method devised by me, and recently printed in these columns. Occultations of the planets may be treated in the same manner as occultations of stars, due allowance being made for the disc of the planet when observing the occultation. Or, the times of first and last contacts may be obtained by increasing the moon's semi-diameter by an amount equal, in divisions of the "Latitude Scale," to the semi-diameter of the planet in seconds multiplied by 100 and divided by the moon's horizontal parallax in seconds; and the times of the second and third contacts may also be obtained by diminishing the moon's semi-diameter by this same amount.

As I am collecting data in reference to occultations of Aldebaran, I shall feel under obligations to observers who will kindly forward to me by mail or through the columns of this paper any observations they may have made of occultations of this star. The information desired has particular reference to the phenomenon of the projection of the star on the moon's disc, and includes the latitude and longitude of the place of observation, the aperture and kind of telescope and the power used, the times and angles of immersion and emersion, moon's age, approximate altitude, duration of the projection, variation of the star's light, condition of the seeing, &c., and general remarks on the observation. Reports of observations of any unusual occultations, and of those in the list below, will also be thankfully received. Please address—

P.O. Box 5193, **Chas. L. Woodside.**
Boston, Mass., U.S.A.

Name.	Declination at Date.		Washington.						Y.	x′.	y′.	Limits.	
			Mean Time of ☌.				Hour Angle.					N.	S.
	°	′		d.	h.	m.	h.	m.					
Mercury ...	− 2	30·7	March	6	0	44·1	− 0	2·2	− 0·1520	·4522	+ ·1322	− 25	− [illegible]
Aldebaran .	− 16	16·5		11	18	18·8	− 10	50·5	+ 0·2444	·5750	+ ·0825	− 50	− [illegible]
Jupiter......	+ 0	56·8		19	14	30·7	+ 2	14·5	− 0·2227	·5849	− ·1901	− 22	− [illegible]
Uranus......	− 1	40·0		19	21	18·7	+ 8	47·8	+ 1·0780	·5804	− ·1927	− 88	− [illegible]
Aldebaran .	+ 16	16·5	April	7	23	45·2	− 3	36·8	+ 0·8348	·5774	+ ·0829	+ 56	− [illegible]
Jupiter......	+ 2	13·5		15	18	47·7	+ 8	30·4	− 0·4830	·5784	− ·1892	+ 9	− [illegible]
Uranus......	− 1	12·7		16	5	8·2	− 5	30·6	+ 0·9995	·5745	− ·1922	− 89	− [illegible]
Venus	− 2	57·8		29	12	7·3	− 8	57·7	− 0·8489	·4875	− ·1612	− 15	− [illegible]
Mercury ...	+ 3	45·4	May	1	7	36·2	+ 9	12·7	+ 0·1005	·5107	+ ·1711	+ 40	− [illegible]
Aldebaran .	− 16	16·5		5	6	14·3	+ 4	39·9	+ 0·4539	·5838	+ ·0858	− 65	+ 1
Jupiter......	− 2	52·3		12	22	38·1	− 9	44·9	− 0·4172	·5737	− ·1887	− 12	− [illegible]
Uranus......	− 0	52·6		13	10	53·5	+ 2	5·3	+ 1·0740	·5653	− ·1906	+ 89	− [illegible]
Aldebaran .	+ 16	16·5	June	1	14	35·3	− 9	11·3	+ 0·4909	·5889	+ ·0889	+ 68	− [illegible]
Mars.........	+ 4	58·3		8	16	7·9	+ 9	56·4	− 0·1035	·5507	− ·1772	+ 28	− [illegible]
Jupiter......	− 2	38·6		9	4	21·8	− 2	14·8	− 0·0238	·5606	− ·1879	− 34	− [illegible]
Uranus......	− 0	45·7		9	15	42·9	+ 8	43·1	+ 1·3050	·5603	− ·1900	− 89	− [illegible]
Aldebaran .	+ 16	16·6		29	0	16·4	+ 2	17·9	+ 0·4105	·5873	+ ·0910	− 62	− 1
Jupiter......	+ 1	36·0	July	6	13	55·7	− 8	58·4	+ 0·5503	·5620	− ·1889	+ 72	− [illegible]
Aldebaran .	+ 16	16·7		26	9	57·7	− 10	12·8	+ 0·2749	·5802	+ ·0909	+ 52	− [illegible]
Jupiter......	− 0	4·4	Aug.	3	3	57·4	+ 0	34·3	+ 1·1370	·6082	− ·1913	− 90	− [illegible]
Aldebaran .	+ 16	16·8		22	18	18·3	− 0	4·4	+ 0·1864	·5706	+ ·0900	− 46	− [illegible]
Mercury ...	+ 13	53·1		27	16	8·9	− 6	47·0	− 0·2360	·5912	− ·1465	− 22	− [illegible]
Aldebaran .	+ 16	16·8	Sept.	19	0	47·9	− 8	12·8	+ 0·2272	·5646	+ ·0889	+ 45	− [illegible]
Venus	+ 6	37·8		25	23	25·0	+ 0	34·3	− 0·5531	·5429	− ·1698	+ 4	− [illegible]
Aldebaran .	+ 16	16·8	Oct.	16	6	19·0	− 8	28·8	+ 0·3706	·5659	+ ·0903	− 59	− [illegible]
Aldebaran .	+ 16	16·8	Nov.	12	12	37·0	− 0	23·3	+ 0·5029	·5720	+ ·0929	− 69	− [illegible]
Aldebaran .	− 16	16·8	Dec.	9	20	54·1	+ 9	41·6	+ 0·5147	·5760	+ ·0964	+ 79	− [illegible]

THE SPECTRUM OF THE AURORA.

[25383.]—IN connection with Mr. Fleming's very graphic description of an aurora observed by him at Kirkwall on Jan. 9 (letter 25351), I may say that on several occasions (notably on 1st Feb., 1870, 25th Oct., 1870, and 13th Jan., 1871), I have remarked the peculiar appearance associated with Angström's line between D and E to which he refers. The display of 25th Oct., 1870, one of the grandest on record in England, was remarkable for the gorgeous flickering streamers which for more than two hours traversed the sky from horizon to zenith, and ultimately formed an auroral crown. Their light, examined with a small direct-vision spectroscope, gave a red band near C, Angström's line between D and E, a faint band near F, and a fourth very faint line about midway between the two last. Angström's line seemed to consist of a number of brilliant dots in rapid motion, which phenomenon at the time I attributed to the intermittent character of the light emitted by the streamers. The red band near C, however, which was fully as bright and well-defined, exhibited no such appearance. On 13th Jan., 1871, the phenomenon was again observed. On this occasion I tried the effect of varying the width of the slit: but this made no difference except as regards definition. So long as the Angström line was visible, it was clear that this peculiar scintillation was going on. The appearance seems to be, for some reason or other, strictly confined to Angström's line, to have nothing to do with the width of the slit, and to be always visible when the line is sufficiently pronounced.

The grand aurora, described by Mr. Fleming was faintly represented here between 6th and 7th. Faint as it was, however, Angström's line was visible in every quarter of the sky to which a small pocket spectroscope, by Hilger, was directed.

Thos. Gwyn Elger.

Kempston, Beds, Feb. 20.

THE TOTAL SOLAR ECLIPSE OF SEPT. 9th.

[25384.]—I OBSERVE (on p. 235) a condensed report of my notes on the Total Solar Eclipse of Sept. 9, 1885, as observed by me from my residence, The Terrace, Wellington, New Zealand, read before the Royal Astronomical Society on the 13th Nov. last.

There is an unfortunate error in the statement of my views which I shall be glad if you will allow me to correct. You say, "Mr. Marten attributed to the dust from Krakatoa, which has continued during the year to give rise to brilliant effects of colour at sunrise and sunset," the "sunset tints" which illuminated the masses of cloud near the horizon. What I remarked in my notes was, that the sunset afterglows and sunrise foreglows *have been attributed* in certain quarters to the dust from Krakatoa; but most certainly I never expressed my concurrence in this theory. On the contrary, I have always strongly held a totally opposite view. I have never been able to realise the possibility of solid matter, however attenuated, remaining so long suspended in the atmosphere, for the "glows" are as vivid now in New Zealand as ever they were. But still less can I conceive that with a constant and persistent cause, the effects should exhibit intermission. Yet this is the case with these "glows," and has been so from the first. There are clear nights showing no meteorological differences, on some of which the "glows" are startling in their chromatic brilliance, while on others there is not the faintest sign of any coloured "glow" at all. I have made observation of the foreglows and afterglows in all quarters of the globe—from Magellan Strait and Terra del Fuego to North Scotland: from the West Coast of Africa to the east coast of South America, and with the same results. The fact of intermission seems to me to furnish an argument also against the meteor dust theory, which I have always regarded as the most feasible solution of the problem, while the successive occurrence of exceptional droughts and exceptionally wet seasons during the prevalence of the glows appears to upset the idea that an excess of aqueous vapour may be the cause. I should be glad to learn the view of "F.R.A.S." on these points.

During the late eclipse, the "glow"—coloured from pink to mauve—began to appear as the sun became obscured, and at totality formed a complete ring round the disc.

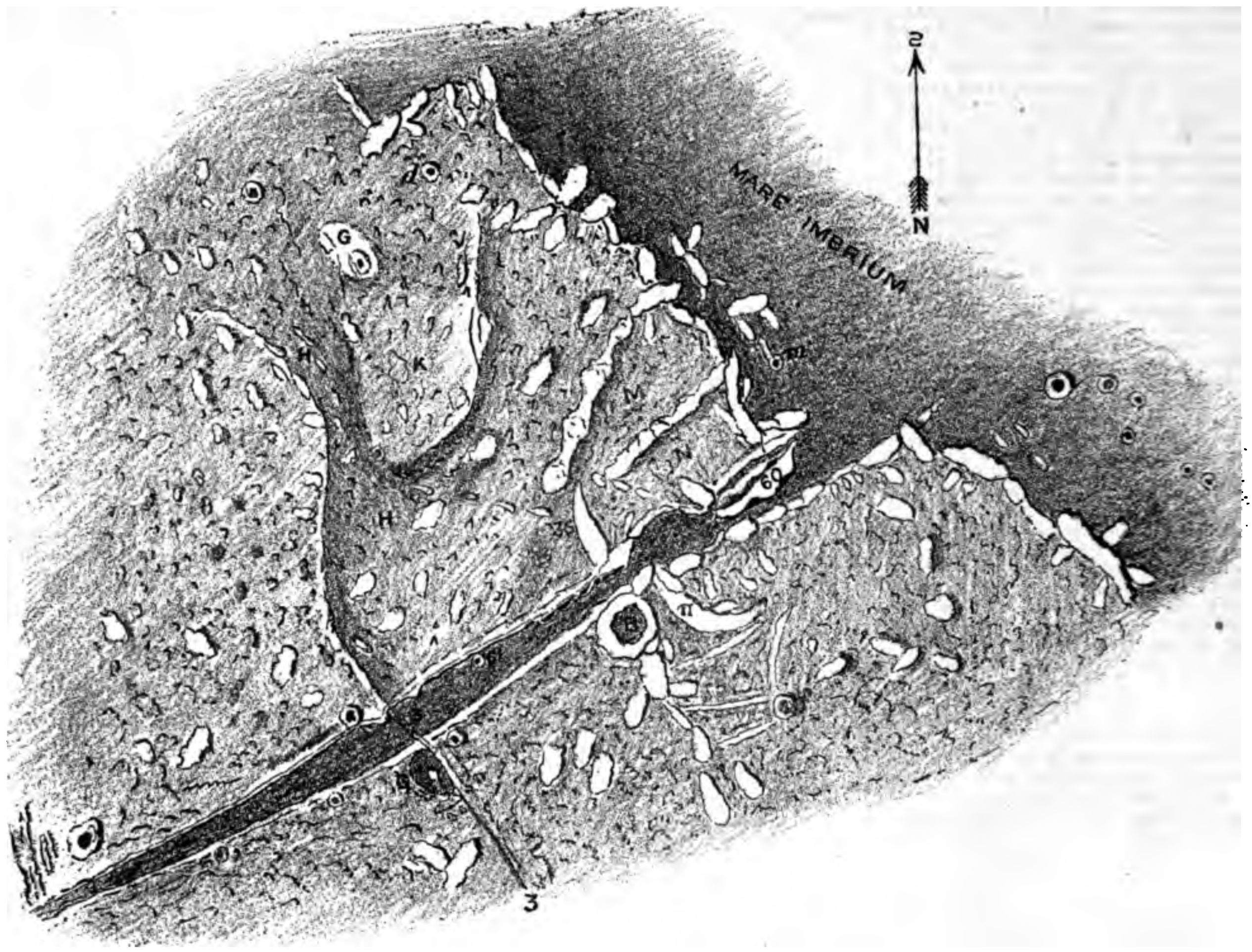
Charles Rous-Marten,
F.R.G.S., F.R.Met.Soc.

Wellington, N.Z.

PROF. PRITCHARD AND GENESIS.

[25385.]—OF the three "statements" that Prof. Pritchard finds in the Proem of Genesis "irreconcilable with what we at present know of the constitution of nature," the third was never, I believe, found there by ancient readers, and the two former are points on which I venture to think Genesis much in advance of the professor's knowledge. At any rate, an equally-learned astronomer who has pushed the only current cosmogonic theory some steps further, M. Faye, has maintained as an established verity, that "the earth is far older than the sun," and the marvel to me has been that the great probability of this, in the Kant and Laplace theory, has not been insisted upon for at least these fifty years. It would seem that at Oxford the sun is the older: and one is reminded of Voltaire's saying, that he left the universe a *plenum* in Paris and came to London to find it a vacuum. It is not merely Genesis that contradicts "the facts of nature as far as we know them," but rather what is "known" of them on one side the Channel contradicts what is "known" on the other.

W[illegible] our professor has been [illegible] m[illegible] declare the Proem [illegible] w[illegible] seem to have been



SELENOGRAPHICAL — THE GREAT VALLEY OF THE ALPS — COPERNICUS—PLATO A.

[25389.]—THE details represented in this sketch of the Great Valley of the Alps and neighbourhood are the results of several observations made at various times, the last of which was the 13th inst. At this last date my chief intention was to make a careful survey of the floor of the valley itself. The terminator was so far E. that only a very short shadow was thrown out by the S. border of the valley. Under these circumstances, I saw very distinctly the object represented at N., which I had never seen before sufficiently plain to form an opinion about its nature. So far as I know, Schmidt only on his map has represented something like it, but he gives it too short. I believe this is a craterlet running along the foot of the S. border of the valley and quite close to it. Each crater has a distinct border on the side towards the centre of the valley. Beginning where Schmidt shows it, it runs as far as the beginning of the well-known enlargement of the valley, where it has above a mass of débris suggesting the idea of an avalanche, which seems to have narrowed the valley on that side. Further W., at 61, there is a craterlet, and not simply a rock or the projection of a rock casting a shadow, as it often looks. I took particular pains to ascertain this, and I believe I am not deceived. At 3 the valley is crossed by a valley or cleft, which at this place is very rugged, and which follows its course far N.E. Near G is a depression, with a hillock in its centre. The mouth of the valley is obstructed by the mountain mass 60, which rises far above the floor, and is divided longitudinally in almost two equal parts. Both are rough, but chiefly the southern half, which is composed of four mountains connected at their bases, but distinct at their summits. This half of the obstructed mountain is somewhat higher than the other. On each side of 60 there is a passage connecting the valley with Mare Imbrium. The southern passage is very narrow, and, I believe, very seldom seen. I would particularly call attention to the whole of the region S. and N. of the mouth of the valley, because it seems to me Schmidt's map is very confusing here. M and N represent two distinct open spaces, separated by a low ridge running from the S. extremity of mountain 36 to the border of the Mare. This ridge has a comparatively prominent peak about its middle, but is itself covered by minute hillocks, as if denudation had carried away soft matter and had left the rocks bare. On the floor of N there are a quantity of minute objects and a row of larger hillocks runs from the E. end of the enlargement of the valley to the S. end of 36. M is bounded on the S. by a more important ridge than the preceding one, and has four hillocks along its course. M is also very rugged, and once I thought I saw a crater in it. H represents a large shallow valley, whose W. side runs as far as the Great Alpine valley. It narrows between H and H, then turns E. and disappears as it extends in all directions. K is a high land, contrasting with the valley H. These features are seen only under a particular angle of illumination. G is a white spot, with a crater on the N. and a hillock on the S.

Plato A.—On the 13th inst. I found a very minute crater on the top of the E. border of this formation, which is not given by Schmidt. On comparing it with the central crater of Plato, I found them about equal. This crater of Plato is not a pit, but a real crater, with raised borders above the floor. Another crater, but larger, was seen between Copernicus A and the cleft which runs from the N.E. side of Plato. About this cleft, may I ask if any observer has ever suspected its communication with the cleft seen on the W. side of same formation? I fancied something like it on the 13th inst.

Feb. 16th. **C. M. Gaudibert.**

SILVERING MIRRORS.

[25390.]—ALLOW me to thank Mr. Woodside (letter 24805, page 82) for his very full reply to my queries anent silvering and silvering vessels.

Various circumstances have prevented the earlier adoption of the suggestions given: but having once used paraffin-coated vessels, I shall certainly not use any other. The film on mirror seems to be considerably thicker and more firmly fixed, and far less silver is deposited on the vessel. I found that I could sponge the newly deposited film with absorbent cotton and water, and was surprised how much rubbing it would bear.

There are two points in silvering where my experience always differs from Mr. Brashear's (in letter 17404, page 327, Vol. XXXI). After cleaning mirror Mr. Brasbear says: "We will take 50 grains of nitrate of silver, dissolved in, say, 2oz. of distilled water, 50 grains of potassa pure by alcohol, dissolved in 2oz. distilled water. Now pour $\frac{1}{10}$th of silver solution into another vessel to hold as a reserve. *Next drop aqua ammoniæ into the silver solution until the light brown precipitate is entirely cleared up.*"

With respect to the last sentence (the italics are mine): After dissolving nitrate of silver in distilled water I do *not* find a precipitate; but have a perfectly colourless solution. Will Mr. Brashear or Mr. Woodside, or any other brother reader kindly give his experience on this point, as I find that it is in these small discrepancies that beginners have most difficulties? Finding a difference, doubts are suggested, and the whole process seems uncertain. Then continuing, Mr. Brashear says: "Pour in your potassa solution, when it will become a very dark brown colour. Clear this entirely by adding ammonia drop by drop, and *leave no precipitate*. Don't be afraid to clear up nicely, as this will save the trouble of filtering, and as we now have a reserve of silver solution we will drop this in carefully, until we have a nice *clear*, yellowish-brown liquid. If you do not get this colour, make a little more silver solution, and drop it in carefully until you do get it, *and never undertake to silver until you do get it.*"

How am I to get it? My most serious difficulty is how to get this "*clear* yellowish-brown." Does Mr. Brashear mean by *clear* a transparent liquid free from floating particles? And do any of my brother readers succeed in getting a clear, transparent liquid, say, like brown sherry?

If so, their experience is very different to mine. After mixing potassa and silver, and clearing with ammonia I find, on dropping in reserve silver, that I get a brownish liquid viewed by transmitted light; but looking down on the surface, the appearance is like weak coffee with a small portion of milk in it.

The brown colour is caused by floating particles, as I find on filtering that I have only a pale straw-coloured liquid left, and, if I again drop in more silver, I only get the same result—viz., a turbid yellowish-brown liquid.

Owing to the uncertainty engendered by failing to get the clear shade required, I have had several failures; and although I have been successful in getting good films, there is to me a want of certainty in the process (caused solely by the discrepancies mentioned), which is tantalising and unsatisfactory, and I shall be extremely grateful to any one who, pitying my density, will so far enlighten my darkness as to enable me to silver with the same certainty that many of my fellow contributors seem to have.

In reply to Mr. Longbottom (letter 25832, p. I made the change from a 8¼ Wray to a 6¼ on-glass (Calver) reflector some five years I have never for a moment regretted it.

The Wray was a perfect instrument,

to drop the valve, and only the small light be left. See Answer to Query No. 58315 in this number.

A. R. F. K.

RAILWAY RETURNS.

[25396.]—THE accompanying table is compiled from the Reports just issued. It shows the mileage and rolling-stock of our chief railways, with the net income for the half-year ending December, 1885. Work over foreign lines is included in the table:—

Railway.	Miles Worked.	Train Mileage.	No. of Engines.	Net Receipts.
Great Eastern	1110	7,498,592	673	£941,234
Great Northern ...	917	8,786,446	768	£926,083
Great Western......	2594	15,291,409	1582	£2,114,788
L. & North-West'n	1810	19,633,749	2323	£2,607,392
L. & South-West'n	837	5,803,930	525	£701,714
Midland................	1852	17,372,303	1732	£1,842,837
North-Eastern ...	1707	11,884,023	1506	£1,454,680

Feb. 20. G.

EXPRESS SPEEDS.

[25397.]—I BEG to state, in answer to "Kappa's" query (letter 25357, p. 515), that, like himself, I do not put much trust in extraordinary runs. But in reference to Aurania bringing it into Rugby (12 o'clock from Euston) 8 minutes before time, I know it for the truth, as I witnessed it myself, and timed it on arrival at Rugby—viz., 1.35 p.m. If "Kappa" is conversant with railways, he will know that it is against the regulations to run before time, as it is to lose time, and that it would not do for any driver to be as much as even 8 minutes before time. The time is sometimes "squared," and on this occasion, to square it, the guard, I believe, booked the train in as 4 minutes before time. If "Kappa" makes inquiries and has access to the driver's tickets, he will find this correct, I have no doubt.

Ghilleasbuig McTomae.

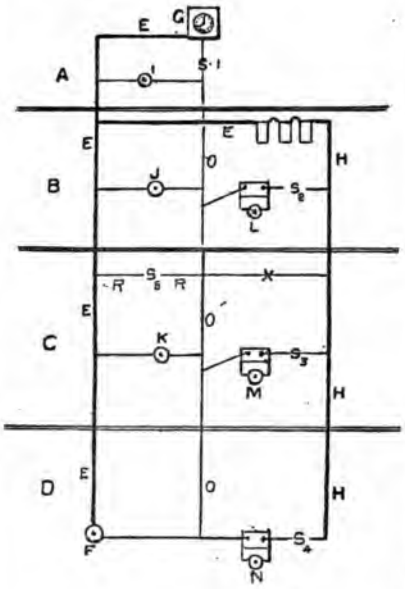
REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[57906.]—**Bearings for Lathe Mandrel.**—I should think "Orient" does not use a sufficiently thick lubricant on his milling machine, as here machines with hard steel bearings will run for a considerable time with one lubrication.—A. F. SHAKESPEAR, Dresden.

[58266.]—**Scene Painting (U.Q.)**—I have done a good deal of scene painting, but only in amateur fashion. Paper (even newspaper) may be pasted on cheap calico or muslin. The colours most used are various shades of green, raw and burnt sienna, and umber. Shading can be put on by the last named, mixed with more or less water, and is best done last, and not mixed with other colours. A little size should be mixed with each colour to prevent rubbing off. Small flat brushes, costing about threepence each, are very useful.—BANGOR.

[58315.]—**Electric Bells.**—I have succeeded in fixing my bells so that one or all can be rung. I thank those who so kindly replied to my question, and thinking they would like to know how I have got on, I send a sketch of my arrangement, which, I think, is very simple:—*a*, *b*, *c*, *d* are different rooms; *e* and *h* are main battery wires; *o o* is the switch wire; *f* is a push at the front door; G is a clock, which closes the circuit at the time wished; *f*, I, J, K are pushes in each room, by which any or all the bells can be rung if the switches 2, 3, 4 are on; *l*, *m*, *n* are bells; S 1 is a switch to stop the clock acting in the evenings or on Sundays; *p* is a three-cell battery. If switch S 4 is the only one on, and push *f* is used, the bell N, which is in the kitchen, will ring. If the people in the house are upstairs and bell N is rung, it may not be heard, so if anyone is stopping in the rooms *b* or *c* they would put the switch in that room on, and then that bell would ring also from the front door. Pushes I, J, and K can be used as call-bells to the kitchen, N, or to either rooms B and C. It will be easily seen that by either the clock G or pushes I, J, K, or *f* being used, that the battery wire *e e* is connected with the switch wire *o o*, and the current will go through any or all bells that have their switch on to battery wire *h h*. The switches S 2 and S 3 are wanted when the clock sets the bell off in the morning; without them the bells would ring about ten minutes. S 4 is put off at night, so that if the front door push is used at night the bedroom bells will ring; it also stops the clock from ringing that bell in the morning. The wires *r r* are taken from the two battery wires *e* and *h* to the switch S 5 at the bed-head, and then to an arrangement at the gas branch at X, by which the gas can be turned up or down as may be wanted. This arrangement is explained in another part of this number.—A. R. F. K.



[58386.]—**Air-Gun Valves.**—To "T. M."—"Amateur" would be obliged by a sketch of valves, if not too much trouble.—AMATEUR.

[58520.]—**Emigration (U.Q.)**—The climates of South Africa and of California are very healthy indeed; but the former is more suited for pasture than agriculture. Land is, however, very cheap. An agricultural emigrant with £300 ought to do well in California, wheat-growing being a staple industry, and land cheap. The unsettled state of South Africa, its droughts, and its bad roads, are great drawbacks; but the Orange Free State is perhaps as good a part as any. Spring is the best time to start for California. Donald Currie and Co. have an "Emigrant's Guide to South Africa," published by White, London Wall; whilst Du Val's "With a Show through South Africa" (Dean and Son, Fleet-street), gives a good idea of the country and people.—BANGOR.

[58572.]—**Minute Fancy Photographs.**—These photographs are made by the aid of a reverse microscope arrangement of lenses, which reduces the size of the picture on the plate. The process was largely used during the siege of Paris for photographing newspapers and letters, and no doubt full details can be found in back numbers under the head of "Micro-Photographs."—J. E. M.

[58583.]—**Crackers.**—I believe fulminate of mercury is generally used, sometimes with a bit of glass paper. It is put on between two strips of strong paper, the ends of which are brought out into the frilled ends of the case, so that when pulled apart a slight explosion takes place.—NUN. DOR.

[58588.]—**Engines for Steamboat.**—The proposed arrangement will be very troublesome to carry out, for the difference in length of stroke will alone be a serious cause of trouble. As there is to be no condenser, too, it is scarcely worth while compounding in so small an affair.—S. R.

[58594.]—**Chemical Bronze.**—If "Reader of the MECHANIC" has correctly named himself, he will find recipes for bronzing in many numbers; but how he expects any one can rectify his recipe it is impossible to conceive, for he has simply made some nitrate of copper. Perhaps that should be dissolved in water or spirit and applied to the articles, as heat will have the effect of turning it black. If the querist would say what he wants to do, it would be much more easy to answer him.—NUN. DOR.

[58596.]—**Fitting Band Saw to Lathe.**—I cannot say I have fitted a band saw to a lathe; but it might be easily done if the lathe is large enough or the saw of such temper as to bend well round a rather small pulley. For what possible object can it be required?—J. K. L.

[58603.]—**Locomotive Experiments.**—No doubt full details will be forthcoming presently. The "coupled-engine advocates" will be glad to see an end of the side-rods, if it can be demonstrated that sufficient adhesion is to be had without.—K. T.

[58607.]—**Storage Batteries.**—This query has been answered many times. General instructions on p. 28, No. 1,016. Look in indices under headings "Accumulator" and "Storage."—T. M.

[58609.]—**Copper and Copper Pipes.**—It is doubtful whether it is affected at all, and it is not easy to see how phosphorus is to be got into it, especially when we remember that phosphor-bronze is the subject of a patent. Sulphur is found in commercial samples, and zinc simply helps to convert copper into "brass." One per cent. of zinc makes copper harder under the file. Wherever copper and iron touch in the presence of acid or saline liquids galvanic action is set up, and the bilges of a ship would be a suitable place for demonstrating the rapidity with which that action works.—NUN. DOR.

[58611.]—**Boiler.**—These questions have been answered as far as they can be answered many times. There is no rule, and if there were, it would be inapplicable, because the character of the workmanship is not in evidence, and in this case not even the thickness of the metal. The simplest method is to try the boiler. Fill quite full of water and apply heat. As the water expands, it will either lift the safety-valve or strain a seam. If it lifts the valve before showing signs of weeping let it cool, and put the weight further out so as to increase the load on the valve. Repeat as often as necessary; but if you get up to 50lb. without weeping, you may safely work at 25lb. with steam; that is, half. See that the boiler is always full of cold or cool water when trying.—ESSAR.

[58617.]—**Albumen Plates for Lantern Slides.**—I suspect the querist will have to prepare these for himself.—KINGSTON.

[58618.]—**Water Company's Power.**—This querist might perhaps have obtained an answer if he mentioned the name of the company; but he can easily find out their powers by getting a copy of their Act. Most likely they have power to order what fittings they prefer—rather a one-sided arrangement; but I cannot think that the inspector is wrong in insisting on wiped joints. A water-pipe with merely plain-soldered joints is not a satisfactory piece of work, unless made in some such manner as I described on p. 265.—S. R.

[58621.]—**Loco. Model Boiler.**—The boiler is 5⅝in. long by 2¼in. diam., made of thin sheet copper bent into a circle, with the seams overlapping, the sides overlap and are turned down over the ends, all the joints are soldered, two metal hoops surround the boiler to strengthen it, the front part fits into a smoke-box (with door), into which a copper tube 1in. diam. passes obliquely from the middle of the boiler through the bottom. A spirit tank with 20 wicks, each ¾in. diam. (10 in a row), play on a copper plate attached to bottom of boiler, having a hole in it corresponding to the opening of the tube through which the heated air passes to the funnel. Without this extra plate the boiler is a failure. The firebox is surrounded on all sides by a tin guard, which protects the flames from the current of air meeting them when the loco. travels. Abundance of steam is kept up, whether the engine runs forwards or backwards, and it hauls a load with ease upon iron rails. For a larger size of boiler, of course, the seams could be brazed or riveted together. I have tried many experiments with model tubular boilers and inclosed furnaces, but all these fail to generate steam rapidly enough to drive a loco., though they do fairly well for a stationary engine. The plan which I have found to succeed best with a tubular boiler is to drive a current of air through the smoke-box in addition to the blast, and one of my models, a slide-valve portable engine, ½in. bore and 1in. stroke, with eccentrics and reversing link motion, is fitted thus, and steams well. As this method is not applicable to a loco., I gave up the idea of a tubular boiler with inclosed furnace for it, and made the form of boiler described above, which is simple and very satisfactory, though not quite a correct model. Further information, along with a sketch, can be given if required.—AMATEUR.

[58623.]—**Induction Coil.**—(Errata: In the second of my letters under this heading last week for "21 sections," please read "22 sections"; and for "the edge of the coil," read "the edge of the core.") My conjecture that the root of "W. J.'s" trouble would not be found in the defective insulation of his secondary coil is now justified. The results which he has succeeded in getting from the reconstructed primary are excellent, consider the low battery power used. The querist has, h ever, gained nothing by substituting cotton-co wire for the silk-covered wire which I recom and it is unfortunate that he has not primary up to the ends advice was [illegible] shorter, and not that a portion of the core should be left uncovered by the primary wire. The office of the condenser is to demagnetise the core through the medium of the primary, and unless the primary convolutions are carried to the extremities of the core the condenser works at a disadvantage. If "W. J." will reduce the length of his core to 10in., his tube will be long enough to include the necessary pole-piece, which I described last week, and which he at present seems to be without; and if he will then work the coil with a suitable battery, instead of relying entirely upon the small Bunsen cells of high resistance, which I have advised him to abandon, there can be no doubt that he will obtain sparks upwards of 5in. long, and the *quality* (i.e., thickness, colour, and vigour) of the spark will be improved. Increasing the battery-power will render an increase of the condenser-surface necessary, and a slight excess of condenser-capacity is beneficial, because its effects are to diminish the sparking at the contact breaker, and to augment the density of the secondary discharge. I notice that "W. J.," in his last letter, speaks of "the ordinary contact breaker." May I ask if he is quite sure that his break is of the Apps form? Probably the querist will let us hear something about his final results from the present coil before he begins to build the larger instrument which he has in contemplation, and for the success of which he has my best wishes.—Ernest Baugh.

[58688.]—**Lighting Vacuum Tubes.**—To Mr. Taafe.—My Voss has 10in. revolving plate, Leyden jars always attached, 5in. high, 1½in. diam.; knobs on conductors small and equal in size. I get 3in. spark easily; on a good night I have got 4½in. I have only three simple vacuum tubes—8, 6, and 5in.; but when attached, as I described, and laid end to end, I can keep them full of a continuous stream of light. I have not succeeded in lengthening the spark by more Leyden jars, nor by the "high-tension discharger."—W. J. B.

[58700.]—**Blake Transmitter.**—I am pleased to see the above described again in "Ours"; but will it be asking too great a favour if "F. C. A." will give us the size of the different parts, and will platinum wire do, as I have read in other accounts of a platinum bead being used?—A. J. T.

[58727.]—**Music Plates.**—Tools for engraving can be obtained of Julius Kratzschmar, Stempelschmeider, Leipsic, Saxony, Kranpraigstrasse 118D. I am unable to find any book or work on the subject.—C. D. R.

[58748.]—**Incandescent Lamp.**—Schanschieff's new single-fluid battery will work hermetically sealed.—A. S.

[58749.]—**Accumulators.**—I should advise our reader not to trouble about making these batteries unless he has a dynamo, by which the formation and charging can be done, as they cause so much trouble and expense if done by primary batteries; then when they are charged, the current from them is merely nothing to what they receive. I am of opinion that it is utterly useless to charge accumulators for the lighting of a 5-c p. and 10-c.p. lamp by means of primary batteries, because in the first instance the charging current would have to be somewhat in excess of capacity of the cells to charge them to their full extent, and not only that, these secondary cells when charged to a certain extent react on the primary source to discharge themselves, and if the E.M.F. of the battery is not kept up to the proper flow, they simply discharge themselves as the battery runs down, and the result being the cells contain energy enough to last about a few seconds or so; and how many batteries give a constant E.M.F. of intensity to last about eight or nine hours, a proper and necessary time for charging to be of any use at all; therefore the dynamo is the only economical means by which these batteries can be enforced, as the current is constant compared with batteries, and does not run down in the least as long as the motive-power is applied. The only ones, I believe, that can be formed and charged with success are the small pocket accumulators, as used for fairy lamps, and they can only be charged for about two hours; and what is the good of the current from such a battery for any purpose, only for theatrical novelties?—and these are being superseded by the chloride of silver and other dry batteries, by which the current is always ready, and no action or usage of the elements takes place unless the circuit is completed, and also requires no charging. Another thing with these accumulators—if they are not used soon after being charged, they run down. I repeat again, if you want to make these batteries for use, do not attempt it unless to have a suitable dynamo for the preparation and charging, but if for a small light, construct a pocket battery, and light a 5 c.p. or 10 c.p. by means of a good and constant primary battery as Bunsen's granule, &c., not accumulators. I had one of these small pocket [illegible] some time ago (about 4 volts). I could [illegible] into it a current to last about 20 [illegible] this I had to keep the battery [illegible] on for about 1½ hour. I must inform you I am not prejudiced against them; but I like to know, as well as everyone does, the faults and advantages of a thing, so as to be ready to receive them when they manifest themselves, for if there were no faults in anything, how would you know the advantages you gain by using certain things to remedy these faults? At the present time I have made a small pocket battery (two cells which I hope will give about 4 volts), the size of the whole being 4in. by 3in. by ⅜in. This is the result of my formation as follows:—I connected the battery to a 21-cell Daniells battery for about ten hours; then discharge by short-circuiting through a galvanometer, then giving it a rest of four hours; afterwards I connected it on to a battery of 8 pint bichromates for three hours, with intervals of quarter-hour between each hour for the battery (bichromate) to recover itself, then discharge, &c. This set out I done every day for the last eight or nine days, and all the current I got when charged for about twenty minutes is to ring a bell for about four or five minutes for the present; so our reader can calculate some idea of how long five or six large batteries with large and thick plates, besides a greater number in each cell, it will take to form, and the primary batteries worn out in doing this troublesome part, all on purpose to light a 5 or 10-c.p. lamp for a certain time, when it can be done almost instantly by the battery itself, and with less cells than it would take to charge the accumulators, and for more than double the time.—Y. E. E., Walworth.

[58764.]—**Legal.**—The answer to this depends on the question, Whose property is the original wall? If the property of the one who raised it, clearly no one has any right to make use of it without his permission. If, however, it is the joint property of the adjoining owners, I am of opinion that the raised portion is also joint property, and either owner can make any use of that portion of the whole wall which is on his own land. This is not the opinion of a "legal" one, but of one connected with "building" matters.—G. M. Pel.

[58775.]—**Calcium Persulphide.**—To Mr. J. Grey, F.C.S.—Your question is certainly justified. I wrote "by shaking," &c.; "slaking" is a misprint.—C. F. P.

[58793.]—**Lifting Power.**—In this case it is not necessary to take into account the whole weight of the tackle, except to ascertain the weight of the rope required for winding, because two cages will be required, and one set of tackle will balance the other. The breaking strain for steel wire ropes is 3 tons (nearly) for each pound weight per fathom, and the working load is from ⅙th to $\frac{1}{10}$th of breaking strain. Now, 13 tons is the total weight to be lifted by the rope. Assume this as ⅛th the breaking strain, then breaking strain = 13 × 8 = 104 tons, and $\frac{104}{3}$ = 34·6lb. per fathom of rope. Depth of pit = 250fm., therefore 250 × 34·6 = 8,650lb. the weight of rope, and 5 × 2,240 = 11,200lb., the weight of coal. 19,850lb. the total weight to be lifted by engines, 40 trips per hour will require to be made, or one every 1½ minute; say 45 seconds is taken up in loading and unloading at surface, this leaves 45 seconds for actual winding, or a rope speed of about 33ft. per second, which is not excessive where wire rope conductors are used, or too great a speed to be practical, as stated by "T. C."

$$\text{Now, H.P.} = \frac{19{,}850 \times 1{,}500 \times 60}{33{,}000 \times 45} = 1{,}203. \text{ Add } \tfrac{1}{5}\text{th}$$

$$\text{for friction in shaft, \&c.} = \frac{240{\cdot}6}{1{,}443{\cdot}9} \text{ H.P.}$$—E. P.

[58800.]—**Amorphous Phosphorus.**—Phos. Amorph. is almost unchangeable in air, and cannot be re-converted into ordinary phosphorus at any temperature below 500° F. I presume the amorphous phosphorus you are experimenting with contains traces of ordinary phosphorus. You can remove these by treating with carbon bisulphide till the latter leaves no phosphorus when evaporated.—W. Stanley Smith.

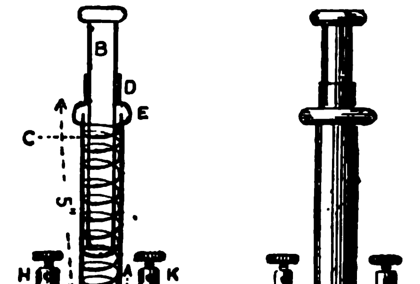
[58806.]—**Soldering.**—C. Hales will find it the safest and most easy way to file off the joints and catches. They can only be unsoldered by the blowpipe. The solder must be melted, and the joints lifted or pushed off. But, as I say, the only satisfactory way is to use a file; cut off as much as possible with the pliers, and file smooth.—Os.

[58819.]—**Asbestos Gas Fire.**—To "Atmospheric."—My office gas fire is hot and noiseless, will not light at the bottom, only smells a little when first lighted, and has answered well for two years. See that the gas is not checked in supply-cock, make a clear ½in. hole through plug, replace ¾ iron barrel by 1 or 1¼. Tube burners should be 3½ long, ½ at top, 1 at bottom, nicely tapered, well cut away both sides at bottom for air supply. The hole inside the burner proper must be very carefully made to pass gas without noise, and if properly made, and fixed at right position in tube, will only light inside tube when gas is turned very low, flame going up to top when pressure is turned on. If you do not succeed ask for a pattern. The heat should be prevented from passing away up the flue, or the room will not be warmed, and the fire will be deemed a failure.—E. Kenyon.

[58819.]—**Asbestos Gas Fire.**—The cause of "Atmospheric's" difficulty is, no doubt, an insufficient supply of air to mix with the gas before its ignition. I have had occasion recently to use some three or four kinds of gas stoves, besides having had one in use in a bathroom for several years past, the latter being a number of pieces of asbestos clinkers, about the size and shape of an orange, with a hole through the centre large enough to thrust in the thumb. These clinkers are tumbled into the ordinary grate, and are rendered incandescent by the action of seven Bunsen burners, which play upon them from beneath, and whenever, from any accident, the outer tubes of the Bunsen burners become more or less choked, the ordinary unaltered gas flame flares out with a roaring noise, giving but little heat. By the way, this arrangement is effective, but the consumption of gas is very great. I had this recently removed, and a gas stove having filaments of asbestos attached to a fire-clay back, and a sheet of flame from a horizontal tube, with a continuous cut along the side play upon the asbestos, with a provision for a mixture of air to the gas before it issued from the side of the tube. The consumption of gas is small, but so also is the warmth to be got out of the stove. If a lighted match is held to this tube before the gas is turned on, it lights the gas, the flame continues with a roaring noise and hardly any heat; but this is instantly remedied by turning out the gas, then turning it on again, and re-lighting it after its being turned on. In a bedroom I have fixed a gas stove somewhat similar, but more ornamental in appearance, made by one Wilson, in which the incandescent material consists partly of iron and partly of moulded fireclay, the gas being supplied through a slit at bottom; it is very effective, consumes a good deal of gas, but not anything like so large a quantity as the first-named arrangement. I have another one, differing from, but on the same principle as, the second I have described, fitted in an office of moderate size; and this is also quite effective. Without exception, they all make a roaring noise when lit before some common air has had time to mix with the gas, which would at once disappear if the gas be turned quite off, and then on again before a light is applied. Another form of gas-stove I have also tried, but as it is ineffective I need not describe it.—Gamma Sigma.

[58821.]—**Battery for Lamp.**—If, as you say, the battery has an arrangement for lowering the plates into the cells, you have a ready means of regulating the quantity of current required. All you need do is to lower the plates only so far that current is supplied as required, be the resistance of the lamp what it may.—C. D. R.

[58821.]—**Battery for Lamp.**—Why not use a simple two-way switch, so as to switch on four or eight cells, according to the lamp used. Another method is by an adjustable resistance, which you ask for; I send sketch of one which I think will answer well for small currents. It is composed of an ebonite tube 5in. long, screwed into an ebonite base 3in. in diam.; a spiral spring of German silver wire, about No. 30 or 36 B.W.G., is then wound to slide into the tube, the spring previously being stretched a little; the upper end of spring is passed through a small hole drilled in the side of the tube and carried down close to the side of terminal H. Close to terminal K another hole is drilled, and a piece of wire screwed into it, as at A, and soldered into terminal; this connects to the mercury inside tube. The split brass tube O fixed to brass cap E screws on the top of ebonite tube, into which slides brass rod B. When sufficient mercury is put into the bottom of the ebonite tube, the brass rod sliding down squeezes the mercury up the sides of tube, consequently, short-circuiting the coils of wire; if the rod is drawn out the current must pass through every turn of G.S. wire till it reaches the mercury; thus by varying the distance of rod, the resistance is also varied.—Les Enfant.



[58822.]—**Voicing Organ Reeds.**—"Angulus" will find pamphlet mentioned by N. E. Child at Willis's, 29, Minories, E.—DIOCTON.

[58822.]—**Voicing Organ Reeds.**—I beg to second the request of "Angulus" for information on the voicing of pipe-organ reeds, and to repeat a like request that I made in this journal many years ago in reference to organ pipes generally, without receiving any satisfactory reply. In course of my inquiries elsewhere, however, I soon became aware that the art of "voicing" is a very exclusive one, and one rarely possessed even by those well acquainted with its theory; that a knowledge of it has to be acquired from demonstration at the hands of a practical expert; and that it cannot be conveyed by any amount of description; although the latter would doubtless be of great assistance to any one endeavouring to master its secrets by persevering manipulation. If any of your correspondents well versed in the matter would describe the causes of the various defects of voice in pipes, he would do much towards removing some of the troubles of the amateur organ-tuner.—G. E. N.

[58822.] — **Voicing Organ Reeds.** — Reed voicing cannot be learned by reading a book; some idea may be had, but only the manipulation; the idea of tone, whereby is judged the quality of the stop, is, and can only be, learned by experience. You must feel in your mind the tone-colour you wish to produce, exactly as a composer for an orchestra can feel and hear in his mind the tone-colour that will be produced by a given number and arrangement of notes. Reed pipes may be voiced to be almost undistinguishable from flue pipes. Your first question is: How are the tongues made? Very easily; out of the hardest sheet brass procurable. The brass is rolled and rolled at the manufactory until it will sharpen and cut like a knife. You obtain the proper thickness and cut off a length sufficiently long for the longest tongue that thickness will make; then you measure the size of the flat or face of the reed, and cut accordingly. 2. A broad, thick reed will produce a very powerful or very thick tone, according to the voicing; a thin reed, of course, the opposite, although a thin reed may, under some circumstances, be made to produce a strong, but unsatisfactory tone. 3. The tongue should not project beyond the edge of the reed; rather, if anything, the other way. 4. The strength of a reed is regulated by the size of the reed and the size of the body, or conical tube; the wider and shorter the tube, the stronger and broader the tone. A basson, 8ft., is the smallest tube, at the broad end (top end), about 2in., the broadest (in ordinary) about 7in. 5. The causes of a reed pipe going dumb are, I am sorry to say, many. There may be something in the tube or in the reed; the reed may be a little to one side, the spring may not fit, the tongue may be bent (buckled) or a little dirt got lodged between the face of reed and tongue, the wedge may be loose, the tongue too much or too little curved, there may be a defect in the tube, the tongue may be too thick, too thin, or of defective material, and many other things that are not of such frequent occurrence. 6 and 7. These defects are caused by tongues being too little or too much curved, by being too thick or too thin. 6. Too thick. 7. Too thin. 8. Here you ask what is the difference between a cornet and an oboe, a trumpet and a vox humana? By this I suppose you mean in construction, because I cannot think you so "green" not to know the difference between a trumpet and a vox humana, in tone. By the "cornet" I suppose, is meant the cornopean. The cornopean is a broad, round, ringing-toned stop, but minus the "clang" of the trumpet. The trumpets made now are not clangy enough, and do not possess sufficient brilliancy, as a rule; but to discuss the why and wherefore would take up too much space. The oboe has tubes nearly straight, with a bell on the top, and the tone is of a peculiar wailing quality, only heard in the organ proper, and not in the orchestra. The vox humana is made similar to a clarionet, with straight tubes, and is supposed, or voiced to be, an imitation of the human voice, which it is—about once in a hundred. The reeds and tongues are the same in every case of a striking reed, although they vary in width and thickness, and in curvature. There are exceptions in free reeds, such as the cor anglais, bombarde, and several pedal reeds, wherein the reeds do not strike, but go clean through the plate, the same as a harmonium reed. There is a way of leathering reeds to obviate rattling; but I cannot say more about it than that a piece of firm soft leather is fastened round the reed, and cut away for the opening, the tongue striking on the leather instead of on the brass. The voicing of a reed is conducted in the following manner, in which I must be as brief as possible. I will suppose you have your reeds, tongues, and springs all made. The first thing is to face up your reed as true as you possibly can; this may be done by first rubbing the reed on a good file, and dressing on an emery wheel in the lathe, and polishing on a surface plate with a little emery and oil. Then you take your tongue, file the edges clean, lay on a flat hard surface, say wood or iron, and run a burnisher over the brass tongue until it assumes the curved shape, which you can copy from another reed. When you think it is sufficiently curved, put into position, follow up with the wedge, which should be firmly fixed, put in the spring, slip on the socket or boot, and try, tuning to a 4ft. stop; it will not be exactly right—it would be a miracle if it were. In all probability it will not speak at all. This would occur if the reed were too thick, or too much curved. If it will speak, but rattles, the tongue is not curved enough. If it flies off into the fifth, look for dust, or the reed is not curved enough, or is too thin. If you happen to get a good note, you will most probably find it out of tune; in that case, if the note is weak, it requires a little cutting off the top of the tube, and most probably when you have cut the piece off, your note is bad again, and you will have to change curve of reed a little more. Supposing you get this note right, the next note will require the tongue a little thinner, and this will necessitate the use of the file, or the planing machine. We plane all our tongues to thickness. This information is very loose and disjointed, but to give a concise and thorough description would well-nigh take up a whole number of the "E. M.," therefore, if you want anything further, you must write again, and I will tell you any other point. If I had time, I might send an article on reed-voicing, but my spare time is very limited.—URANIUM.

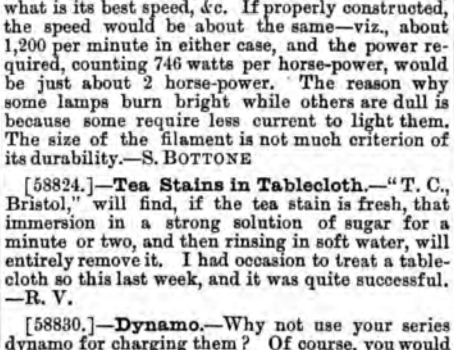
[58823.]—**Dynamo Efficiency.**—Theoretically, for a perfect dynamo, the same horse-power would do, since 50 × 30 = 1,500 watts in either case. It is impossible to say, without testing the machine, what is its best speed, &c. If properly constructed, the speed would be about the same—viz., about 1,200 per minute in either case, and the power required, counting 746 watts per horse-power, would be just about 2 horse-power. The reason why some lamps burn bright while others are dull is because some require less current to light them. The size of the filament is not much criterion of its durability.—S. BOTTONE

[58824.]—**Tea Stains in Tablecloth.**—"T. C., Bristol," will find, if the tea stain is fresh, that immersion in a strong solution of sugar for a minute or two, and then rinsing in soft water, will entirely remove it. I had occasion to treat a tablecloth so this last week, and it was quite successful.—R. V.

[58830.]—**Dynamo.**—Why not use your series dynamo for charging them? Of course, you would need to be careful that the back E.M.F. of the cells did not exceed the E.M.F. of your dynamo, else you would have too large a current in your machine, which might bring it suddenly up, or overheat the wires, &c. You might contrive a cut-out which would break the circuit at the right time.—C. L.

[58832.] — **Cough Cure.** — TO "OSBALDESTON, Harrogate."—It is impossible to dissolve either ipec. or any other vegetable; but you have extracted all its strength. It will not do the least harm to take, as it is much nicer, and pleasant to look at if filtered through paper. Any druggist's apprentice will show you how to do it.—OSBALDESTON, Harrogate."

[58834.]—**L. B. and S. C. R Locomotives.**—I regret being unable to furnish particulars of the oldest express engines on this line; but herewith send sketch of the "Gladstone." The principal dimensions and a full description of this celebrated engine may be found on pp. 527, 528, Vol. XLI. About 12 years ago some old single engines were still running on this railway. They had outside bearings to all the axles, raised external fireboxes, and large steam domes, and were somewhat similar in appearance to the old S. E. R. (see p. 453, present Vol.); but I am not sure if they were the oldest type used.—W. H. THURLOW.



[58839.]—**Duplex Telephony.**—TO "SIGMA."—I should think it unlikely that telephone messages will be able to pass in opposite directions at the same time. In fact, telegraph signals do not so pass; the actions at each end of the line, when simultaneous, do not traverse the line at all, but each works its own instrument; thus each instrument is irregularly actuated from instant to instant, sometimes by its own battery, sometimes by the distant one. The fluctuations of the telephone currents are so rapid and variable in intensity, and are of necessity attended by some inductive actions, that the delicate processes of balancing employed in duplex telegraphy, with constant electro-motive forces in action, would fail with the telephone. I know of no book on the subject; in fact, the telephone companies appear to wish to prevent any information being supplied to the public or the scientific world.—SIGMA.

[58845.]—**Voltmeter and Am-meter.**—Procure a short, well-magnetised, well-pivoted steel needle, about 1in. long. For an ammeter poise this on a fine point in the centre of a board, at about 3in. from a stout band of copper running across the board. To this copper band must be attached the binding screws, and under the needle must be placed a circular card, on which divisions may afterwards be marked. A light straw pointer must then be fastened to the top of the pivot, at right angles with the needle. This must be guided by sending a current of known strength through the copper band. The voltmeter can be constructed in the same manner, substituting a coil of fine German silver wire (silk covered) for the copper band. To be of any use the resistance of the coils of wire should not be less than 5,000 ohms, if you wish to measure up to 100 volts.—S. BOTTONE.

[58846.]—**Storage Battery.**—The + should be connected to carbon of charging battery, and the − to zinc. The battery you have, I presume, is formed, and has been used; that being so, all that is required is to put in a solution of sulphuric acid, one of acid to ten of water, and connect to charging source, as pointed out.—C. D. R.

[58846.]—**Storage Battery.**—To charge the above, connect the + pole of your battery to the binding screw of your secondary cell, which you wish to be + on discharging, and your − pole to the binding screw you wish to be negative. If your plates are properly made, they will be coated with minium or other insoluble lead oxide.—H. H. B.

[58848.]—**Legal.**—B. has clearly no claim on C. for A.'s arrears of rent; but B. will re-enter into possession of the leased premises by reason of A.'s default, and of course notify C. that henceforth rent must be paid to himself (B.). All this is assuming that the leases are in the ordinary form.—G. M. PEL.

[58850.]—**Expansion of Mercury and Air.**—I sent an answer to this query last week, but suppose it has been mislaid. According to Regnault, the mean coefficient of expansion of mercury at temperatures between 0° C. and 50° C. is $\frac{1}{5547}$; from 50° C. to 100° C. $\frac{1}{5509}$; from 100° C. to 200° C. $\frac{1}{5479}$; and from 200° C. to 300° C. $\frac{1}{5360}$. Air expands $\frac{1}{273}$ of its volume at 0° C.: therefore, at 100° C. its expansion is $\frac{100}{273}$, and so forth. To convert the degrees Fahrenheit into Centigrade, $C = \frac{5(F - 32)}{9}$. You can work from these figures.—W. STANLEY SMITH.

[58851.]—**Copper and Mercury**—The mercury will in time eat the copper. Have the latter coated with iron by the aciertype process, which I believe any electrotyper can carry on now.—NUS. DOR.

[58851.]—**Copper and Mercury.**—Mercury does not amalgamate directly; to effect union it is necessary to act on the copper and mercury with acids or a salt of mercury; but when once the surface of the copper has been amalgamated, the mercury will gradually penetrate the whole mass and make the copper brittle. Unless electrical contact is required, the copper should be varnished; if such contact is necessary, I should screw and rivet a rod of copper to the vessel, make the contact with the end of the rod, and varnish all the rest.—SIGMA.

[58855.]—**Dynamo.**—TO MR. BOTTONE.—If well constructed, you should have no difficulty in getting 50 volts and 9 or 10 ampères from your dynamo. Say about ten 10-candle-power lamps.—S. BOTTONE.

[58840.]—**Induction Coil.**—I think the following sketch will aid Mr. Fenwick in getting over his difficulty. It is to be understood that I do not vouch for the proper proportions in this rough sketch. It is merely a graphic answer to Mr. Fenwick's two questions. In answer to his third *re* silk and shellac, the method might do for a not more than 6in. long, but I am afraid to [illegible] it for larger ones. Good ebonite is to be [illegible] at 4s. 6d. per pound, in sheet and tube; but [illegible] column I am not allowed to indicate whe[illegible] F. will, of course, [illegible] his [illegible] himself if he buy[illegible] how much time [illegible] the lamps employed. If you have only one horse-power at command it would only work about six lamps directly, and what it would do with irregular working with accumulators would depend upon the proportion of time it would work into them, always remembering that you can only calculate upon getting from the accumulator (so called) about half the work you have put into it. These sort of questions want more details to answer them usefully, and are best put to the engineers who undertake this sort of work.—SIGMA.

[58880.]—**Algol.**—The following are the dates of minima of Algol—viz., Feb. 28th, 11h. 24m.; March 3rd, 8h. 13m.; March 6th, 5h. 2m.; March, 9th, 1h. 51m. If "Al Fard" will write to me, I shall be glad to give him further data.—T. R. CLAPHAM, Austwick Hall, Lancaster.

[58880.]—**Minimum of Algol.**—"Al Fard" will find in the "Agenda Astronomique" contained in the January number of "*La Revue d'Astronomie*," by C. Flammarion, just what he wants. There was a minimum on the 8th inst. at 9.51 p.m., Paris M.T. He can look out on the 28th inst. for another, 11.33 p.m. Paris M.T.—W. R. K.

[58881.]—**Heating Apparatus.**—I should advise larger than ¾in. pipes—1in. at least. The rushing and crackling always happens when steam is first turned on, and is caused by the condensation and consequent sudden rush of steam and condensed water—being, in fact, a water hammer. Turn steam on gently, and when the pipes are hot the noise will cease. I advise you to have a small leak at highest point of pipes to keep rid of the air, which otherwise accumulates.—T. C., Bristol.

[58886.]—**Reed Organ.**—I should advise the querist to adopt the usual method of dividing the registers into half sets. Let the treble sets be of three octaves, instead of two and a half octaves. This will obtain some advantages in solo performances. Here is a good specification: Upper manual, Exhaust principle, three rows of reeds, one 16ft., one 8ft., and one row 4ft. pitch. Stops: Baritone, violoncello, bassoon, hautboy, principal, flute, vox humana, forte. Lower manual, pressure system, three and a half rows of reeds. Stops as follows: Bourdon, clarionet, diapason, flute, cor anglais, cornet, piccolo. The latter would be a 2ft. stop in treble. Mechanical stops: Manual coupler, forte, and sourdine. Each of the manuals should be C scale, nearly all American organs are F scale. If the querist will advertise his address, I will send him a drawing of the arrangement he desires, free of charge, and also for the MECHANIC if desired.—G. FRYER.

[58888.]—**Strains on Girders.**—"Gyrtona" makes an error in describing the curve of a uniformly-loaded beam supported at both ends as being a parabolic curve. He will find it elliptic, I think, and this will account for the difference of his construction and his calculation.—T. C., Bristol.

[58888.]—**Strains on Girders.**—The best practical method of joining two points by a parabola, provided you have the tangents at those points, or else the summit and direction of axis, is certainly this: Call the points A and B; the points where perpendiculars from them to the axis would fall, a and b; the summit, S. Then the distance aS repeated beyond S gives the point where the tangent at A will meet the axis; and, similarly, bS repeated gives the meeting of the axis with the tangent of B. You have thus the two tangents. Make them meet, and divide each, from their meeting point to A and to B, into a certain number of equal parts—say, 16. Number the points from A to the meeting, and, similarly, from the meeting to B. Then join 1 to 1, 2 to 2, 3 to 3, and so on. If these 16 tangents don't define your parabola smoothly enough, bisect each part, and join ½ to ½, 1½ to 1½, and so on. The two extremities need not be equidistant from the axis, though in "Gyrtona's" case I suppose they are so.—E. L. G.

[58888.]—**Strains on Girders.**—Draw horizontal line representing half the span; at one end of it set up a line representing the strain in flange at centre of girder. Divide the half-span line into (n) equal parts, and the strain line into ($n \times n$) equal parts. Through end of strain line draw a line parallel to span line, and through the division points in span line draw lines parallel to strain line, cutting the other line and dividing it into (n) equal parts. Then at the 1st, 2nd, 3rd, &c., distances (n) from strain line on this other line set down 1, 4, 9, &c., of the parts into which strain line is divided; through the points so found draw a curve which will be a parabola. The ordinate at any point between the half-span line and the curve represents the flange strain at that point. "Gyrtona" must have drawn one or both of her curves incorrectly; they ought to coincide. Why does she draw them on the length and not on the span of the girders? The points where flange-plates may stop is found by letting the strain line represent the flange area, then where an ordinate represents the flange area, less one or more plates, is also nearly where the reduction in section may be made. But the rivets transmit the strain to the plates, so that the sectional area of the riveting has also to be considered in determining where the plates may stop. If the rivets are set out, the strain at each rivet and the increase of strain from rivet to rivet can be measured, and the sufficiency of the rivet area can be ascertained.—J. S. C.

[58891.]—**Warped Harmonium Pan.**—This gentleman is not quite plain in his statements, for I, for one, cannot understand how his pan got warped or bulged. Does he mean that the pan rose out of the frame, or what? "At the beginning of the 8ft. treble the sound is weak and muffled." If he means the centre notes on the keyboard, they ought to speak best of all, and I should fancy that the pan has sprung. He must take the instrument down, and let us know more about it. The best pans for wear are those cut out of the solid; the best, from the musical point of view, are the built pans; but unless the finisher is an artist, it does not matter which is chosen, and as this is apparently liable to damp surroundings, I should say, choose a solid pan next time.—FLIEGEN.

[58891.]—**Warped Harmonium Pan.**—This particular pan will probably take more time and trouble to put in repair than it is worth. Remove keyboard, stops, pallets, springs, &c. Put the pan aside to light the fire, and purchase one from a good maker. The cost of a new one, with beech veneers, would be 25s. A cheaper pan may answer your purpose, but it is better to purchase a really good article while you are about it. Unless the pan in question has been exposed to the damp, it could not possibly have ever been a good one. I made one in particular, some 15 years back, which was condemned by "Elève." That soundboard is now (and has been since the time it was first made) in general every-day use, and is as sound as ever. I made it of pine (20 years seasoned), but it has not been exposed to damp. Always keep your harmonium in a dry room, but not too near the fire.—G. FRYER.

[58892.]—**Legal.**—The stepfather can certainly claim for boarding and educating the widow's children. The surplus, you say, left in 1869, was only £500. This in bank would yield about £15 per annum, and two children could not be clothed, fed, and educated for less than £40 yearly. The £500 principal and interest must be eaten up long ago.—B. SC., Plymouth.

[58894.]—**Gramme Dynamo.**—You will find sketch at p. 570, No. 1066 of the ENGLISH MECHANIC for August 28, 1875. Use about 2lb. of No. 18 d.c.c. on the armature, and about 6lb. of No. 16 on the fields, if wound as a series machine. If you wish to run it as a shunt machine, put about 8lb. of No. 20 d.c.c. on the F.M.'s, leaving armature as obove.—S. BOTTONE.

[58895.]—**Chloride Battery.**—The fault lies not so much in the battery as in your expecting too much from it. If you can see, beg, buy, borrow, or steal specification of R. H. Courtenay's new patent battery No. 9,570, you will read a description of the most perfect battery I know of for the purpose you require.—S. BOTTONE.

[58899.]—**Grinding Lawn Mowers.**—Fix knives between centres, and an emery-wheel in a frame carried by slide-rest (or a small grindstone, but emery wheel is best). If you haven't a slide-rest, make a wooden frame to slide on the bed of lathe, and carrying the stone. Drive it sharp from overhead, and move back and forth by a hand lever or rack and pinion.—T. C., Bristol.

[58899.]—**Grinding Lawn Mowers.**—Given a self-acting slide-lathe, put the cutting cylinder between the centres, and run at slowest speed. Mount an emery wheel on slide-rest in place of tool, and drive from a long drum overhead at a surface speed of about 1,500ft. per minute—say, a 6in. emery wheel running at 1,000 revolutions per minute. Remember, a "grindstone" is of no use for this job. If this is not sufficiently plain, and the Editor permits, I will send sketch of a machine I made for the same purpose.—MILLWRIGHT.

[Please send.—ED.]

[58901.]—**Double Electric Bells.**—As you do not state either the size or sort of your cells or wire, I cannot offer any opinion worth having. But, supposing that you use Leclanché cells, and wire of 20 B.W.G. copper, it is clear that the quantity of current furnished would be so much less than the carrying capacity of the conductor that there would be no chance of the current being divided, because it would all go viâ the shortest circuit, and when this was closed by the action of one bell, then it would, as a matter of course, go through the other. If your materials are good, and you put them up properly, they cannot help acting. The principle indicated is undoubtedly the right one; but I do not know that I can add anything to the directions already given as to its application.—ELECTRICIAN.

[58903.]—**Double Electric Bells.**—As you have only two bells and a three-cell battery, there is no reason whatever why they should not ring as perfectly together as they do separately, supposing always that the articles are good, and that they are properly connected. Those which I have had in daily use for many years ring well with two cells, and these are now nine years old. Your second query, as to a proposed device "to make the current divide equally between the two," suggests the possibility that perhaps there may still be some misconception as to the meaning of the term "multiple arc," as applied to bell-work. The method of wiring, it is true, is the same on this principle, both for incandescence lamps and for bells; but whereas in the former case the current is divided, and, therefore, equal resistances are desirable, in the latter it is practically alternate, and a difference in resistance is rather an element of success than otherwise. It will be observed, during the action of a properly-adjusted bell, that when the hammer has completed about two-thirds of its stroke the whole of the current from the battery is cut off by the contact breaker, the stroke being completed by the acquired momentum; immediately after this the hammer is brought back to its original position by the tension of the armature spring assisted by the recoil, and the cycle is repeated as long as the circuit remains closed. When in rapid action, allowing for the effects of increased amplitude and the elasticity of the contact spring, it will be found that the current is cut off during half the stroke. Unless this is so, you do not get the maximum effect from your bell. It is during this interval that the entire current is available for ringing the second bell, and it would obviously do so just as efficiently as in the case of the first. It is not the case, as supposed, that each bell is rung by means of half the current from the battery simultaneously, but each is rung alternately by the whole of it, although the ear may not be quick enough to detect the alternations. If your bells are adjusted so as to ring freely with one cell, it is clear that if three cells are used the result obtained would be less satisfactory, whether they were rung singly or in combination, inasmuch as the increased force of such short strokes would produce more rattle than tone by interfering with the free vibrations of the gong. Adjust each bell, therefore, so that it rings at its best with the full power of your battery, and they will then be adjusted to the best advantage for ringing together; the hammer should be set so that it does not quite touch the bell when the armature is in contact with the magnets. If three cells are used the stroke must of course be longer than if you use only one; but care should be taken not to exceed the limit within which the armature will make at least one complete stroke during the mometary closure of the circuit caused by striking one wire with the other. (When more than two bells are to be rung together, the interval available for each being shorter, a somewhat closer adjustment and an increase of battery power may be necessary.) To fit up two bells in "multiple arc," connect the push to one screw of each bell; connect the other screw of each bell to the zinc pole of the battery, and connect the carbon pole to the push: or, in other words, fit up one bell first in the usual way complete: see that it rings well, then put up the other bell, and carry a wire from each of its binding screws to the corresponding screws of the first bell. As stated in former communications on this subject, I have put up so many scores of bells in this way during the last fifteen years, of all possible sorts and sizes, that I speak with the confidence of practical knowledge and experience. The only thing about the matter which surprises or puzzles me is the fact that a problem which seems so very simple should so often figure in the "E. M." as the *Pons Asinorum* of the amateur bell-fitter.—R. T. LEWIS.

[58902.]—**Accumulators.**—I believe the corrosion which is noticed in the + plates but not in the – ones is due to the current and acid combined oxidising the lead in the solder, the same as the plate itself in the positives; while the negatives are only reduced to a form of spongy lead. Some good articles on lead burning were given by Mr. Davies some time back. But the way I did them was to place the plate on a block of iron, clean one corner, and place the lead lug (also cleaned) close up to it, put a little piece of lead at the joint, and then melt the whole joint with sharp blowpipe flame. It was then trimmed up with a knife. It requires care and practice to do it properly.—P. C., Hornsey.

[58903.]—**Turning.**—This seems a simple matter. Drive the collar on a mandrel and turn it true.—OS.

[58903.]—**Turning.**—Turn down a piece of slightly taper to size of hole in collar, drive on this and turn down until true, when the of metal will be equal all round.—T. C., Br

[58903.]—**Turning.**—Drive your [illegible] mandrel of wrought iron or of wood, between the centres of the lathe, and be able to turn the outside [illegible] hole [illegible] though here in disguise. The explanation is, that if we could draw a visually straight black line on the sky from the moon to the sun it would be part of a great circle of the celestial sphere; the horizon, also a visually straight-line, being another great circle of the same sphere; if we carried the eye along the former from the moon to the sun we should find its inclination to the horizon always increasing; although it would everywhere fit along a straight-edge. To take a simple case: Suppose it to be sunset on the day when the moon is in the first quarter, 90° away from the sun, she is then half-moon: and suppose that she is then at the altitude of 30° (she could have, as seen from London, an altitude of nearly 67° under such circumstances). If we were to draw a straight black line on the sky from sun to moon it would be a great circle of the celestial sphere, and it would rise from the horizon at an angle of 30°; but at the moon it would be running parallel to the horizon, and the middle point of the moon's illuminated limb would be directed along it, that is, horizontally, though the illuminating sun would be 30° lower down. If we produced this straight line beyond the moon it would descend to the horizon and meet it at the point opposite to the (setting) sun. Hence the middle of the illuminated limb of the gibbous moon, though, at sunset, turned more or less upwards, is in reality pointing directly towards the sun on the horizon, which may easily be 50° or 60° lower. Sydney Smith would not permit us to speak disrespectfully of the horizon any more than of the equator. We do not wish to do so; still we must point out that the horizon is to blame for the present trouble. If "W. E. C." will disregard the horizon and incline his head until the medial line of his face is at right angles to the line joining sun and moon, he will see, even without the use of a straight-edge, that the middle of the moon's illuminated limb is turned directly towards the sun. Refraction, of course, affects the phenomenon by acting unequally on the sun and moon when at different altitudes; but we may neglect it, not only because its effect is small, but also because it tends to diminish, not to increase, the illusion in question.—DUBLINIENSIS.

[58929.]—**Occultation.**—I happened to observe the occultation A. Cutter speaks of; but find it is not included in the list of occultations visible at Greenwich, published in the *Nautical Almanac.*—T. R. CLAPHAM.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, "Bangor" has replied to 58266, 58520.

58310. Photography, p. 327.
58317. Launch Engines, 327.
58322. Tinman's Jenny, 327.
58335. Screw-Cutting Tools, 327.
58342. Lathe Queries, 328.
58345. Lathe Countershaft and Overhead Motion, 328.
58355. To "Prismatique," 328.
58359. Water Barometer, 328.
58371. Lifting Cable, 328.
58378. Parson's High-speed Engine, 328.

58562. To Mr. Wetherfield, p. 413.
58571. Difficulties in Collodion Process, 413.
58574. Joy's Valve-Gear, 413.
58579. Brick-Making Machine, 414.
58580. Launch Engine and Boiler, 414.
58582. Clockwork Pedestrians, 414.
58592. Double Slide-rule Problem, 414.
58598. Midland Engines, 414.
58600. Hull and Barnsley Engines, 414.
58610. Light and Radiation, 414.
58615. Oscillating Cylinder, 414.
58616. Joy's Valve Gear, 414.

Midland Railway.—The report of the directors of the Midland Railway Company shows that the company possessed at the end of December, 1885, 1,732 engines, 1,440 tenders, 332 first-class carriages, 893 composites, 1,199 third-class, 76 travelling post-office tenders and vans, 352 horse-boxes, 318 carriage trucks, 540 passenger brake vans, or a total of 3,710 passenger train vehicles. Of goods waggons the company possessed 1,485 cattle trucks, 85,231 goods waggons, 1,124 covered goods waggons, 89,025 coke and coal trucks, 18 creosote tanks, 2,035 timber trucks, 1,049 brake vans, or a total of 79,969 vehicles for merchandise and mineral traffic. The horses and carting stock included 3,166 horses, 2,297 drays and carts. The total receipts amounted to £8,846,049 16s. The locomotive power cost £538,977 16s., of which £116,493 10s. was for coal and coke. The completed miles of railway owned by the company reached 1661·25, and the miles worked by the company's engines reached 1,852. The total passenger train mileage was 7,271,324, and goods 10,100,979, or a total train mileage of 17,372,303.

QUERIES.

[58930.]—**Wimshurst Machine.**—Will any reader of the "E. M." kindly give dimensions of combs, conductors, and ebonite pillars of King and Co.'s machine (20in. plates)? Also say how the terminals are made to slide?—ELECTRIC.

[58931.]—**Leclanche Battery.**—Will any reader kindly tell me how many pint Leclanché cells it would require to light a 5-c.p. lamp, to be used as a night-light? Also how many cells would it want to make a foot of copper wire (28 B.W.G.) red hot?—A BOY AT HASTINGS.

[58932.]—**Dynamo.**—TO MR. BOTTONE.—I have made an eight candle-power hand dynamo, from Mr. Jones's castings (same dimensions and pattern as motor described by you in No. 1,006 of "Ours") according to instructions given in your book, "The Dynamo." The fields are wound with 17oz. of No. 18 B.W.G., and the armature (solid), with 3½oz. No. 20. On coupling up as directed, the machine would only faintly excite itself, though I have altered commutator brushes to every angle. Castings were so smooth, I did not bore F.M.'s; the insulation is perfect, and it works splendidly as motor.—D. WILLIAMS.

[58933.]—**To "Os."**—I have a vulcanite plate for the upper jaw, which is broken into two pieces; and as I have spent some pounds already, I should like to try and repair them myself. You appear to be able to help me, and I shall hold myself your debtor if you will tell me how to proceed. I read the Cantor lectures, to which you allude, with much interest; but they do not go into details such as I want.—J. SLATER.

[58934.]—**Battery for Lamp.**—I have a 2½ candle-power incandescent lamp (carbon), which works well with four small bichromate cells, having lifting arrangement for zincs. I find after zincs have been lifted a few times they get coated with small blueish-green crystals, which coating increases every time of lifting, and very seriously diminishes the battery power. These crystals are easily soluble in water, and when washed off the battery works as well as at first with the same solution (ordinary bichromate solution). Is there any means of preventing these crystals forming? Would it be possible to work the lamp with ten or twelve Leclanché cells? Expense is not an object; neither is space.—LIGNOZOTE.

[58935.]—**To Mr. W. H. Eaves.**—I am about to make a dynamo (Gramme) of 100 c.p., of the same pattern that you describe in your papers on a 30-lighter. Will you please state the sizes of the field-magnets and ring? Also quantity and size of wire, how many sections of wire on ring, and how many layers in one section? What h.p. would this machine absorb? A rough sketch would greatly oblige—A YOUNG BEGINNER.

[58936.]—**Wimshurst Electrical Machine.**—I have just completed one of these beautiful 17in. machines, and it works wonderfully; but I cannot understand why all four Leyden jars should be connected at the bottoms, as evidently two jars on one side are negatively charged and the two opposite positively charged, therefore the outsides, one would suppose, should be also two positive and two negative. Will Mr. Wimshurst kindly explain if this is not correct? I should have thought that the two outsides of the left-hand jars should be connected by a chain to the right-hand comb and the outsides of the right-hand jars to the left-hand comb, not all the four together; and I hope Mr. Wimshurst will kindly tell the readers of the "E. M." what experiments can be performed by the machine, as he promised in one of the recent numbers. The machine is very powerful, and works well under conditions in which it would be quite impossible so get any results from those of the older kinds.—R. V.

[58937.]—**Annuity.**—Will some correspondent kindly inform me the present capital value at 5 per cent., and also at 4 per cent., of £100 per annum for 100 years, the value of life not to be taken into consideration in the calculation? Please show working.—J. W.

[58938.]—**Chucking.**—I have a circular piece of iron 9in. in diam. and ½in. thick, to turn both sides and edge. There is no hole through it. Will some friend please say how I am to chuck it?—J. W.

[58939.]—**Lathe.**—American lathes have no stop at tail of mandrel. Can anyone tell me if in drilling the mandrels jam? Also, what is the angle of the cones? If a stop must be used, what is the best form for hollow mandrels?—A. F. SHAKESPEAR, Dresden.

[58940.]—**Planing Machine.**—What is the object of making upper edge of cross slide L-shaped instead of the usual V shape?—A. F. SHAKESPEAR, Dresden.

[58941.]—**Planing Machine.**—The tool-box of my machine is always getting loose and chatters on the hinge pin. Is there any way of making a pin that will take up wear? I am now using a conical pin with lock nuts at small end. The tool-box was at first hung on centres; but the plan was very unsatisfactory.—A. F. SHAKESPEAR.

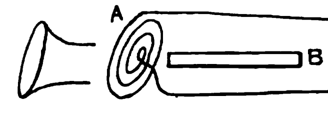
[58942.]—**Platinising Carbon.**—Will some of your readers kindly give me full particulars how to platinise carbon?—A. B. C.

[58943.]—**Iron Brand.**—Will a brother reader inform me how to make a brand for stamping names on wood with letters, all loose, as I have a great many different names for stamp? I have got a full set of letters cast in malleable, and a box; but I can't get them to remain in box when taken from the fire. I want to lift it when hot to place on the wood. Kindly give a small sketch.—FIFER.

[58944.]—**Bell for Melodeon.**—I will be very much obliged if any reader would let me know how to make a bell for a melodeon, and how to fasten it on? The size of the melodeon is 13in. by 8in., so I would like one suitable for that size, and I will be greatly obliged if someone will give rough sketch of the bell. Also let me know to what part of the melodeon the bell should be fastened?—BUBBLE AND SQUEAK.

[58945.]—**Electric Bells.**—Would some of "ours" kindly assist me respecting the above? I fitted up a set in my house some five years ago with chattering bell, indicator, and five Leclanché cells in battery. Since then it has been a constant source of trouble. My battery is in the passage beside the indicator, where it is quite dry; but wherever wires are exposed, either at junctions, at pushes, or battery terminals, oxidation goes on and soon stops the working. The wires attached to indicator and bell terminals never oxidise. Once I found the hall-door wire oxidised right through at a spot where the rubber covering was apparently intact. I fitted up the bells myself, so suppose, in doing so, I committed some error, which is the cause of all the subsequent troble, and I now crave help to enable me to set things right.—DOCTOR MEDICINE.

[58946.]—**Telephone.**—Can any reader tell me if the following plan for a telephone would be practicable?



A, coil of wire suspended suitably, so as to give a large amount of vibration, and having a current passed through it; B, piece of iron. The vibration of the wire makes it have diff. effects on B, and alter current.—ALPHA.

[58947.]—**Brass Moulding and Mixing.**—Will any brother reader tell me if there is any kind of wash to put on very small cores to prevent the brass or copper from burning into them, because I have had to make some pipes 18in. long, 1in. diam., ¾in. round hole through. I poured them cold, and they blowed; then I poured them hot to keep them solid, but the metal burnt the core away. I have got to make some round blocks of copper to be faced up all over. I made one of ingot copper alone, and poured it hot, and it turned up full of blow-holes. Will any reader please tell me how to remedy it? Any hints on brass mixing would be a favour.—G. S.

[58948.]—**Feed-water for Steam Boilers.**—I have often heard that the use of pure water as feed-water for steam boilers causes pitting or wasting of the plates inside of the boilers. I think it is quite likely that the use of rain-water might have that effect; but could anyone tell me? Would the use of pure distilled water as feed-water have a bad effect upon the plates of a steam boiler?—J. G., Bristol.

[58949.]—**G.N.R. Locos., &c.**—Could any reader of the "E. M." kindly give me the dimensions of the Pandora on G.N.R.; and also of the Grosvenor on the Brighton Railway?—YOUNG HOPEFUL.

[58950.]—**Hot-air Engine.**—I am making one of these engines; but cannot make the piston of working cylinder air-tight. Can any reader tell me how to do this? Also what power I ought to get? Cylinder is 2in. dia. by 2in. stroke.—R. I. J.

[58351.]—**Dynamo.**—TO MR. EAVES.—Kindly favour me with sizes and weight of wire for small machine wanted for charging accumulators, or incandescent lamps. H laminated A., 1¾in. dia., 4in. long; fields, where wire goes, ¾in. by 3¾in. by 4in. Compound preferred, if most suitable. Also, for ordinary house purposes, what gauge wire will safely carry one ampère?—PLUMBER.

[58952.]—**Chloride of Silver Battery.**—To "BOBADIL."—You kindly promised to give particulars for making a chloride of silver battery in the "E. M." I shall esteem your answer a great favour, as I want to make a small battery to light a small incandescent lamp.—JOHN D. MUCKLONG.

[58953.]—**Wood Pulp.**—Would any reader tell me how to make wood pulp for paper-making, and the probable cost of the same?—PAPER.

[58954.]—**Lantern Microscope.**—Would any of "ours" give a few hints that would help me in the construction of the above? I want to make one to throw a picture on screen about 2ft. dia. What are the necessary lenses on condensers? Is the eyepiece of microscope used? Any wrinkles would greatly oblige a—TADPOLE.

[58955.]—**Defective Object Glass.**—I have a [illegible] o.g., focal length 6ft., with which I can do very little. With full aperture, a star looks like a bright disc surrounded by an irregular grotty appearance. Separating the lenses about 1-16in. improves it somewhat. Stopped down to 2in. it works fairly well on the moon. Reducing the aperture to 1in. it shows a star perfectly round with no appendage whatever. Am I likely to improve it if I cement together with balsam? Will any of "ours" kindly give their opinion as to cause of defect?—BIT O' GLASS.

[58956.]—**Steam.**—Many thanks to "T. C., Bristol," and "Glatton." I will be very glad indeed of "Glatton's" kind offer. I always understood in non-condensing engines the pressure shown on the gauge was taken to compute with. Supposing the atmosphere to be 15lb. Now, as the steam will have to exhaust from the cylinder against the 15lb. atmosphere, I thought the 15lb. that is in the boiler and not shown on the steam gauge would press on the exhaust side of the piston, and so making the pressure on both the steam side and the exhaust side equal, as there would then be the same pressure on piston as the atmospheric pressure on the exhausting steam. If this was the case, I thought the pressure shown on the gauge might be taken as the initial pressure—that is, supposing none lost travelling from boiler to cylinder, and the mean of the initial + the terminal would be the effective pressure in the cylinder — any back pressure there is in cylinder. I should like very much to have seen a diagram given with the answer to my last query; but perhaps it will be too much trouble, as I see you answer so many questions. I should like to know what backlash was in wheel gearing and screw, and a way of preventing it.—ANXIOUS.

[58957.]—**Hot-air Engine.**—TO MR. SUTCLIFFE.—Will you kindly give the dimensions of the two cylinders and lengths of strokes for a hot-air engine on the plan you described, with cut, in recent number, to be ample for one-third horse-power? Should not the tube connecting the two cylinders communicate with the underside of the hot-cylinder piston instead of the upper side, as shown in your cut? What should the hot piston be packed with to make it air-tight? Full particulars will greatly oblige—MOTOR.

[58958.]—**Plante Cells.**— [illegible]
many one and two-g [illegible]
like to use for Plan [illegible]

XXXI. and XXXII. The rubber is shredded up and masticated in powerful machines, and with the proper quantity of sulphur intermixed, is cured in the flasks or moulds with steam heat, which also implies pressure.)—YOUNG SMITH. (That is your want of knowledge, not the fault of the water or the steel. However, see pp. 152, 174, 196, last volume.)—L. COSTELLO. (We know of no other practicable method than the appearance of the prints; but as a rule carbon prints give an idea of ink on the surface. Experience in comparing the two is necessary.)—ALFRED PHILLIPS. (We do not know. Collodion or thin rubber solution might answer. Why not procure one of the toy balloons?)—L. C., Plymouth. (Convex inside. See the indices.)—T. MORRALL. (Must send more details. We do not recognise the battery under that name. What elements are used?)—T. M. B. H. (Cover the magnets with a coat of wire as thick as themselves. See indices for much information on the subject.)—P. BYRNE. (Selling or using is an infringement, and damages can be recovered from the infringer.)—W. C. CUMMING. (Probably of many of our advertisers. See letter 25356, last week.)—J. L. (The particulars are not sufficient; but slagwool, fireclay, or Leroy's composition might answer.)—JARVIES. (We believe we answered you at the time. It is a matter of experiment, and your experiments seem conclusive. Judging by the signature, you were answered on p. 338.)—WOOD. (Boiled or steeped in creasote as a rule.)—B. B. (Has it ever been done? If so, where do you find any mention of the fact?)—BELGIAN. (Please send drawing relating to small screws.)—COUNTRY SOLICITOR, JOHN BALLOT. (In type.)

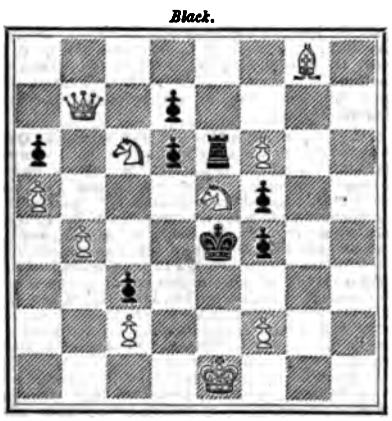
CHESS.

◆

ALL Communications for this department must be addressed to J. PIERCE, Langley House, Dorking.

PROBLEM DCCCCLXXX.—BY J. P. TAYLOR.

Black.



White. [10 + 8

White to play and mate in two moves.

SOLUTION TO 978.

White.	*Black.*
1. P-Kt 3	1. K-B 4 (*a*)
2. B-Q R 7 (ch)	2. K moves
3. Mates.	
	(*a*) 1. K-Q 6 (*b*)
2 B-K R 7 (ch) &c.	
	(*b*) 1. P-B 7 (*c*)
2. B-K 5 (ch) &c.	
	(*c*) 1. P-B 4
2. Q-Q 2 (ch) &c.	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 977, by Link, J. J. Spence, A. Dean, James Palmer, T. H. Billington, and A. Sharpe; to 978, by V. S. Pochin, Harold, G. T. Stringfellow, James Gillan, (best three-mover in present series, and that is saying a good deal), Louis Morris.

THE solutions to 979 will be acknowledged in the next number.

THE author of Problem 974 is not H. F. L. Meyer, as we supposed. It was extracted from the *Tri-Weekly Gleaner.*

G. T. S.—We regret the oversight. The mistake has been rectified.

C. F. S. AND A. B.—The corrections noted.

A. DEAN.—As the suggested three-mover would begin with a check, it would not do.

LINK.—There is no mate in your ingenious attempt at 978 if after 1. $\frac{}{\text{K-B 4}}$ 2. $\frac{\text{B-B 7}}{\text{K-Q 5}}$; it fails also if 1. $\frac{}{\text{K-Q 6}}$ 2. $\frac{\text{B-B 4}}{\text{K-B 7}}$.

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Front Page Advertisements Five Shillings for the first 40 words, afterwards 9d. per line. Paragraph advertisements One Shilling per line. No front page or paragraph advertisement inserted for less than Five Shillings. Reduced terms for series of more than 6 insertions may be ascertained on application to the Publisher.

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	s.	d.
Sixteen words	0	6
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⁎ It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions; and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement, and charged for.

Advertisements *must* reach the office by 1 p.m. on Wednesday, to ensure insertion in the following Friday's number.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Good Value Offered (cash or instruments) for all kinds of sound or repairable Scientific Appliances.—CAPLATZI, Science Depot, Chenies-street, near British Museum. Established 1862.

Wanted, new or second-hand **Microscopical Apparatus**, by good makers, also Scientific Books, in exchange for first-class Micro. Slides.—C. COLLINS, Bristol House, Harlesden, N.W.

Half-Horse **Engine**, double oscillating cylinders, on horizontal bed, in good condition, complete, with governors. What offers?—JOURNET, 194, Gt. Portland-street.

28 volumes "**Encyclopædia Britannica**," first-class condition, for Microscope, old China, or small piece Artistic Furniture.—SCOTT, 39, Queen's-crescent, Haverstock-hill.

What offers for Jones's new medium **Sewing Machine**, with cover?—STAFFORD, Practical Maker and Repairer of all kinds, 17, Bradshaw-street, Shude-hill, Manchester. Established 1872.

Lathe Wheel and Crank, single speed, Taylor, maker, Birmingham; 3½in. Leg Vice and Bench, 6ft.; 14 Chasing Tools. Exchange.—W. SMITH, Bilston-road, Wolverhampton.

Bicycle Fittings, Head, Hubs, Rims, Backbone, Forks, Treadles, Cranks, Youth's 26in. Tricycle, all above new. What exchange? Stamp for reply.—W. SMITH, Bilston-road, Wolverhampton.

"**Spohr's Violin School.**" "Sidney Smith's Method for Piano," Tutor for the Violoncello, and spring back folio, cost 20s. Exchange for covered wire, bending screws, clamps.—T. MORRELL, High-street, Brierley-hill, Staffs.

Wanted, good 80 to 100 c.p. **Dynamo**, 1 horse-power Engine, with Boiler. Exchange Photo Apparatus, splendid Lathe, fitted with overhead gear, suit fine work only; wheel-cutting Engine, valuable Stamping Press, and great quantity of Beds and Dies for wheel stamping, all by Ralph Neal, and useful electrical apparatus.—MCCLELLAN, Clock House, Sidcup, Kent.

Astronomical Telescope wanted. Useful exchange. Write for list.—MCCLELLAN, Clock House, Sidcup.

Printing Press, £5 Musical Cabinetto, Musical Box, Knitting Machine, Magic Lantern. Wanted, whole-plate Camera Lens and Large Magic Lantern.—BEDE, Belbroughton, Stourbridge.

36in. Facile pattern safety **Bicycle**, [illegible] order, nearly new, at Fisher's, Devonshire-street. [illegible] change for Tricycle.—BROWN, 79, Victoria-road, [illegible]

Highly-finished half horse-power **Horizonta** GINE, in exchange for front-steering Tricycle. [illegible] LANG, Carrick-street, Ayr, N.B.

An ivory-keyed German **Concertina**. [illegible] exchange offers.—W. STANLEY SMITH, Mount-[illegible] ham.

Good **Banjo**, 7 strings. Exchange [illegible] Apparatus.—R. NUTT, 18, Holden-road, Devons-road [illegible]

Will exchange Ross's quarter-plate **Portr** good as new, for Rapid Rectilinear. State particulars [illegible] 14, Pendrill-street, Hull.

Autophone, with 12 tunes, cost 30s. W[illegible] for small Slide-rest, Carpenter's Tools, or any [illegible] COLLARD, 22, Gladstone-road, Deal, Kent.

"**English Mechanic**," Vol. XXIX., [illegible] "American Bee Journal," 1885, unbound [illegible] Popular Educator,' all good condition. Exchange [illegible] or Electro-Motor preferred.—A., 13, Albert-street [illegible]

Dynamo. Telegraph Lineman's set. [illegible] Bicycle, Musical Box, Dulcimer, Camera, Lens, &c. [illegible] Stamp for monthly list.—EXCHANGE DEPOT, [illegible] chester.

Water Motor. Empress make; cost [illegible] change. What offers? Pocket high-speed [illegible] pocket steam gauge, 120lb. wanted.—WHEELER, [illegible]

French, German, and Spanish Book LISH MECHANIC,' Vol. XXXVII., cloth, [illegible] scopic slides.—GEORGE JONES, Duke-street, [illegible]

Model of Brush Dynamo. 100 [illegible] never been used, and practically as good as new. [illegible] Offers in exchange.—MAYSON, Bridgend, [illegible]

Automatic **Knitting Machine**, with [illegible] £9. What offers in exchange?—CLAYTON.

Pulvermacher's Galvanic Belt [illegible] condition. Good exchange.—CLAYTON, Colchester.

Fret Saw, treadle, with Lathe Attachment [illegible] offered 30s.; exchange.—CLAYTON, Colchester.

Walking-stick Gun, three inter[illegible] barrels, mahogany case with brass mountings. [illegible] lathe heads, or offers.—J. SPENCE, Antrim-road, [illegible]

"**Dr. Ure's Dictionary of the Arts, S** AND MANUFACTURES." 3 vols., nearly new. [illegible] value £3.—GILBERT, 129, Beresford-street, [illegible]

Wanted, half-plate tourist folding **Camera** Stand, two double backs. Exchange 54 bicycle, bal[illegible] —W. NEWBOULD, Eyre-lane, Sheffield.

Will exchange 26 2s. 6d. numbers of "En ASSISTANT," with engravings by Blackie, for [illegible] 4½ Lathe.—J. W., 25, Peel-terrace, Stafford.

Wanted, first-class **Engine and Boiler** horse power. Can give good jewellery in [illegible] LOWE, 11, Will-street, Hunt's-lane, Birmingham.

Engine Force Pump, vertical, [illegible] horse, new. What offers?—J. LEECH, South-view, [illegible] Stockport.

"**Letters of Junius.**" London, 1789, [illegible] bound, in good condition. What offers [illegible] Hertford-heath, Herts.

100 c.p. **Gramme Dynamo**. Pacinotti [illegible] Offers? Bicycle preferred.—STOREY, St. Mary [illegible]

Large **Barrel Organ**, 10 tunes, for La[illegible] centres.—W. WHITE, 17, York-street, Nottingham.

Offers for my fine steel-reed, twenty [illegible] TINA. Want small camera or electrical apparatus. [illegible] SMITH, Mount-street House, Wrexham, N. Wales.

"**English Mechanic**," Vols. XXV. [illegible] sive, with indices, for photographic apparatus [illegible] BOWSKILL, 74, Kilton-street, Battersea Park, London.

Steam Engine, horizontal, 1in. bore, [illegible] stop valve, force pump, complete working [illegible] baritone or euphonion.—MIDDLETON, [illegible]

Half H.P. **Engine**, extra well finish[illegible] Cylinder, bored. Exchange either for boiler [illegible] H. BERRY, Motcombe-lane, Eastbourne.

Wanted, a 54in. **Bicycle**. I am willing [illegible] 3in. Centre Lathe with chucks and tools. [illegible] tion. See below.

Wanted, a 54in. **Bicycle**. Exchange [illegible] Photographic Apparatus for taking pictures [illegible] —T. HALL, 50, Finchley-road, Kennington, London.

Iron **Treadle Lathe**, 3¾in. centres, [illegible] slide-rest, chucks, quantity of tools. Exchange [illegible] stantograph and cash to £6 10s., or offers.—[illegible] Beeston, Notts.

Reflector, 6½ mirror and flat, Calver's [illegible] motion, £14, perfect, or reasonable offer.—A. [illegible] Hackney-wick, London.

Eleven large, fourteen small **Files**. 15 [illegible] three Flat, two Twist Drills, Parts of a small [illegible] of Brass and Steel, two Chasers, and Brass [illegible] SMITH, 15, Coombdale-road, East Greenwich.

8in. **Iron Lathe**, emery wheel, 16in. [illegible] Engine, improved, two-wheeled Milk Barrow, [illegible] Rubbers. 10, Bridge-terrace, Croydon.

Wanted, **Diamond Scarf Ring or Pin** Electrical Exchange to value of 25s., and [illegible] T. A. C., Fairfield House, Warrington.

Siemens Armature, 12 magnets, [illegible] or power, 2 bells. Cost £20. (Exchange [illegible] Wanted.—WHEELER, Preston.

Model **Horizontal Engine**, 1in. bore, [illegible] Will exchange for neat Model, ½in. bore, [illegible] ISAAC LEYLAND, Park-lane, near Wigan.

Wanted, **Rubber Stamp Apparatus** [illegible] works on Chemistry, Photo Apparatus, [illegible] what required.—UNDERWOOD, Priory-terrace, [illegible]

"**Treatise on the Steam Engine**" [illegible] Bown, containing 35 plates and [illegible] J. BRASS, 1, Lindsay-place, Leith.

Electro-Magnetic Machine, in [illegible] up box; 1 do. do., with all appliances, in [illegible] Motors, Siemen's Armatures, 2 Electric Bells.—[illegible]

Electro Motor, by Cuttriss, Leeds; Medical Coil, nickel-plated fittings; ¼in. Induction [illegible] Telephones; strong Double-vacuum Tube; ½-gall. [illegible] mate Battery.—Address below.

1in. spark **Induct**[illegible] **Coil**, ½ hor[illegible] zontal Engine, Accordion [illegible] for any of the above.—T. [illegible]